

St Clare's Calculation Policy

September 2017



Addition

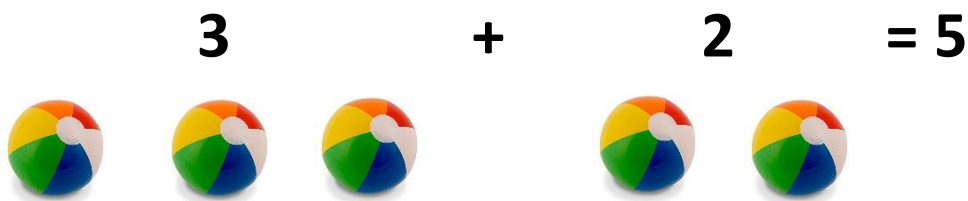
Early Years: Addition

- **Add with numbers up to 10**

Count reliably up to 10 every day using everyday objects.

Begin adding by counting two sets of objects into one group (5 cubes and 3 cubes).

Add 2 groups together by adding all of them. Understand that addition means adding 2 groups together.

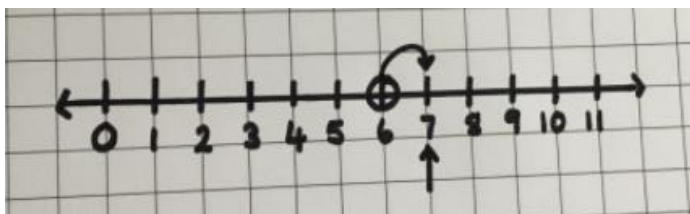


Only when ready, use numbered number lines to add, by counting on in ones.

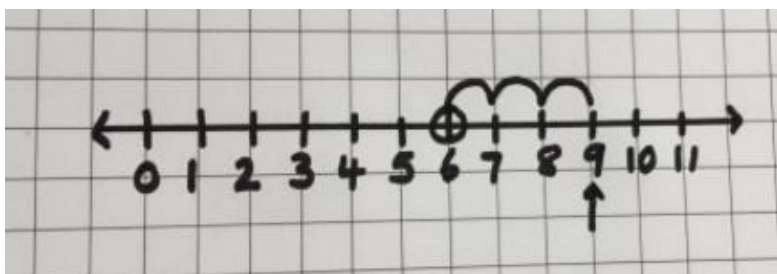
Encourage children to start with the larger number and count on.

To count one more, and then several more, on a number line:

For example: $6 + 1 = 7$



For example: $6 + 3 = 9$



Key vocabulary: Add, addition, total, plus, more than, and, altogether, increase, equals, make, sum

Key skills for addition at Reception:

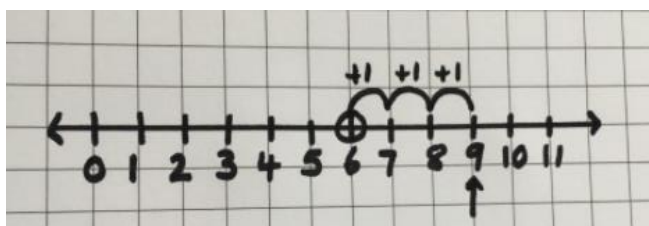
- Count reliably with numbers 1-20 (including objects that cannot move)
- Estimate how many objects they can see and check by counting
- Say which is one more and 1 less than a given number to 20
- Add two single digit numbers
- Count on to find the number
- Solve problems, including doubling, halving and sharing
- Can record, using marks that they can interpret and explain

Year 1: Addition

- **Add with numbers up to 20**

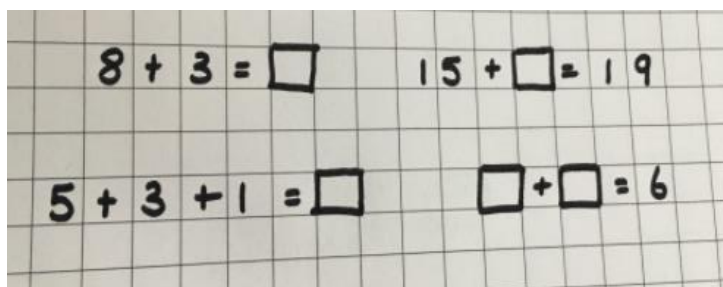
Use numbered number lines to add, by counting on in ones. Encourage children to start with the larger number and count on.

For example: $6 + 3 = 9$



Children should:

- Have access to a wide range of counting equipment, everyday objects, number tracks and number lines (including blank number lines), missing number box sliders and be shown numbers in different contexts.
- Read and write the addition sign (+) 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:



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

Key skills for addition at Year 1:

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Written by Rebecca Nicholas, Mathematics Lead
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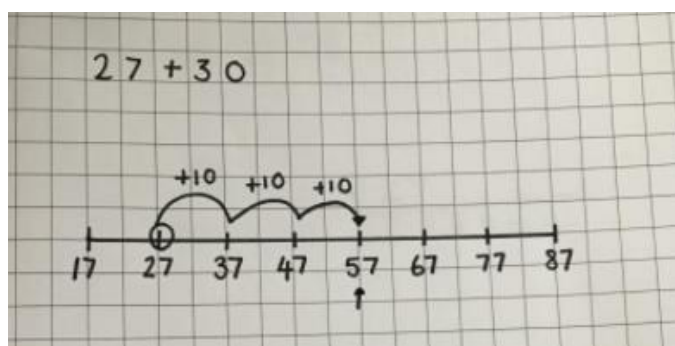
- Read and write numbers to 100 in numerals, including 1-20 in words
- Recall bonds to 10 and 20, and addition facts within 20
- Count to and across 100
- Solve simple 1-step problems involving addition, using objects, number lines and pictorial representations
- Understand the place value of 2-digit numbers by partitioning into tens and ones
- Given a number, say one more or one less

Year 2: Addition

- **Add with 2-digit numbers**

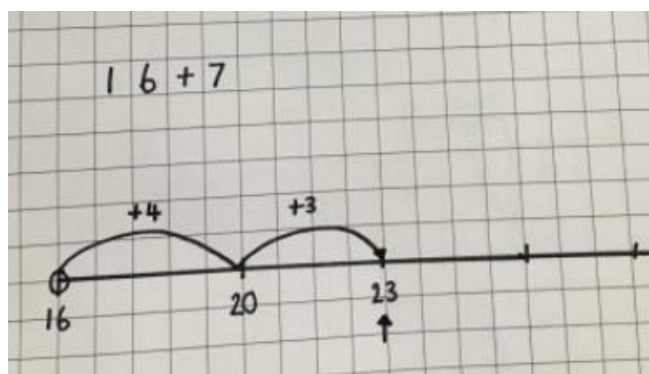
Developing mental fluency with addition and place value, involving 2-digit numbers, then establish more formal methods.

