Calculation

Foundation Overview

Children engage in a number of activities through adult led and child initiated play activities. The focus of learning is based on a multi-sensory approach including sand, water, play dough and foam on a daily basis. Children have access to learning both in the indoor and outdoor classroom. Children engage in 'tell me more' mathematical activities.

Children are introduced to use new mathematical vocabulary for example: halving, sharing, doubling, count on, count back and number sentences.

Key Stage 1 Overview

The maths work your child is doing at school may look very different to the kind of calculations you remember. This is because children are encouraged to work mentally, where possible, using models, images and personal jottings to help support their thinking. Even when children are taught more formal written methods (from late year 2 onwards) they are only encouraged to use these methods for calculations they cannot solve in their heads.

Maths is taught this way to enable the children to have a good understanding of what the numbers represent before they move on to written methods.

Discussing the efficiency and suitability of different strategies is an important part of a maths lesson. Talk to your child about how you work things out and ask your child to explain their thinking.

Key Stage 2 Overview

In the juniors children are taught to become 'masters' of the formal methods of arithmetic. Mental calculation and jottings, as well as trial and error, are still strategies that are encouraged for use in problem solving. As your child moves from fluency to reasoning they will become more confident using 'bar modelling' and visualisation strategies.

When faced with a calculation problem, encourage your child to ask……

- Can I do this in my head?
- Could I do this in my head using drawings or jottings to help me?
- Do I need to use a written method?
- Should I use a calculator?

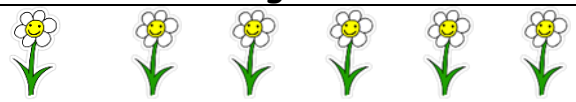
Also help your child to estimate and then check the answer. Encourage them to ask….

Is the answer sensible?

ADDITION

Foundation Stage

Children are taught to understand the 'reality of number'



1 2 3 4 5 6

Children need to be able to count in a fixed order. Counting backwards is no more difficult than counting forward and should be encouraged. Children need to be able to identify and explore numbers 0-20 with confidence.

Songs, rhymes and chanting.
Multi-sensory approach to learning using sand, water and dough. Recognising number in the environment.

Children are able to match one number name to an object. The list below tends to aid progression in using numbers:

- Objects that can be seen, touched and moved.
- Objects that be seen, touched but not moved.
- Objects that can be seen but not touched.
- Objects that can be seen and are moving.
- Objects that cannot be seen.

Using the language of one more.

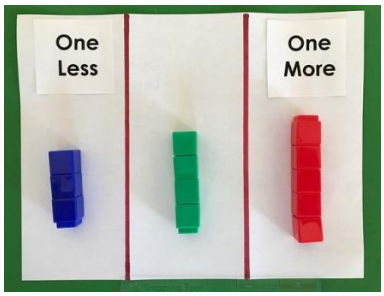
1 2 3 4 5 6

one more is 

7

Children learn that the next number after any given number or object is always one more.
Number sentences:
Through play children explore and experiment using number sentences in areas of their interest.

1 more than 6 is 7 because it is NEXT to 6.



Children will focus on combining groups of objects.

They will then move onto writing the number sentences.
4+3=7

They are introduced to the mathematical sign of + (addition) and = (equals)

Children will discuss what is one more than zero? What is one less than one?

<u>Key Stage 1</u>

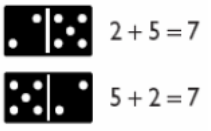
<u>Year 1</u>

Children are taught to understand addition as combining two sets and counting on. Children need to understand the concept of =, therefore calculations should be written either side of the = sign so that it is not just interpreted as the answer.

Example

2=1+1 3=3 2+3=4+1 2+2+2=4+2

Children also need to know that addition can be done in any order

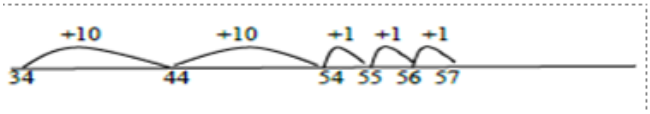


Children will learn to add using zero.

Example

3 + 0 = 3 2 + 0 = 1 + 1

2 + 3 = At a party I eat 2 cakes and my friend eats 3. How many cakes do we eat *altogether*. 	Children could draw a picture to help them work out the answers. They could use a bar model to represent this: 2 | 3 ?
7 + 4 = 7 people are on a bus, 4 more get on at the next stop. How many people +are on the bus? 	Children may use Numicon as a visual aid.
12 + 7 = 12 sheep went in to the field and 7 followed them. How many sheep are there in the field? 6 + ☐ = 9 Children choose the large number, even when it is not the first number and count on from there. Or they could use a bar model – 6 | ? 9 Children will begin to balance calculations using the language of the equals sign.	Children to touch their head saying the largest number, then using their fingers count on. Children then to check their answers using a number line. Children could use a bar model – 12 | 7 ? Children will use zero in calculations: 12 + 0 = 12

5 + 5 + 10 = 7 + ☐ = 10 or 10 = 7+ ☐ Children use known facts (number bonds and double facts to 10 and then 20) to calculate answer. E.g. 5 + 5 = 10 10 + 10 = 20 Children are encouraged to remember their past knowledge of number bonds to 10 and doubling facts. 1 + 9 = 10 2 + 8 = 10 3 + 7 = 10 etc	
<u>Year 2</u> Children will begin to add two 2-digit numbers 34+23=57  Next, Children are taught to become more efficient by adding ones in one jump and then the tens in one jump:	Drawing an empty number line helps children to record the steps they have taken in a calculation (start on 34, +10, +10 then +3 ones). This is much more efficient method when counting bigger numbers rather than counting on in ones. Children may be ready at this point for the partitioning method – see below.

<u>Key Stage 2</u>

<u>Year 3</u>

Children continue to solve missing digit problems throughout Key Stage 2.