Add 2-digit numbers and tens:



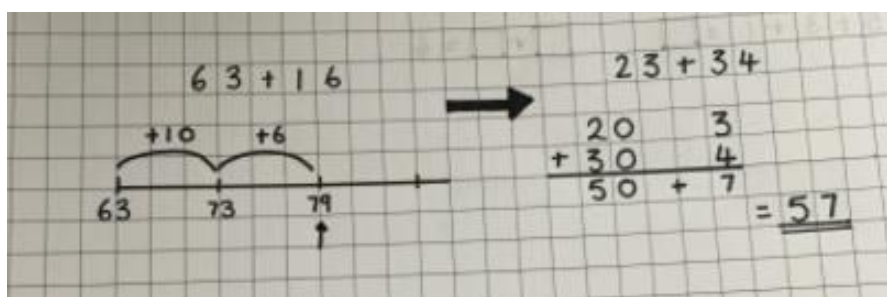
Add 2-digit numbers and ones:

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



Add pairs of 2-digit numbers, moving to the partitions column method when secure adding tens and ones:

Step 1: Only provide examples that DO NOT cross the tens boundary until they are secure with the method itself.



Step 2: Once children can add a multiple of 10 to a 2-digit number mentally, e.g. $80+11$, they are ready for adding pairs of 2-digit numbers that DO cross the tens boundary, e.g. $58+43$.

$$\begin{array}{r} 58 + 43 \\ \begin{array}{r} 50 \quad 8 \\ + 40 \quad 3 \\ \hline 90 \quad 11 \end{array} \\ = \underline{\underline{101}} \end{array}$$

Step 3: Children who are confident and accurate with this stage, should move onto the expanded addition methods with 2 and 3-digit numbers (see year 3).

To support understanding, pupils should physically make and carry out the calculations with Dienes, HTU boards, Numicon, arrow cards or place value counters, then compare their practical version to the written form, to help them to build an understanding of it.

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

Key skills for addition at Year 2:

- Add a 2-digit number and ones bridging the tens 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 (commutative law)
- Recall bonds to 20 and bonds of 10 to 100 ($30 + 70$ etc)
- Count in steps of 2,3 and 5 and count in tens from any number
- Understand the place value of 2-digit numbers (tens and ones)
- Compare and order numbers to 100 using $<$ $>$ and $=$ signs
- Read and write numbers to at least 100 in numerals and words

Year 3: Addition

- **Add numbers with up to 3-digits**

To support understanding, pupils should physically make and carry out the calculations with Dienes, HTU boards, Numicon, arrow cards or place value counters, then compare their practical version to the written form, to help them to build an understanding of it.

Introduce the expanded column addition:

Add the ones first to prepare for the compact method.

The image shows a handwritten calculation on grid paper. At the top, the numbers are written with place value labels: H T O H T O, followed by 3 6 0 + 1 5 7. Below this, the numbers are expanded into their place value components: 300, 60, and 0 for the first number, and 100, 50, and 7 for the second. These are added in columns. The first column (hundreds) shows 300 + 100 = 400. The second column (tens) shows 60 + 50 = 110. The third column (ones) shows 0 + 7 = 7. The final result is 517, which is underlined.

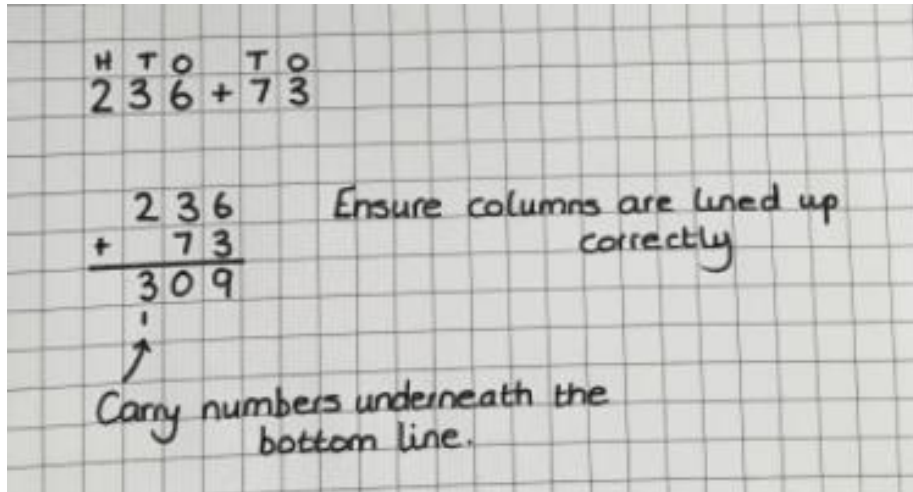
$$\begin{array}{r} \text{H T O} \quad \text{H T O} \\ 360 + 157 \\ \\ 300 \quad 60 \quad 0 \\ + 100 \quad 50 \quad 7 \\ \hline 400 \quad 110 \quad 7 \\ = \underline{517} \end{array}$$

Compact method

Children need to recognise the value of the hundreds, tens and ones without recording the partitioning.

Children who are very secure and confident with 3-digit expanded column addition, should be moved onto the compact column addition method, being introduced to 'carrying or exchanging' for the first time. Compare the expanded method to the compact column method to develop an understanding of the process and the reduced number of steps involved.

Remind children, that the actual value is three tens add seven tens, but we say three add seven because they are already in the tens column.



Key vocabulary: Add, more, plus, and, make, altogether, total, equal to, equals, double, most, count on, number line, sum, tens, ones, partition, addition, column, tens boundary, hundreds boundary, increase, vertical, 'carry/exchange', expanded, compact

Key skills for addition at Year 3:

- Count, read and write numbers to 1000 in numerals and words
- Add 2-digit numbers mentally, including those exceeding 100
- Add a 3-digit number and ones mentally (175+8)
- Add a 3-digit number and tens mentally (175+50)
- Add a 3-digit number and hundreds mentally (175+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
- Recognise place value of each digit in 3-digit numbers (hundreds, tens, ones)
- Continue to practice a wide range of mental addition strategies i.e. number bonds, adding the nearest multiple of 10, 100, 1000 and adjusting, using near doubles, partitioning and recombining

Year 4: Addition

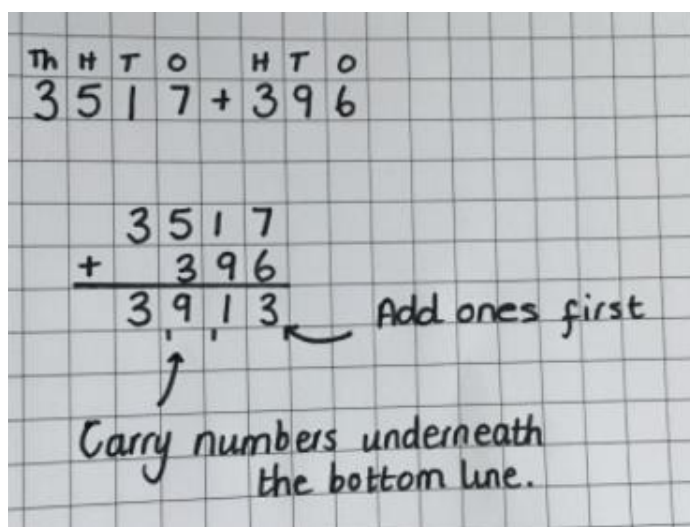
- **Add numbers with up to 4-digits**

Continue to support understanding, for those who still need it, pupils should physically make and carry out the calculations with Dienes, HTU boards, Numicon, arrow cards or place value counters, then compare their practical version to the written form, to help them to build an understanding of it.

Move from the expanded addition to the compact column method, adding ones first, and 'carrying or exchanging' numbers underneath the calculation. Also include money and measures in context.

Introduce the compact column method by asking children to add the two given numbers together using the method they are familiar with (expanded column addition – see year 3). Teacher should model the compact method with carrying, asking children to discuss similarities and differences and establish how it is carried out.

Remind children, that the actual value is one ten add nine tens, but we say one add nine because they are already in the tens column.



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

- Select most appropriate method; mental, jottings or written and explain why
- Recognise the place value of each digit in a 4-digit number
- Round any number to the nearest 10, 100, 1000
- Estimate and use the inverse operation 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
- Continue to practice a wide range of mental addition strategies i.e. number bonds, adding the nearest multiple of 10, 100, 1000 and adjusting, using near doubles, partitioning and recombining
- Add numbers with up to 4-digits using the formal written method of column addition

Year 5: Addition

- **Add numbers with more than 4-digits including 2 decimal places**

Continue to use practical apparatus for those who still need the visual experiences using Dienes, HTU boards, Numicon, arrow cards or place value counters. Include money, measures and decimals with different numbers and decimal places.

$$\begin{array}{r} \text{£} 23.59 \\ + \text{£} 7.55 \\ \hline \text{£} 31.14 \\ \hline \end{array}$$

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.

Numbers should exceed 4-digits.

$$\begin{array}{r} 23481 \\ + 1362 \\ \hline 24843 \end{array}$$

$$\begin{array}{r} 19.01 \\ + 3.65 \\ \hline 22.66 \end{array}$$

say 6 tenths add 7 tenths to reinforce place value

Empty decimal places can be filled with a place holder

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

Children should:

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

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

Key skills for addition at Year 5:

- Add numbers mentally with increasingly large numbers, using and practicing a range of mental strategies i.e. add the nearest multiple of 10, 100, 1000 and adjust; use near doubles, inverse, partitioning and recombining; using number bonds
- Use rounding to check answers and accuracy
- Solve multi-step problems, in contexts, deciding which operations and methods to use and why
- Read, write and order and compare numbers to at least 1 million and determine the value of each digit
- Round any number up to 1,000,000 to the nearest 10, 100, 1000, 10,000, 100,000
- Add numbers with more than 4-digits using formal written method of column addition

Year 6: Addition

- Add several numbers of increasing complexity (up to 3 decimal places)

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.

A handwritten addition problem on grid paper. The numbers are aligned by their decimal points:

$$\begin{array}{r} 23.361 \\ 9.08 \\ 59.77 \\ + 1.3 \\ \hline 93.511 \end{array}$$

An arrow points to the empty decimal places in the sum, with the text: "Empty decimal places can be filled with 0 to show the place value in each column."

Adding several numbers with more than 4 digits.

A handwritten addition problem on grid paper. The numbers are aligned by their rightmost digits:

$$\begin{array}{r} 81059 \\ 3668 \\ 15301 \\ + 20551 \\ \hline 120579 \end{array}$$

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

- Perform mental calculations, including with mixed operations and large numbers, using and practicing 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
- Read, write, order and compare numbers up to 10 million and determine the value of each digit
- Round and whole number to a require degree of accuracy
- Children to understand how to add mentally with larger numbers and calculations of increasing complexity

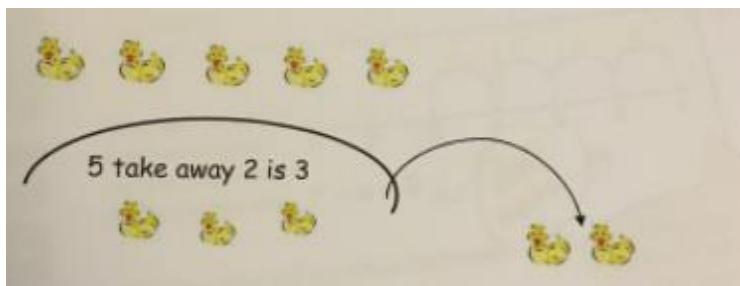
Subtraction

Early Years: Subtraction

- **Subtract from numbers up to 20**

In the early stages, children will be taught to 'take away' one or two objects and find the new total.

For example: $5 - 3 = 2$

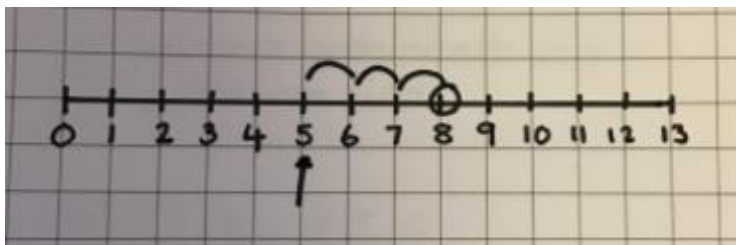


The next step is for children to be able to work out one less or several less on a number line.

1 less than 8 is 7 – “8 in my head, count back 1 is 7.”

2 less than 8 is 6 – “8 in my head, 7, 6. “

3 less than 8 is 5 – “8, 7, 6, 5.”



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Key vocabulary: Minus, subtract, less than, take away, left

Key skills for subtraction at Reception:

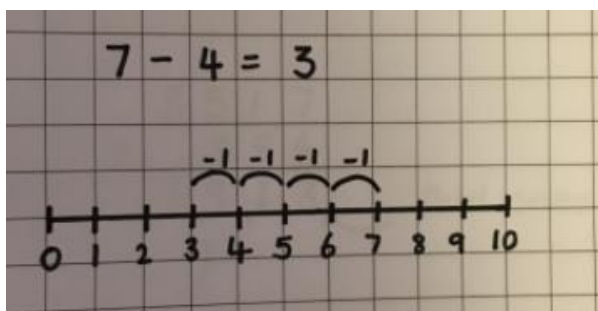
- Make a record in pictures, words or symbols of subtraction activities already carried out
- Use of games, songs and practical activities to begin using vocabulary
- Construct number sequences to go with practical activities
- Relate subtraction to taking away and counting how many objects are left

Year 1: Subtraction

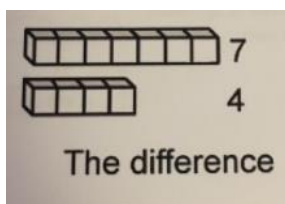
- **Subtract from numbers up to 20**

Children consolidate understanding of subtraction practically, showing subtraction on bead strings, using cubes, number lines, Numicon and small world objects in familiar contexts and are introduced to more formal recording using number lines.

Count back in ones on a numbered number line (and a blank number line) to take away.