Example:

Solve missing number problems
Example
24 + 55 = 30 + □

32 + □ + □ = 150

135 = 11 + □ + 45

Children will learn about partitioning and recombining

12 + 23 = 35

Partition each number into tens and ones:

10+2 20+3

Add the tens the ones:

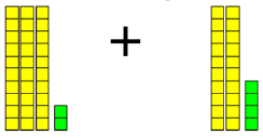
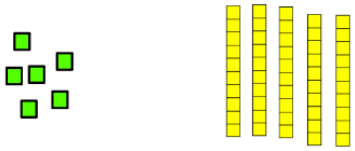
10+20=30

2+3=5

So 30+5=35

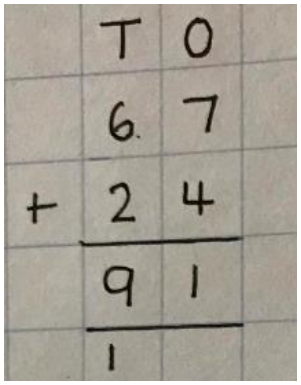
Children then verbally explain how they reached the answer.

Children split 2-digit numbers mentally in to tens and ones adding the tens first and then the ones.

This can also be done for 3-digit numbers 243+321= 200+300=500 40+ 20=60 3+1=4 So, 500+60+4=564	
Before moving onto column addition, children need to understand regrouping to make 10. This can be shown using cubes: 6+5=11  Children can be supported to do column addition using dienes on a Place Value mat. This develops the understanding of partitioning and place value. Children will always begin with numbers that do not need to be regrouped e.g. 32+24=56  Count the ones and then the tens 	Children will be taught written methods for those calculations that cannot be done in their heads.

67 + 24 =

There are 67 boys and 24 girls in a year group. How many children are there altogether?



	T	O
	6	7
+	2	4
	9	1
	1	

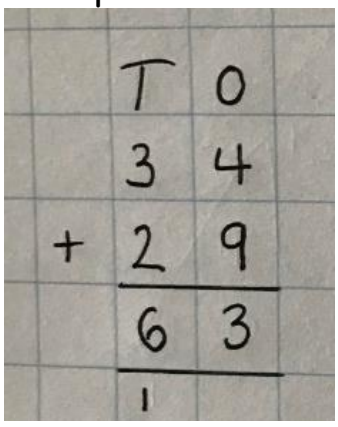
Or children can use a bar model to visualise and then solve the problem:

67	24
?	

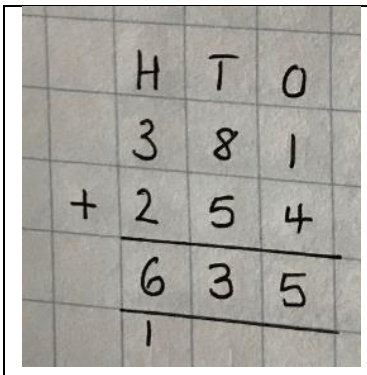
<u>Year 3-6</u>

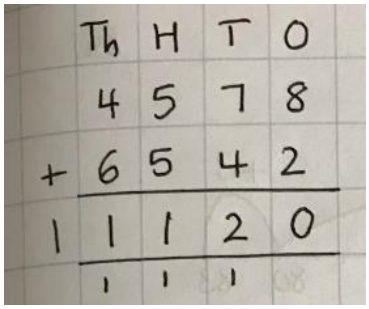
There is a progression from adding tens and ones to adding hundreds, tens and ones etc.

Examples:

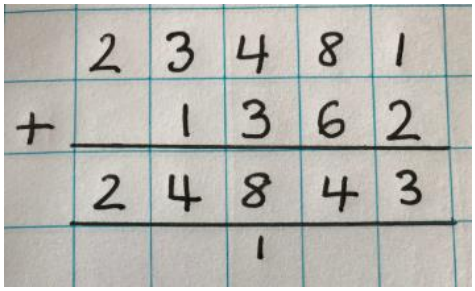


	T	O
	3	4
+	2	9
	6	3
	1	

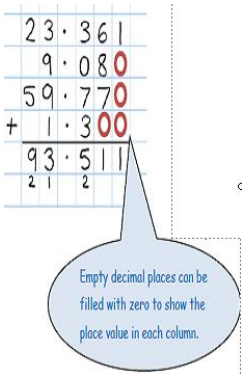


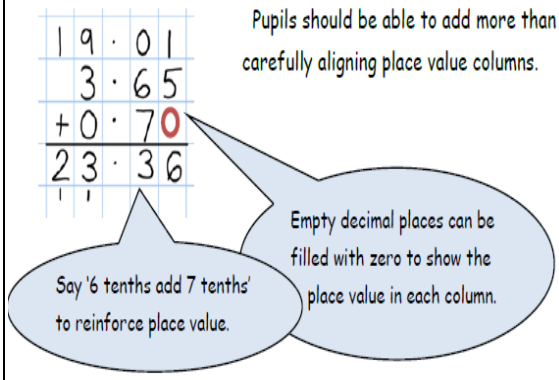


Throughout Key Stage Two children will be asked to reason and problem-solve using their knowledge of calculation.
Example:
23481 people visited the museum last year, the number increased by 1362 this year. How many people visited altogether?



Once children are secure with column addition, they are introduced to decimals (Year 4), firstly when adding money and then linking it to measurement.





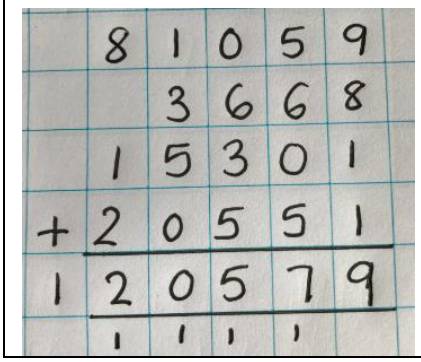
The decimal point should be aligned in the same way as the other place value columns, and must be in the same column in the answer.

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

Zeros could be added into any empty decimal places to show there is no value to add.

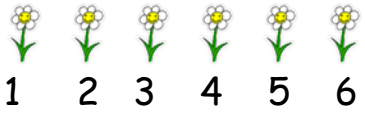
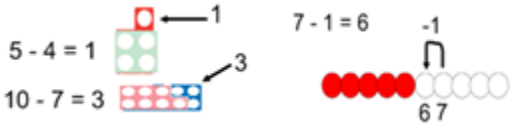
<u>Years 5 & 6</u>

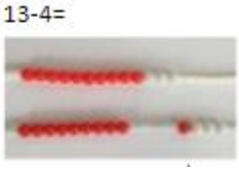
Children will be able to add several numbers with more than four digits.