Finding the difference between: Children should be introduced to this practically with the language 'find the difference between' and 'how many more to make' (complimentary addition).



'Seven is 3 more than four'.

Children should:

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

Mental subtraction

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

Key vocabulary: Minus, subtract, less than, take away, left, equal to, take, less, leaves, difference between, how many more, how fewer/less than, most, least, count back, how many left, how much less is...

Key skills for subtraction at Year 1:

- 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
- Solve one-step problems that involve addition and subtraction, using concrete objects (e.g. bead strings, objects, cubes) and pictures and missing number problems
- Read and write numbers from 0 to 20 in numerals and words

Year 2: Subtraction

- **Subtract with 2-digit numbers**

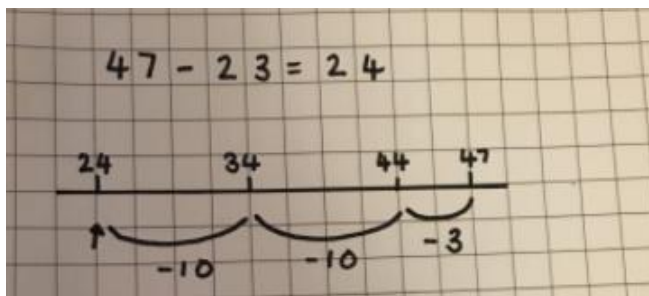
Subtract on a number line by counting back, aiming to develop mental subtraction skills.

This strategy will be used for:

- 2-digit numbers subtract ones only (by taking away/counting back) e.g. 36-7
- 2-digit numbers subtract tens only (by taking away/counting back) e.g. 48-30
- Subtracting pairs of 2-digit numbers

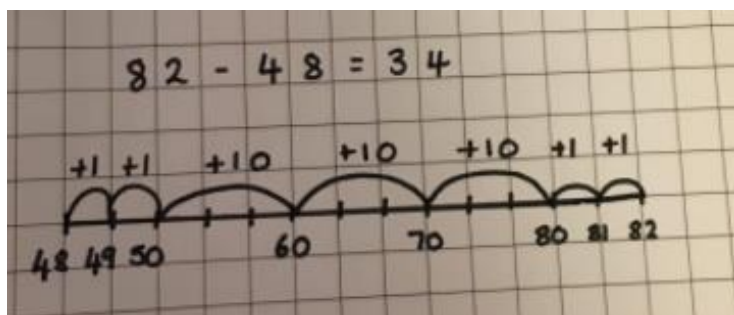
Subtracting by counting back

Counting under the line, subtracting the ones then the tens.



Subtracting by finding the difference using a number line

Always count to the next ten (children will need knowledge of number bonds). Then do jumps of ten and then single jumps.



When numbers are far apart, children are to use the most efficient method of counting back.

Resources: Dienes, Numicon, number line, multi-link, small world objects, money, hundred squares, bead strings.

Key vocabulary: Minus, subtract, less than, take away, left, equal to, take, less, leaves, difference between, how many more, how fewer/less than, most, least, count back, how many left, how much less is.., difference, count on, strategy, partition, tens, ones

Key skills for subtraction at Year 2:

- 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 a 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
- Solve simple addition and subtraction problems including measures, using concrete objects, pictorial representation, and also applying their increasing knowledge of mental and written methods
- Read and write numbers to at least 100 in numerals and words

Year 3: Subtraction

- **Subtracting with 2 and 3-digit numbers**

Introduce partitioned column method.

When learning to exchange, explore partitioning in different ways, so that pupils understand that when you exchange, the value is the same i.e. $72 = 70 + 2 = 60 + 12 = 50 + 22$ etc.

Emphasise that the value hasn't changed, we have just partitioned it in a different way.

Step 1: Introduce this method with examples where no exchanging is required.

Handwritten calculation of $89 - 35$ using the partitioned column method. The calculation is written on a grid background. The first row shows $89 - 35$. Below it, the numbers are partitioned into tens and ones: 80 and 9 for the minuend, and 30 and 5 for the subtrahend. A horizontal line is drawn under the partitioned numbers. The result is shown as 50 and 4 for the tens and ones respectively, with an equals sign and the final answer 54 written below.

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



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

Handwritten calculation of $72 - 47$ using the partitioned column method. The calculation is written on a grid background. The first row shows $72 - 47$. Below it, the numbers are partitioned into tens and ones: 60 and 12 for the minuend (after exchanging one ten for ten ones), and 40 and 7 for the subtrahend. A horizontal line is drawn under the partitioned numbers. The result is shown as 20 and 5 for the tens and ones respectively, with an equals sign and the final answer 25 written below.

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.

The image shows a handwritten calculation on grid paper for the subtraction $238 - 146$. The numbers are partitioned into hundreds, tens, and ones. The calculation is as follows:

238	-	146	
100			
200		130	8
- 100		40	6
0		90	2
			= 92

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).

Key vocabulary: Minus, subtract, less than, take away, left, equal to, take, less, leaves, difference between, how many more, how fewer/less than, most, least, count back, how many left, how much less is., difference, count on, strategy, partition, tens, ones, exchange, decrease, hundreds, value, digit

Key skills for subtraction at Year 3:

- Subtract mentally a: 3-digit number and ones, 3-digit numbers 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 the 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
- Read write numbers up to 1000 in numerals and words

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- Practice mental subtraction strategies, such as subtracting near multiples of 10 and adjusting (e.g. subtracting 19 or 12), and select most appropriate methods to subtract, explaining why

Year 4: Subtraction

- **Subtracting with up to 4-digit numbers**

Partitioned column subtraction with exchanging (decomposition).

As introduced in year 3, but moving towards more complex numbers and values. Use place value counters to reinforce.

$$\begin{array}{r}
 2754 - 1562 \\
 \hline
 2000 - 1000 = 1000 \\
 700 - 500 = 200 \\
 50 - 60 = 150 - 60 = 90 \\
 4 - 2 = 2 \\
 \hline
 = 1192
 \end{array}$$

Compact column subtraction

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 and what is different, to develop understanding of it.

$$\begin{array}{r}
 2\overset{6}{7}54 \\
 - 1\overset{1}{5}62 \\
 \hline
 1192
 \end{array}$$

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

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

Mental Strategies

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

Continue to use apparatus for children who require it.

Key vocabulary: Minus, subtract, less than, take away, left, equal to, take, less, leaves, difference between, how many more, how fewer/less than, most, least, count back, how many left, how much less is., difference, count on, strategy, partition, tens, ones, exchange, decrease, hundreds, value, digit, inverse

Key skills for subtraction at Year 4:

- 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 subtractions 2-step problems, choosing which operations 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, 1000
- Solve number and practical problems that involve the above, with increasingly large positive numbers

Year 5: Subtraction

- **Subtract with at least 4-digit numbers and 2 decimal places.**

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.

Compact column subtraction (with exchanging)

Subtracting with larger integers

$$\begin{array}{r} 28928 \\ - 2128 \\ \hline 26800 \end{array}$$

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

A zero can be added as a place holder

$$\begin{array}{r} 6796.5 \\ - 372.5 \\ \hline 6424.0 \end{array}$$

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

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Key skills for subtraction at Year 5:

- Subtract numbers mentally with increasingly larger 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 and order and compare numbers to at least 1 million and determine the value of each digit
- Interpret negative numbers in context, counting forwards and backwards with positive and negative integers through zero
- Round any number up to 1 million to the nearest 10, 100, 1000, 10,000 and 100,000

Year 6: Subtraction

- Subtracting with increasingly large and more complex numbers and decimal values

Using the compact method to subtract more complex integers.

$$\begin{array}{r}
 0 \ 14 \quad 9 \quad 1 \\
 850699 \\
 - 89949 \\
 \hline
 60750
 \end{array}$$

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

A zero can be placed as a place holder

$$\begin{array}{r}
 105.34 \\
 - 08.19 \\
 \hline
 69.339 \text{ Kg}
 \end{array}$$

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: Minus, subtract, less than, take away, left, equal to, take, less, leaves, difference between, how many more, how fewer/less than, most, least, count back, how many left, how much less is., difference, count on, strategy, partition, tens, ones, exchange,

decrease, hundreds, value, digit, inverse, tenths, hundredths, decimal point, decimal, integer

Key skills for subtraction at Year 6:

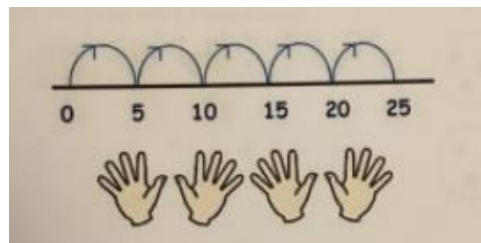
- Solve addition and subtraction multi-step problems in context, deciding which operations to use and why
- Read, write, order and compare numbers up to 10 million and determine the value of each digit
- Round any whole number to a required degree of accuracy
- Use negative numbers in context, and calculate intervals across zero
- Children need to utilise and consider a range of mental subtraction strategies, jottings and written methods before choosing how to calculate

Multiplication

Early Years: Multiplication

- **Multiply with concrete objects using repeated addition**

By the end of reception, children are expected to understand the concept of doubling and to be able to double a number up to 10. Before doubling can be introduced, children need to have a secure knowledge of counting, number facts and addition in order to double.



Real life contexts and use of practical equipment to count in repeated groups of the same size; counting in twos, fives, and tens. Also chanting 2s, 5s and 10s.

They are encouraged to solve real life problems e.g. if one pair of wellington boots = 2, then 3 pairs = 6.



They are encouraged to draw pictures and represent their mathematical thinking through various representations e.g. bead strings, Numicon, cubes.

They will work on practical problem solving activities, involving equal sets or groups, including the introduction to finding doubles.

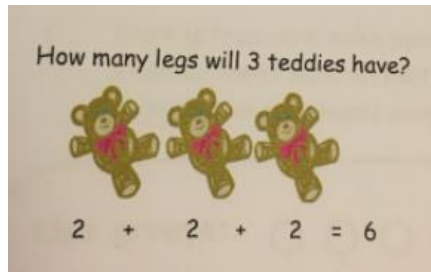
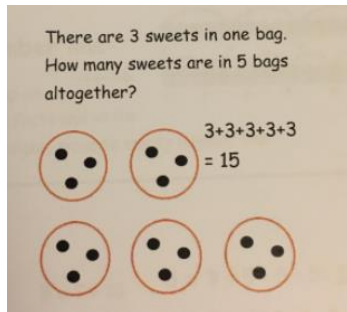
Key vocabulary: Lots of, groups, times, altogether

Key skills for multiplication at Reception:

- They will count in 2s and 10s and begin the count in 5s
- They will work on practical problem solving activities involving equal sets or groups
- Secure number facts and counting
- Double objects and numbers up to 10

Year 1: Multiplication

- **Multiply with concrete objects, arrays and pictorial representations**



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

Present practical problem-solving activities, involving counting equal sets of groups.

Equipment to use: Counters, small world objects, Numicon, counting stick, pegs and peg board and money.

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

Key skills for multiplication at Year 1:

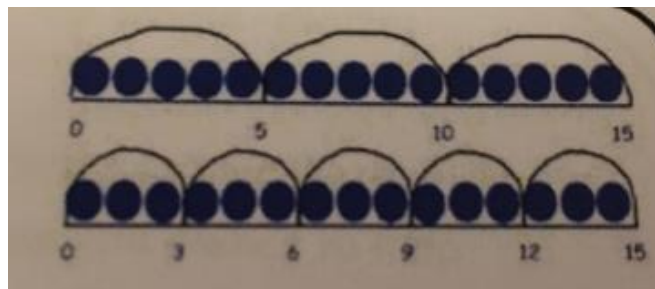
- Count in multiples of 2, 5 and 10, forwards and backwards
- Solve one-step problems involving multiplication, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher
- Make connections between arrays, number patterns and counting in twos, fives and tens
- Begin to understand doubling using concrete objects and pictorial representations

Year 2: Multiplication

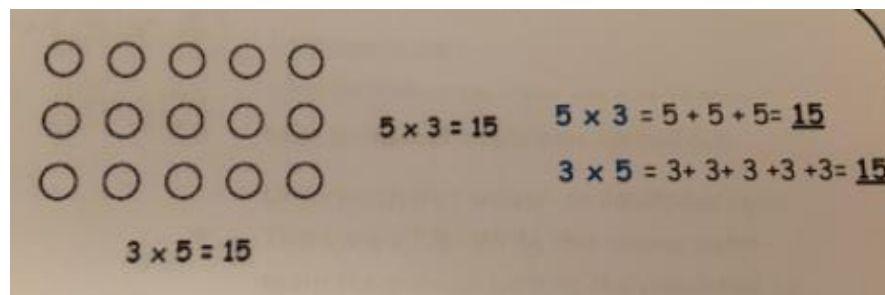
- **Multiply using arrays and repeated addition (using at least 2s, 5s and 10s).**

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, move to empty number lines.



Use arrays to help teach children to understand the commutative law of multiplication and give examples such as $3 \times _ = 6$



Use mental recall

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

Key vocabulary: Lots of, groups, times, altogether, groups of, array, 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 Year 2:

- Count in steps of 2, 3, 5 from zero and in 10s from any number
- Recall and use multiplication facts from the 2, 5 and 10 multiplication timestables, including recognising odds and evens
- Write and calculate number statements using the x and = sign
- 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
- Children to use a variety of language to discuss and describe multiplication

Year 3: Multiplication

- **Multiply 2-digits by a single digit number**

Introduce the ladder method for multiplying 2-digit by single-digit numbers.

In year 3 and 4, stick to the ladder method. It is important that you use the Dienes to help model this and allow the children to do it with Dienes.