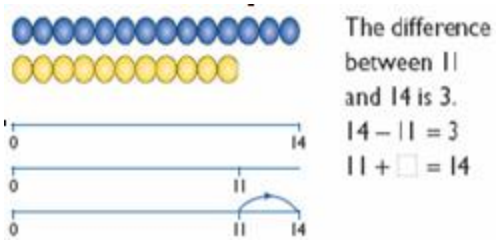
SUBTRACTION

Children are taught to understand subtraction as taking away (counting back) and finding the difference (counting up)

Foundation stage Using the language of one less.  1 2 3 4 5 6 1 less than 6 is 5 because it is the previous number, in our fixed order of counting. Focus on subtracting groups of objects. They will then move onto writing the number sentences.	Children learn the previous number after any given number or object is always one less. Number sentences: Children are introduced to the mathematical sign of -(subtraction) and = (equals).
Key Stage 1 Year 1 Children need to read, write and interpret the – and = sign Example: 7=4-3 7-3=4 7-4=3 They will use number bonds and related number facts to 20 	Drawing a picture helps children to visualise the problem.

5-2 = I had five balloons, two burst. How many did I have left?  Take away/counting back Children could use a bar model to represent the calculation – <table><tr><td colspan="2">5</td></tr><tr><td>2</td><td>?</td></tr></table>	
7 - 4 = 7 people are on a bus, 4 get off at the next stop. How many people are left on the bus? 	Children may use Numicon as a visual aid. Finding the difference between two pieces of numicon. The 4 would be put on top of the 7.
13– 4 = 'Counting back from' I had 13 sweets and ate 4 how many did I have left? 	The child mentally counts 4 numbers back from 13 and then checks answer on number line. (Landmarked - has numbers on it).
'Counting up' or 'Finding the difference' 14 – 11 =	The child counts up from 3 to 12 using their fingers as a tally. (This is not a natural

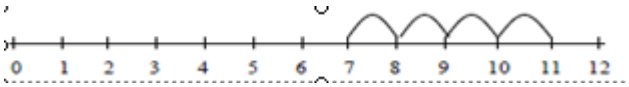
If my friend is 14 and his brother is 11 – how much older is he?



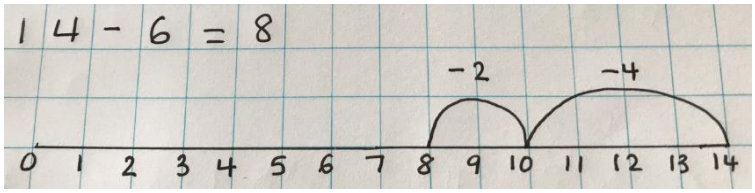
Children could represent this as a bar model -

14	
11	?

Children can find the difference by counting on.
The difference between 7 and 11:

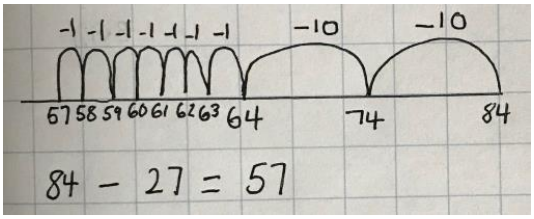
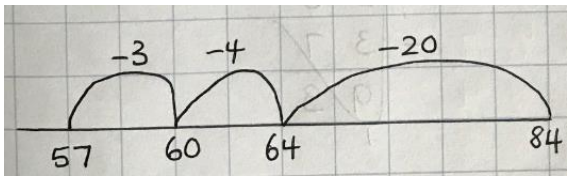
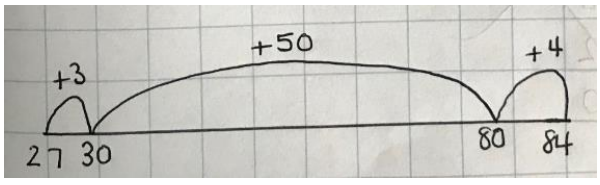


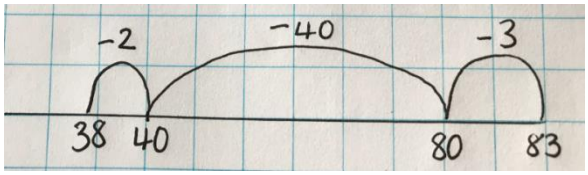
Children will then be taught how to bridge ten.



Emphasise JUMP on number line, NOT counting!
Use number bonds to jump back to the previous ten on the number line. Then subtract what is left in one jump.
14—6 = 8

strategy for many children because their perception of subtraction is taking away)

20-5 = 15, so 20-6 must be 14. Children use known facts (number bonds and double facts to 20) to calculate answer.	Children are encouraged to remember their past knowledge of number bonds to 20 and halving facts. 20-1 =19 20-2= 18 20-3 = 17 etc
<u>Year 2</u> Children will subtract two 2-digit numbers. Example I cut 27cm off a ribbon measuring 84cm. How much is left?  Or  Children could also find the difference on a number line by starting at the smaller number and jumping up.  	Children could count back using an empty number line. This is a really good way for them to record the steps they have taken (start on 84 – 20, then – 7) Children may need support to decide whether to count on or back depending on the size of the difference E.g. 98-11= count back 85-62= count on Or children could use a bar model to represent this calculation – 84 27 ?

Children will move on to solve one-step problems using concrete objects and pictorial representation, and missing number problems	
<u>Key Stage 2</u> <u>Year 3</u> Children need to be able to subtract numbers that cross the tens boundary (near tens). For example, adding 9, 99, 11, 21 etc. Partitioning 23 - 12 = 23-10-2= Children then verbally explain how they reached the answer.	Children split a two digit numbers in to tens and ones subtracting the tens first and then the ones
83 – 38 = The library owns 83 books. 38 are out on loan. How many books are on the shelves?  2+40+3= 45 (recombining the digits or adding the jumps together)	Children could jump backwards in chunks from the biggest to the smallest using an empty number line. It is easiest to count backward to a multiple of 10 or 100 (a friendly number).