A handwritten example of the ladder method for multiplying 14 by 3 on grid paper. The calculation is as follows:

$$\begin{array}{r} 14 \\ \times 3 \\ \hline 42 \end{array}$$

The intermediate steps are shown to the right of the main calculation:

- 12 (3 x 4)
- 30 (3 x 10)

The final result, 42, is written below the main calculation.

Children will need to be able to:

- Have a good knowledge of the tables – they need to be able to recall and work out multiplication facts for 2, 3, 4, 5, 8 and 10
- They will need to be able to add single digits together

Key vocabulary: Lots of, groups, times, altogether, groups of, array, multiply, count, multiplied by, repeated addition, column, row, commutative, sets of, equal groups, times as big as, once, twice, three times.., partition, ladder method, multiple, product, tens, ones, value

Key skills for multiplication at Year 3:

- Recall and use multiplication facts for the 2, 3, 4, 5, 8 and 10 multiplication table 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. $4 \times 12 \times 5 = 4 \times 5 \times 12 = 20 \times 12 = 240$)
- Solve simple problems in contexts. Deciding which operations and methods to use
- Develop efficient mental methods to solve a range of problems e.g. using commutativity ($4 \times 12 \times 5 = 4 \times 5 \times 12 = 20 \times 12 = 240$) and for missing number problems

Year 4: Multiplication

- **Multiply 2 and 3-digits by a single digit, using all of the multiplication tables up to 12 x 12**

See year 3. Carry out the same as year 3, but now moving to 3-digit multiplied by a one-digit number.

Handwritten multiplication calculation on grid paper:

$$\begin{array}{r} 314 \\ \times 3 \\ \hline 12 \quad (3 \times 4) \\ 30 \quad (3 \times 10) \\ 900 \quad (3 \times 300) \\ \hline 942 \end{array}$$

As children become more confident you can start to take the written calculations from the side away.

When ready, move the children onto short multiplication.

Handwritten short multiplication calculation on grid paper:

$$\begin{array}{r} 327 \\ \times 4 \\ \hline 1308 \\ \quad 1 \quad 2 \end{array}$$

Children should be able to:

- Approximate before the calculate, and make this a regular part of their calculating, going back to the approximation to check the reasonableness of their answer e.g. 346×9 is approximately $350 \times 10 = 3500$
- Record an approximation to check the final answer against it
- Multiply multiples of ten and one hundred by a single-digit, using their multiplication table knowledge

Key vocabulary: Lots of, groups, times, altogether, groups of, array, multiply, count, multiplied by, repeated addition, column, row, commutative, sets of, equal groups, times as big as, once, twice, three times..., partition, ladder method, multiple, product, tens, ones, value, inverse, estimation

Key skills for multiplication at Year 4:

- Count in multiples of 6, 7, 9, 25 and 1000
- Recall multiplication facts for all multiplication tables up to 12×12
- 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 by 3 numbers
- Use commutativity and other strategies mentally $3 \times 6 = 6 \times 3$, $2 \times 6 \times 5 = 10 \times 6$, $39 \times 7 = 30 \times 7 + 9 \times 7$
- Solve problems with increasingly complex multiplication in a range of contexts
- Recognise the place value of each digit in a four-digit number (Thousands, hundreds, tens and ones)

Year 5: Multiplication

- **Multiply up to 4-digits by 1 or 2 digits.**

Introducing long multiplication.

Children need to be taught to approximate first e.g. 72×38 , they will use rounding: 72×38 is approximately $70 \times 40 = 2800$, and use the approximation to check the reasonableness of their answer.

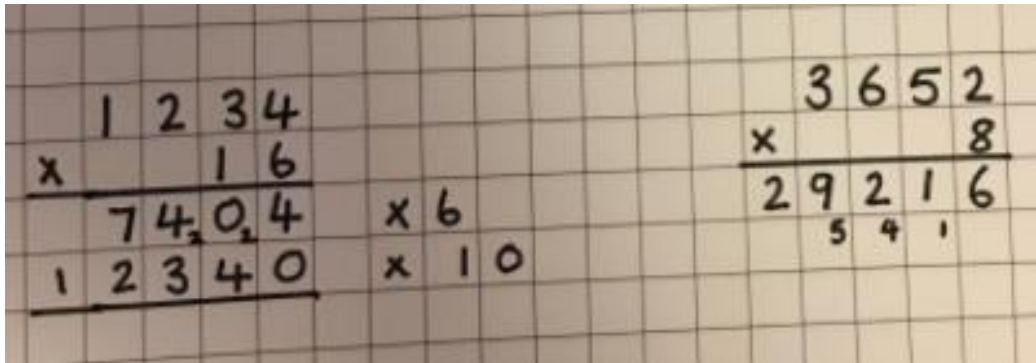
The image shows a handwritten long multiplication problem on grid paper. The main problem is 56×27 . The first partial product is 392 (from 56×7), and the second partial product is 1120 (from 56×20). The final sum is 1512 . To the right of this, there is a smaller example of 7×20 with a partial product of 140 .

Explain that first we are multiplying the top number by 7, starting with the ones (any carrying/exchanging needs to be done under the numbers).

Then explain, that we need to put a 0 underneath, in the ones column, and this is because we are multiplying the number by 20 (2 tens), which is the same as multiplying by 10 and 2.

Then we add the two number together, to give the answer.

Then the children can move onto more complex numbers:



Key vocabulary: Lots of, groups, times, altogether, groups of, array, multiply, count, multiplied by, repeated addition, column, row, commutative, sets of, equal groups, times as big as, once, twice, three times..., partition, ladder method, multiple, product, tens, ones, value, inverse, estimation, square, factor, integer, decimal, short/long multiplication, 'carry or exchange'

Key skills for multiplication at Year 5:

- Identify multiples and factors, using knowledge of multiplication tables to 12×12
- Solve problems where larger numbers are decomposed into their factors
- Multiply and divide integers and decimals by 10, 100, 1000
- Recognise and use square and cube numbers and their notation
- Solve problems involving combinations of operations, choosing and using calculations and methods appropriately

Year 6: Multiplication

- Short and long multiplication as in year 5, and multiply decimals with up to 2 decimal places by a single-digit

A handwritten multiplication problem on a grid background. The problem is 3.19×8 . The numbers are aligned with their decimal points. A horizontal line is drawn under the numbers. Below the line, the product 25.52 is written. There is a small '1' written below the '5' in the tens place and a small '7' written below the '5' in the tenths place, indicating carry-over from the previous steps.

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

This works well for multiplying money and measure.

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 year 5) to multiply numbers with more than 4-digits by a single-digit; to multiply money and measures; to multiply decimals with up to 2 decimal places by a single-digit
- Use long multiplication (see year 5) to multiply numbers with at least 4-digits by a 2-digit number

Key vocabulary: Lots of, groups, times, altogether, groups of, array, multiply, count, multiplied by, repeated addition, column, row, commutative, sets of, equal groups, times as big as, once, twice, three times..., partition, ladder method, multiple, product, tens, ones, value, inverse, estimation, square, factor, integer, decimal, short/long multiplication, 'carry or exchange', tenths, hundredths, decimal

Key skills for multiplication at Year 6:

- Recall multiplication facts for all timestables up to 12×12 (as year 4 and year 5)
- Multiply up to 4-digit \times 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

Early Years: Division

- **Group and share small quantities**

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

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

Find half of an object by sharing into 2 equal groups.