Year 3-6

In year 3 children will begin to solve more complex subtraction calculations including missing number questions.

137—80 = ☐ ☐ = 137—80

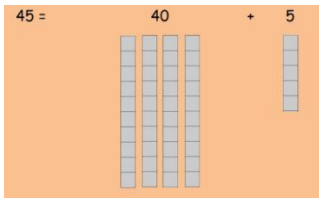
137— ☐ = 57 57 = ☐ - 80

Standard written method – column subtraction.

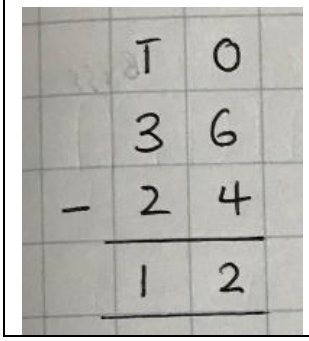
There is a progression from subtracting tens and ones to subtracting hundreds, tens and ones etc throughout Key Stage 2.

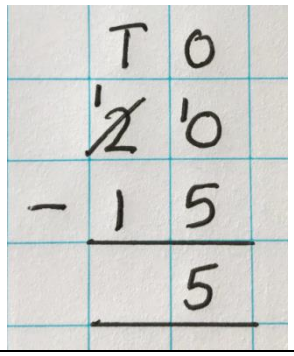
Children are introduced to column subtraction using Dienes.

45-26=



1) Start by partitioning 45
2) Exchange one ten for ten more ones
3) Subtract the ones, then the tens

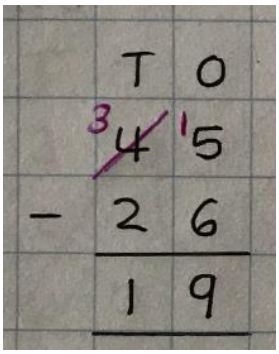


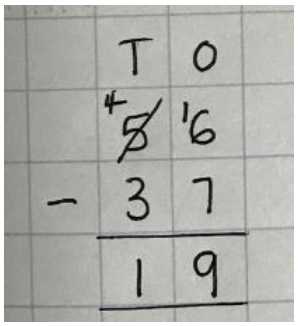


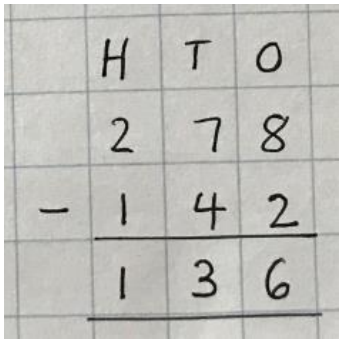
We use the language 'exchange' ten or the hundred when a number needs to be regrouped.

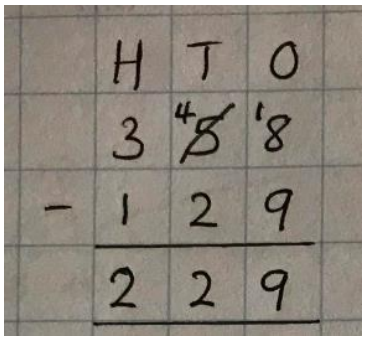
It's crucial that the children understand that when they have exchanged the 10 they still have 45.