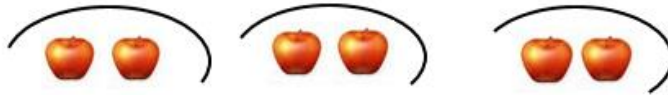
Grouping

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

E.g. How many groups of 4 can be made with 12 faces?



Share objects into equal groups and count how many in each group.



Key vocabulary: **Share, dividing, groups**

Key skills for division at Reception:

- Share objects into equal groups
- Use related vocabulary

Some additional activities:

Sharing milk at break time

Sharing sweets on a child's birthday

Sharing activities in the play corner

Year 1: Division

- **Group and share small quantities**

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

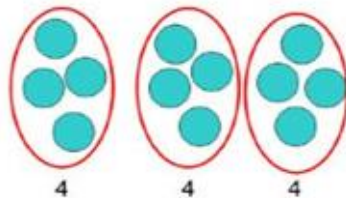
Grouping

E.g. How many groups of 4 can be made with 12 stars?



Sharing

E.g. 12 shared between 3 or $12 \div 3 =$



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?

Children should:

- Use lots of practical apparatus, arrays and picture representations, small world objects, counters, Numicon, number lines, bead strings, counting stick, money
- 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

Key vocabulary: Share, share equally, one each, two each..., group, groups of, lots of, array

Key skills for division at Year 1:

- 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 simple fractions of objects, numbers and quantities.
- They make connections between arrays, number patterns, and counting in twos, fives and tens.
- Begin to understand halving using concrete objects and pictorial representations.

Year 2: Division

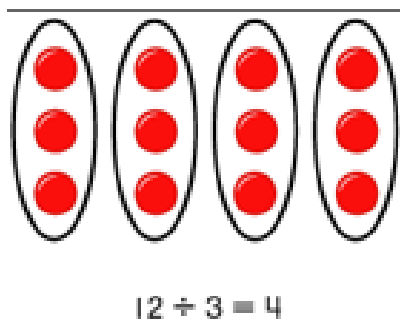
- **Division using the \div and $=$ sign and move more towards grouping**

Use objects, arrays, diagrams and pictorial representations

Arrays

This represents $12 \div 3$, posed as how many groups of 3 are in 12?

Pupils should also show that the same array could represent $12 \div 4 = 3$ if grouped horizontally.



Know and understand grouping

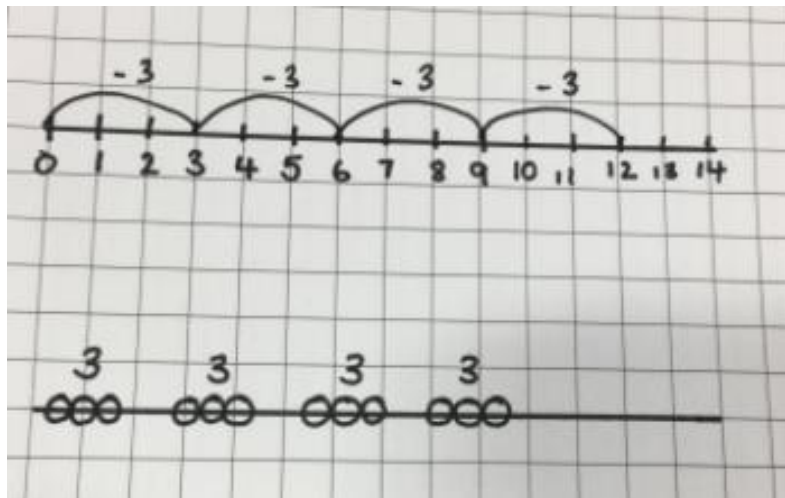
There are 6 sweets, how many people can have 2 sweets each?



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

Grouping using a number line and introducing remainders

Group from zero in equal jumps of the divisor to find out how many groups of _ in _. Pupils could use a bead string or practical apparatus to work out problems like 'A CD costs £3. How many CDs can I buy with £12?'



Key vocabulary: Share, share equally, one each, two each.., group, groups of, lots of, array, divide, divided by, divided into, division, grouping, number line, left, left over

Key skills for division at Year 2:

- 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 \times , \div and $=$ 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.

Year 3: Division

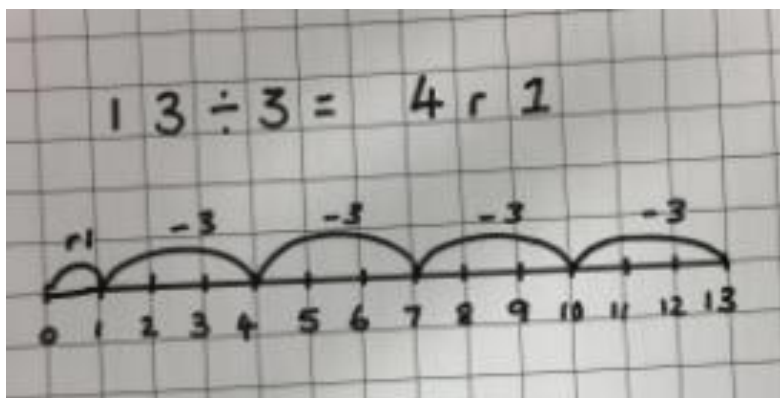
- **Division 2-digit numbers by a single-digit**

Use objects, arrays, diagrams

Grouping on a number line

Step 1: Children continue to work out unknown division facts, by grouping on a number line from zero. They should also now be taught the concept of remainders. 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 10s, ready for 'carrying' remainders across within the short division method.



Short division: Limit numbers to No remainders in the answer or carrying

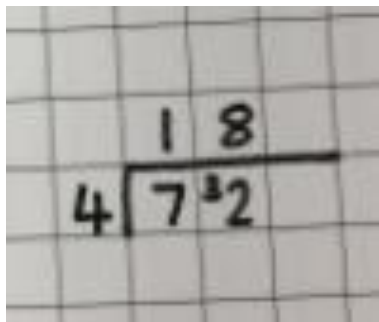
Step 2: Once children are secure with division as grouping and can demonstrate this using number lines, arrays etc., short division for larger 2-digit numbers should be introduced (initially with carefully selected examples requiring no calculating of remainders at all).

$$\begin{array}{r} 32 \\ 3 \overline{)96} \end{array}$$

Remind children of the correct place, that 96 is equal to 9 tens and 6 ones, but in short division we say, "How many 3's are in 9, and how many 3's are in 6?"

Short division: Limit numbers to no remainders in the final answer, but with carrying across

Step 3: Once children demonstrate a full understanding of remainders, and also the short division method taught, they can be taught how to use the method when remainders occur within the calculation (e.g. $96 \div 4$), and be taught to 'carry' the remainder onto the next digit.