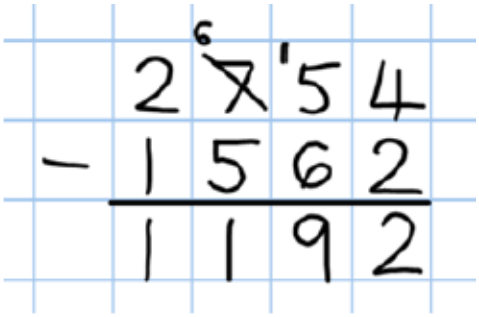
45=30+15



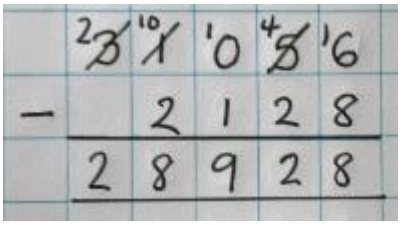


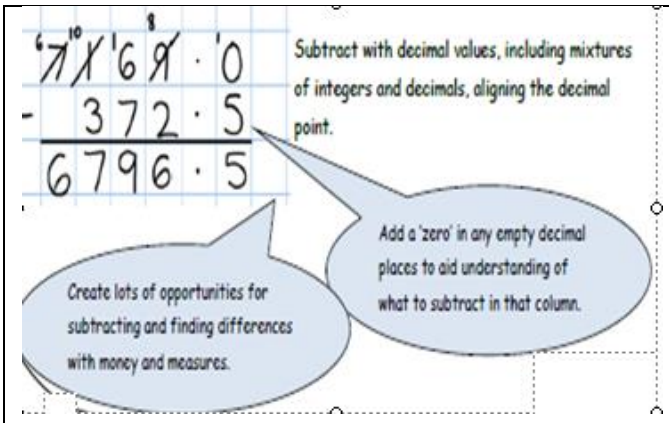


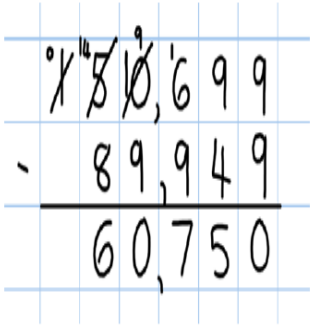


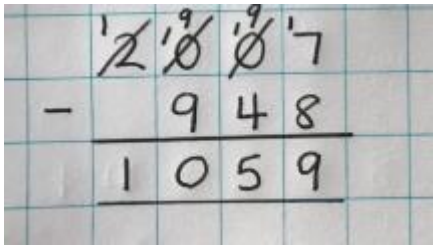


By Year 6 children will be subtracting using more complex numbers



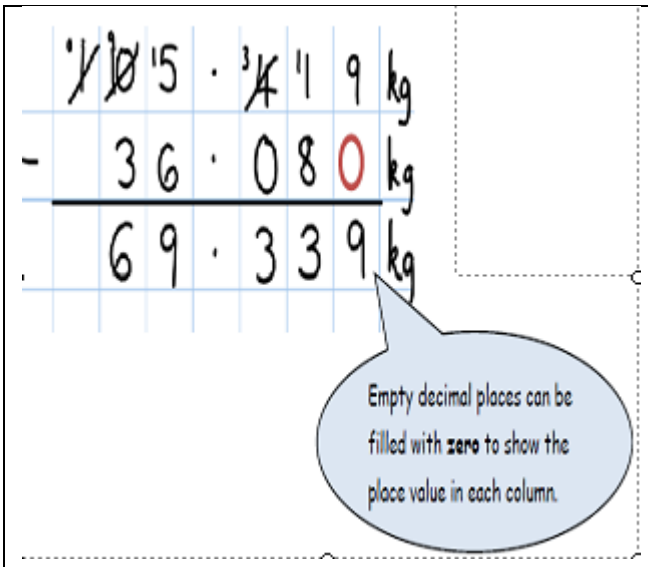






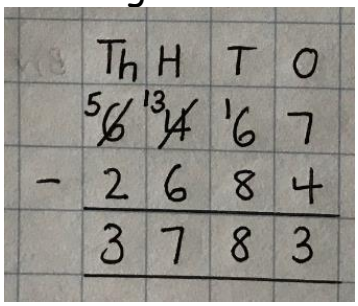
Children will carry out calculations involving money and measures, including decimals with different numbers of decimal places

Once fluent in the column method, children will begin to apply this knowledge through reasoning and problem solving. These problems will develop from one step to a number of steps in order to solve the problem.



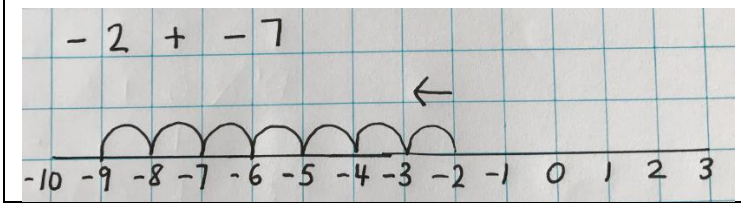
6467-2684=

There are 6467 fish in the lake. 2684 are caught. How many fish are left?



In Year 4 children will be introduced to negative numbers for reading temperature.

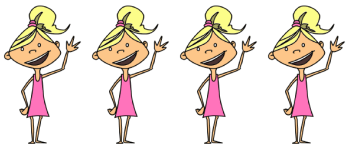
Year 6 children will add and subtract negative numbers using a number line.



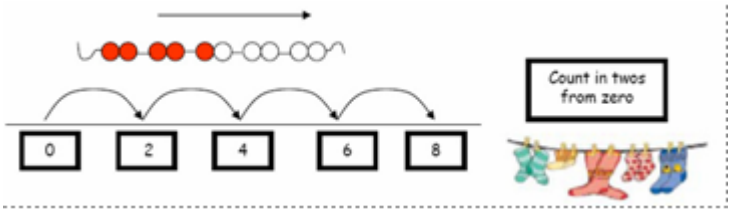
The language we use for this is minus 6 degrees Celsius. Other than for temperature negative numbers must be referred to as such rather than 'minus' numbers.

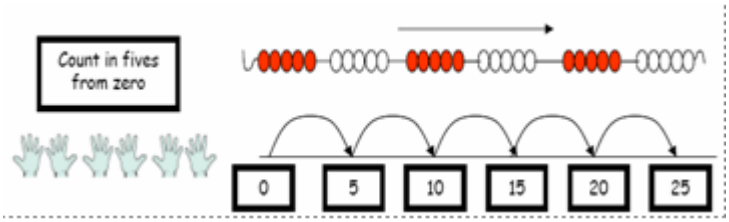
MULTIPLICATION

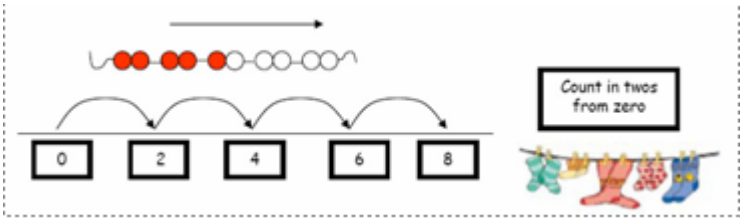
Children are taught to understand multiplication as repeated addition and arrays.

Foundation Stage Counting in groups – in 2s,5s,10s In 2s – counting  Children will count pairs of socks, eyes, shoes. In 5s – counting handprints or gloves. In 10s – counting bundles of straws Children will begin to double numbers to 20	This can be learnt by rote but children need to explore with real objects and make connections.
Key Stage 1 2x4= Each child has two eyes. How many eyes do four children have?  Children begin to learn about multiplication by repeated addition 2+ 2+ 2 +2= 	Lots of pictures are used to represent the numbers.

4 lots of 2 make 8







Children learn about commutativity e.g. 4x2=, 2x4=
Children explore the effect of multiplying by 0.

Children count in twos, fives and tens from zero using visuals such as number lines, 100 square or Numicon

5x3=

There are 5 cakes in a pack. How many cakes in 3 packs.

*****	*****	*****
5	+ 5	+ 5

Dots or tally marks are drawn in groups. This shows 3 groups of 5.

Children could represent this using a bar model

?		
5	5	5

4x3=

A sweet costs 4p, how much does 3 sweets cost.

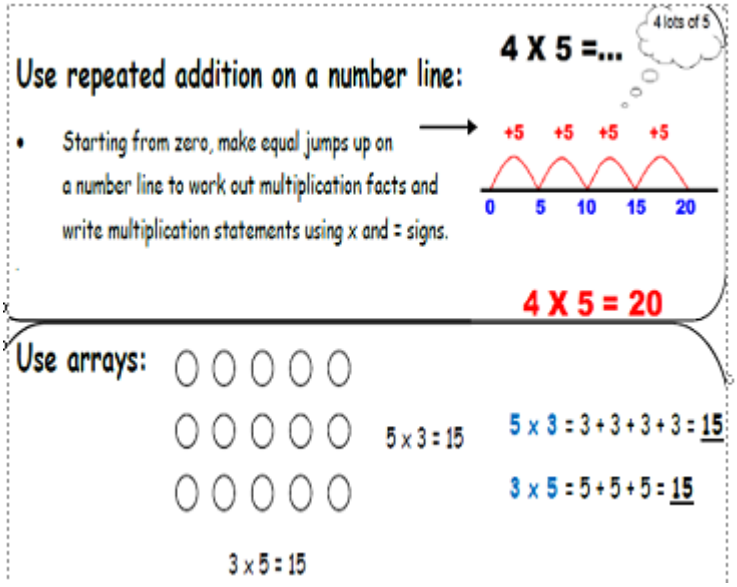
*** ****

*** or ****

*** ****

***

By Year 2 children will move onto multiplication using repeated addition on a number line.



Children learn to solve missing box problems using their knowledge of multiplication. Example

7 x 2 = □	□ = 2 x 7
7 x □ = 14	14 = □ x 7
□ x 2 = 14	14 = 2 x □

Drawing an array (3 rows of 4 or 3 columns of 4) gives children an image of the answer. It also helps develop their understanding that 4x3 is the same as 3x4 (Commutative Law)

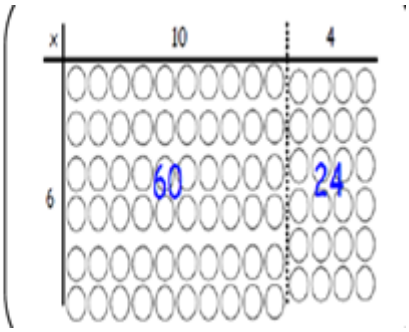
Key Stage 2

8 x 23 =

23 books are sold each book costs £8. How much money was taken?

X	20	3
8	160	24

160 + 24 = 184



In Year 4 children will develop the grid method

Developing the grid method:

Eg. 136 x 5 = 680

X	100	30	6
5	500	150	30

500
150
+ 30
680

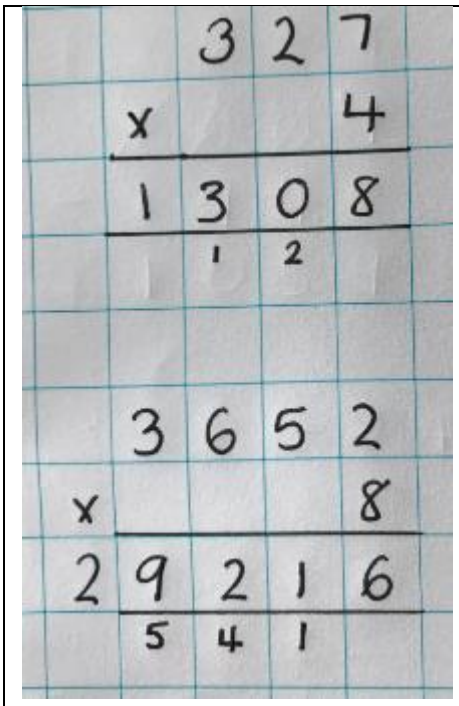
136 x 5

136
X 5
680
3

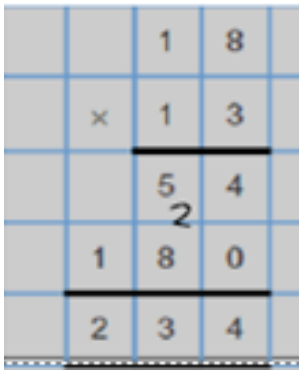
Children will learn how to multiply by 10, 100, 1000 mentally using their knowledge of place value.

This is called the grid method. Using past learning the 23 is partitioned in to 20 and 3. Each of these is multiplied by 8. The answers are then added together.

Compare the grid method calculation to a formal short multiplication method, to see how the steps are related, but notice that there are less steps involved in the formal column method.



Children will then progress to multiplying two digits by two digits.

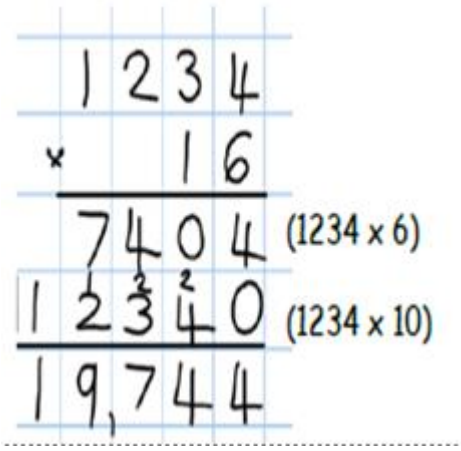


By Year 6 children will be able to multiply using more complex numbers and decimals.

Only move onto the formal short multiplication method when the children are confident and accurate multiplying 2 and 3-digit numbers by a single digit this way, and are confident in 'carrying' for written addition.

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

Children learn about zero being a place holder, understanding place value. They explore what happens when we multiply using zero and will understand what happens if zero isn't used as a place holder in long multiplication.



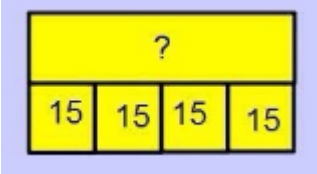
Throughout KS2 children will continue to solve missing number questions involving multiplication.

□ X 5 = 20 3 X □ = 18 □ x □ = 32

Children will continue to use bar modelling to solve multiplication problems where the whole is unknown.

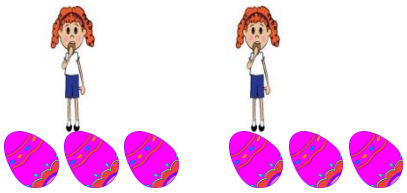
Example:

4 children go to the cinema. They each pay £15. How much do they spend altogether?



DIVISION

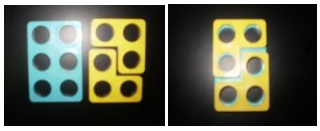
Children are taught to understand division as sharing and grouping.