A photograph of a handwritten short division calculation on grid paper. The calculation is $4 \overline{)72}$. The quotient '18' is written above the horizontal line. The divisor '4' is written to the left of the vertical line. The dividend '72' is written inside the division box. The calculation shows that 4 goes into 7 one time (18) with a remainder of 3, and then 4 goes into 32 eight times (18).

Key vocabulary: Share, share equally, one each, two each.., group, groups of, lots of, array, divide, divided by, divided into, division, grouping, number line, left, left over, inverse, short division, carry, remainder, multiple

Key skills for division at Year 3:

- 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 multiplied by one-digit numbers, using mental and progressing to formal written methods.
- Solve problems, in contexts, and including missing number problems, involving multiplication and division.
- Pupils develop efficient mental methods, for example, using multiplication and division facts (e.g. using $3 \times 2 = 6$, $6 \div 3 = 2$ and $2 = 6 \div 3$) to derive related facts ($30 \times 2 = 60$, so $60 \div 3 = 20$ and $20 = 60 \div 3$).
- Pupils develop reliable written methods for division, starting with calculations of

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Written by Rebecca Nicholas, Mathematics Lead
September 2017

2-digit numbers by 1-digit numbers and progressing to the formal written method of short division.

Year 4: Division

- **Division up to 3-digit numbers by a single-digit (without remainder initially)**

Continue to develop short division.

Step 1: Children must be secure with the process of short division for dividing 2-digit numbers by a single-digit (those that do not result in a final remainder), but must understand how to carry within the calculation process.

A handwritten short division problem on grid paper. The divisor 4 is written to the left of a vertical bar. The dividend 18 is written above the bar. The quotient 4 is written above the 8, and a remainder of 2 is written below the 8. The calculation is $4 \overline{)18} 4 \text{ r}2$.

Step 2: Children move onto dividing numbers with up to 3-digits by a single-digit; however, problems and calculations provided should not result in a final answer with a remainder.

A handwritten short division problem on grid paper. The divisor 4 is written to the left of a vertical bar. The dividend 218 is written above the bar. The quotient 54 is written above the bar, and a remainder of 2 is written below the 8. The calculation is $4 \overline{)218} 54 \text{ r}2$.

A handwritten short division problem on grid paper. The divisor 5 is written to the left of a vertical bar. The dividend 037 is written above the bar. The quotient 07 is written above the bar, and a remainder of 2 is written below the 7. The calculation is $5 \overline{)037} 07 \text{ r}2$.

When the answer for the first column is zero ($1 \div 5$), children can initially write a zero about to acknowledge its place, and must always carry the number over to the next digit as a remainder.

Key vocabulary: Share, share equally, one each, two each..., group, 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

Key skills for division at Year 4:

- Recall multiplication and division facts for all numbers up to 12×12 .
- 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 $200 \times 3 = 600$ so $600 \div 3 = 200$
- Pupils solve two-step problems in contexts, choosing the appropriate operation, working with increasingly harder numbers. This should include correspondence questions such as three cakes shared equally between 10 children.

Video clip: Pupil demonstrating 3-digit short demonstration without remainders

Year 5: Division

- **Division up to 4-digit numbers by a single-digit, including those with remainders**

Short division with remainder answers.

Short division with remainders

Now that pupils are introduced to examples that have remainder answers, division needs to have a real life problem solving context, where pupils consider the meaning of the remainder and how to express it, ie. as a fraction, a decimal, or as a rounded number or value, depending upon the context of the problem.

A photograph of a handwritten short division problem on grid paper. The problem is $8 \overline{) 53529}$. The quotient is written as 0663 with a remainder of 5, indicated by a horizontal line and 'r5' to the right. The digits of the quotient are aligned above the corresponding digits of the dividend. The remainder 5 is written below the final digit of the dividend.

The answer could be expressed as five eights, or remainder 5, or as a decimal (see year 6 for writing the answer as a decimals) or rounded as appropriate to the problem involved.

Include money and measure in contexts.

Key vocabulary: Share, share equally, one each, two each..., group, 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 skills for division at Year 5:

- Recall multiplication and division facts for all numbers up to 12×12 (as in Year 4).
- 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.
- 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
- Use multiplication and division as inverses.
- Interpret non-integer answers to division by expressing results in different ways according to the context, including with remainders, as fractions, as decimals or by rounding (e.g. $98 \div 4 = 24 \text{ r}2 = 24\frac{1}{2} = 24.5 \approx 25$).
- Solve problems involving combinations of all four operations, including understanding of the equals sign, and including division for scaling by different fractions and problems involving simple rates.

Year 6: Division

- **Division at least 4-digits by both single-digit and 2-digit numbers (including decimal numbers and quantities)**

Short division, for dividing by a single digit.

A handwritten short division calculation on grid paper. The dividend is 0812.125 and the divisor is 8. The quotient is 101.5. The calculation shows the following steps: 8 goes into 08 one time (1), 8 goes into 12 one time (1), 8 goes into 17 two times (2), and 8 goes into 12 one time (1). The remainder is 5, which is then brought down as 50, and 8 goes into 50 six times (6). The final quotient is 101.5.

$$\begin{array}{r} 0812.125 \\ 8 \overline{) 6497.000} \\ \underline{8} \\ 0 \\ \underline{8} \\ 0 \\ \underline{8} \\ 0 \\ \underline{8} \\ 0 \\ \underline{8} \\ 0 \end{array}$$

Short division with remainders: Children should continue to use this method, but with numbers to at least 4-digits, and understand how to express remainders as fractions, decimals, whole number remainders, or rounded numbers. Real life problem solving contexts need to be the starting point, where children have to consider the most appropriate way to express the remainder.

Calculating a decimal remainder: In this example, rather than expressing the remainder as r 1, a decimal point is added after the units because there is still a remainder, and the one remainder is carried onto zeros after the decimal point (to show there was no decimal value in the original number).

Keep dividing to an appropriate degree of accuracy for the problem being solved.

Try this equation: $848 \div 16$	
Approximation $800 \div 16 =$	50

$$\begin{array}{r}
 0 \quad 5 \quad 3 \\
 16 \overline{) 848} \\
 \underline{- 8} \\
 4 \\
 \underline{- 4} \\
 0
 \end{array}$$

Start with the largest place-holder in this case it will be the hundreds column.

$8 \div 16$ not possible so put a 0 above the hundreds column

Carry the 8's digit over to the Tens column!

$84 \div 16 =$

$16 \times 5 = 80$

$84 - 80 = 4$

$48 \div 16 = 3$

No remainders

Key vocabulary: Share, share equally, one each, two each., group, 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), common factor

Key skills for division at Year 6:

- 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.

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- Solve problems involving all four operations.
- Use estimation to check answers to calculations and determine accuracy, in the context of a problem.
- Use written division methods in cases where the answer has up to two decimal places.
- Solve problems, which require answers to be rounded to specified degrees of accuracy.
-