<u>Foundation Stage</u> Children begin by halving even numbers to 20 using objects. After this, children begin to share numbers using objects.	
<u>Key Stage 1</u> 6÷2 = <u>Sharing</u> 6 Easter eggs are shared between 2 children. How many eggs do they each get?  Sharing between 2. Children can use hoops to divide the objects. <u>Grouping</u> There are 6 Easter eggs – how many children can have 2 each?  Grouping in to 2s.	More pictures – drawing often gives children a way in to solving the problem. Children will begin to understand the effect of using zero. 6 divided by 0 is 0.

<u>Sharing</u>

6÷2 =

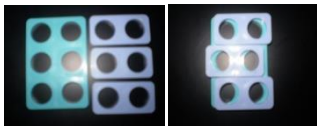
6 Easter eggs are shared between 2 children. How many eggs do they each get?



<u>Grouping</u>

6÷2 =

There are 6 Easter eggs – how many children can have 2 each?



Using Numicon tiles, the children are to choose which 2 tiles will fit the 6 tile equally.

The children decide how many number 2 tiles fit the number 6 tile.

Division can be represented by a bar model

6	
?	?

12 ÷ 4 =

4 Apples are packed in a basket, how many baskets can you fill with 12 apples?

****	****	****

Grouping in 4s

Sharing into 4 groups

As a bar model:

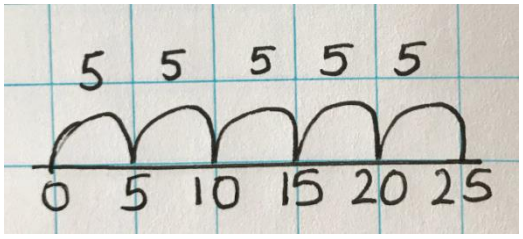
12			
?	?	?	?

Dots or tally marks can either be shared out one at a time or split up in to groups.

Children will explore what happens if you divide by zero and begin to reason about what this means.

25÷5 =

A Refresher bar costs 5p – how many can I buy for 25p?



As with other calculations, children will develop their skills in solving missing box questions.

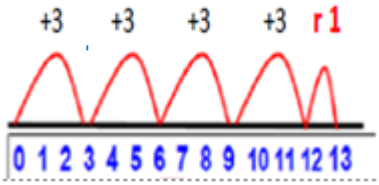
6 ÷ 2 = □	□ = 6 ÷ 2
6 ÷ □ = 3	3 = 6 ÷ □
□ ÷ 2 = 3	3 = □ ÷ 2

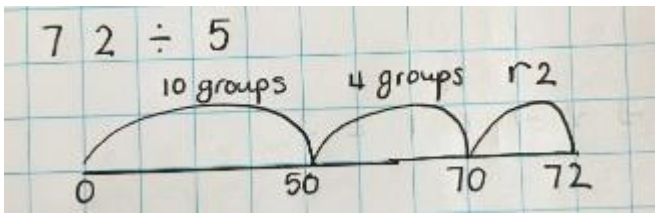
To work out how many 5s there are in 25, draw groups of 5 along a number line. This shows you need 5 groups of 5 to reach 25. This can be done either going forwards or backwards (repeated subtraction). Or as a bar model:

25						
?	?	?	?	?	?	?

<u>Key Stage 2</u>

$13 \div 3 = 4 \text{ r } 1$

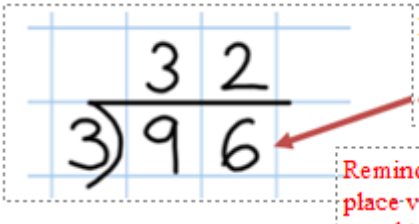




Children begin by using the inverse and thinking about number facts known to them. They will work out unknown division facts by grouping on a number line from zero. They will also be taught the concept of remainders.

This depends on the ability to recall multiples mentally.

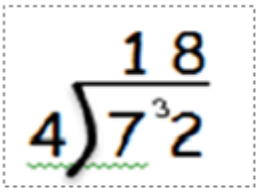
By Year 4 children will be using the short division method beginning with no remainders.



Each digit must be a multiple of the divisor

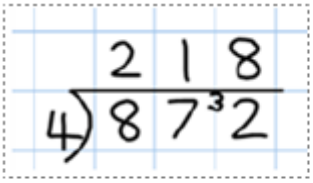
Remind children of correct place value, that 96 is equal to 90 and 6, but in short division, pose:
How many 3's in 9? = 3
How many 3's in 6? = 2

Next introduce carrying

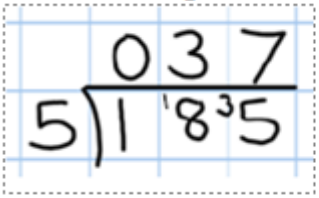


Real life contexts need to be used routinely to help children gain a full understanding, and the ability to recognise the place of division and how to apply it to problems.

Move onto dividing numbers with up up to 3 digits.

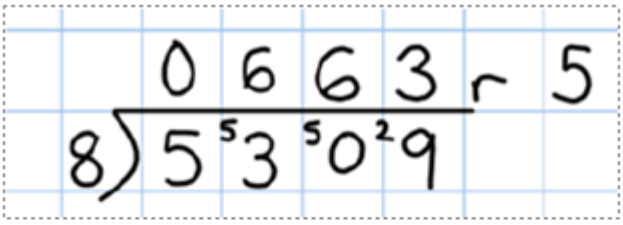


Introduce adding a zero as a place holder

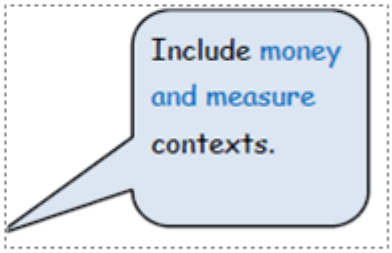


Include money and measure contexts when confident.

This is also known as the bus shelter or bus stop method!

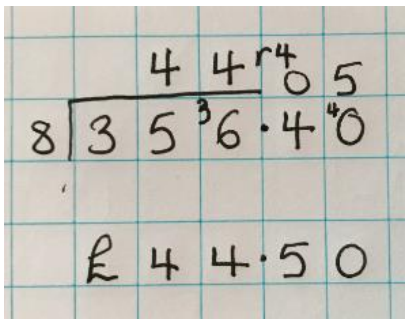


Real life contexts need to be used routinely to help children gain a full understanding, and the ability to recognise the place of division and how to apply it to problems.



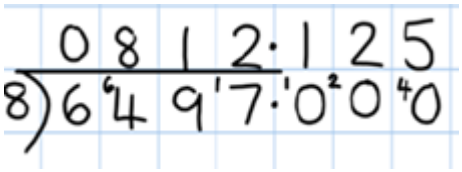
Example: You and your 7 friends run a lemonade stall over three days. You make £356 in total. How much money would you each get if you split it fairly?

356 ÷ 8 =

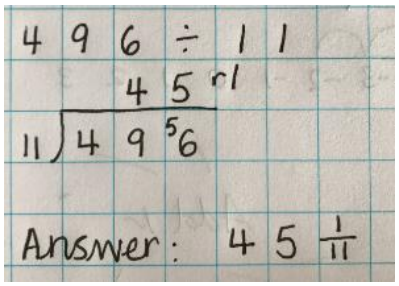


Children need to understand how to express remainders as fractions, decimals or rounded numbers. Real life problem solving contexts are the starting point where pupils have to consider the most appropriate way to express the remainder. Decimal answers are shown to 2 or 3 decimal places depending on context of the question.

By Year 5, children will move onto short division with remainders and in Year 6 they will be asked to show remainders as decimals or fractions.

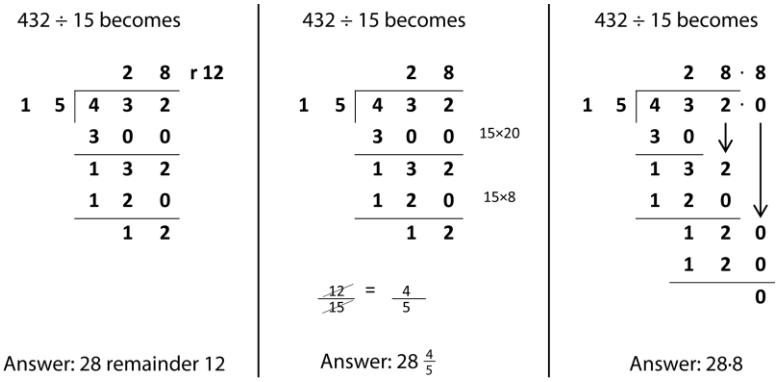


Calculating a decimal remainder: Add a decimal point after the units and carry the remainder onto zeros added after the decimal point. (Keep dividing to an appropriate degree of accuracy for the problem being solved.)

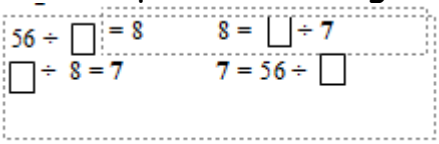


Calculating a fraction remainder: The remainder goes on the top line (numerator) and the bottom number (denominator) is the number you have divided by.

Children will be taught the long division method:

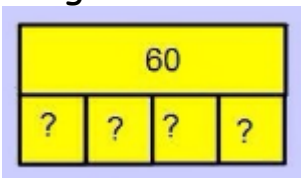


Throughout Key Stage 2 children will develop their skills at solving missing number questions using division.



Children will continue to use bar modelling to solve division questions.

If the size of the groups are unknown bar modelling can be used.
Example
4 children go to the cinema. They pay £60 altogether. How much do they spend each?



REAL LIFE PROBLEMS

- Go shopping with your child to buy 2 or 3 items. Ask them to work out the amount spent and how much change they will get.
- Buy some items with % extra free. Help your child to calculate how much of the product is free.
- Plan an outing during the holidays. Ask your child to think about what time you will need to set off and how much money you will need to take.
- Use a TV guide. Ask your child to work out the length of their favourite program. Can they calculate how long they spend watching TV per day/week?
- Use a bus/train timetable. Ask your child to work out how long a journey between two places should take. Go on the journey. Did you arrive earlier or later than expected?
- Help your child to scale a recipe up or down to feed the right amount of people.
- Work together to plan a party or meal on a budget.

PRACTISING NUMBER FACTS

- Find out which number facts your child is learning at school (addition facts to 10, times tables, doubles etc). Try to practice for a few minutes per day.
- To practice number bonds, play games which encourage your child to answer quickly without counting or using fingers.
- Throw 2 dice. Ask your child to find the total of the numbers (+) the difference between them (-) or the product (x). Can they do this without counting?
- Use a set of playing cards (no pictures). Turn over 2 cards ask your child to add or multiply the numbers. If they answer correctly, they keep the cards. How many can they collect in a given time?
- Play bingo. Each player chooses 5 numbers (e.g. Numbers to 10 to practice simple addition, multiples of 5 to practice the 5 times table). Ask a question and if the player has the answer, they can cross it off. The winner is the first player to cross off all their answers.
- Give your child an answer and ask them to write as many addition sentences as they can with this answer. Try with multiplication and subtraction.
- Give your child a number fact (e.g. 5 + 3 = 8). Ask them what else they can find out about this fact (e.g. 3+5=8, 8-5=3, 8-3=5, 50+30=80, 500+300=800 etc). Add to this list over the next few days. Try starting with multiplication facts as well.

GLOSSARY FOR CALCULATION

Calculation – This is the number sentence. Not to be referred to as sum because this confuses children when they learn about the 'sum of' in addition.

Number Line – This is a drawn line with numbers at regular intervals used for addition, subtraction, multiplication and division which supports the child to calculate an answer.

Partitioning – We can partition numbers according to their place value into tens and ones so 21 would be partitioned to 20 and 1.

Exchange – This is when a number needs to be regrouped. For example, when using column subtraction children will move from the ones column to the tens and exchange one ten for ten ones in order to complete the calculation.

Groups of – When dividing or multiplying we can ask how many groups of a number there are.

Decimal point – This is the dot placed after the number of whole units in a number.

Decimal place – This is the position of a digit to the right of a decimal point.

Negative number – This is a number that is less than zero.

Minus number – Negative numbers are only referred to as minus when reading temperature.

Bar modelling – A bar model is a visual representation of a calculation used to help solve a problem. They come from the Singapore method for teaching and learning Maths and are really great tools for visual learners.