Telford Infant School

Calculation policy

March 2017

Contents

Introduction

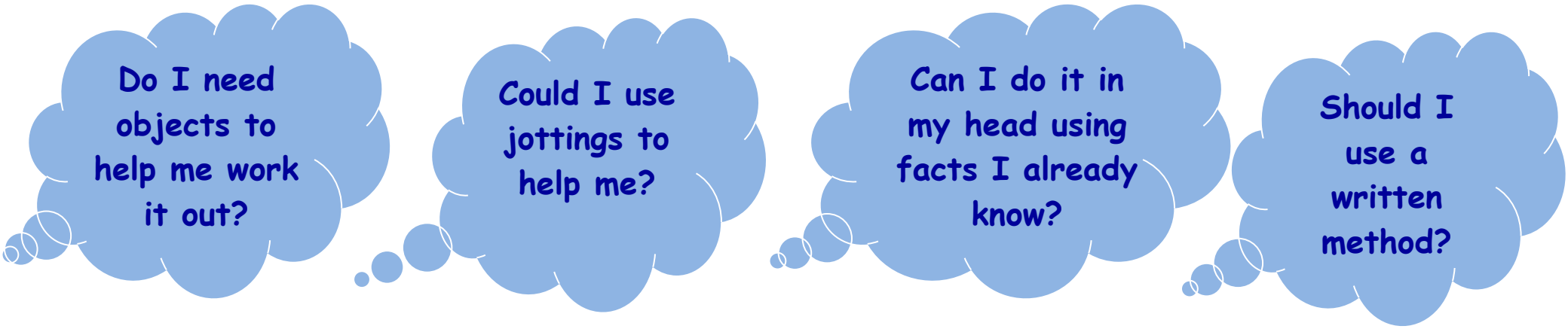
We want all our pupils to be confident, independent mathematicians who can reason mathematically and solve everyday problems. To be numerate – really confident with numbers – children's understanding needs to be underpinned by four things:

1. A sound understanding of place value and how our number system works.
2. Knowledge of a growing bank of number facts (as age appropriate, but this includes things such as the order of numbers; knowing 1 more and 1 less than any number; number bonds for all numbers to 20 and associated subtraction facts; doubles and halves for numbers to 20; counting in 2s, 3s, 5s and 10s).
3. Confidence with doubling and halving and the links and patterns associated with this.
4. Access and exposure to consistent images and models across the school (see Appendix 1).

With these in place, children can begin to develop the calculation skills set out in the National Curriculum. This policy sets out the specific methods and approaches that we use, but it is important to remember that we keep it grounded in a real life context or a problem solving approach. This helps build children's understanding of the reasons why we need to be able to calculate, and which operations and methods we should choose for different problems.

Choosing a calculation method

During the EYFS and for much of KS1, children use objects and pictures to add, subtract, multiply and divide. At the same time, they will be building up a bank of number facts that they have committed to memory, which in turn helps them to undertake more complex calculations. Children are taught and encouraged to use the following processes in deciding what approach they will take to a calculation, to ensure they select the most appropriate method for the numbers involved.



Progression of core skills in number and calculation

This section sets out what progress looks like as children develop their skills in number and calculation. The three different sections broadly equate with the school years (Reception, Year 1 and Year 2) but all children are different and their progress may not always fit neatly within a school year! All teachers in school are aware of the progression required and will ensure that children are confident with the skills in one stage before moving on to another.

1) Number and place value

Foundation skills:	Stage 1 skills:	Stage 2 skills:
• Count up to 20 independently. • Understand number values to 10 (e.g. knowing that 6 is bigger than 4). • Count backwards from 10 independently. • Represent these numbers (eg with fingers, objects, numicon etc) • Recognise, read and write these numerals. • Say one more or one less for any number up to 10. • Continue basic patterns and sequences. • Subitise numbers up to and including 6 (recognise arrays, e.g. 6 dots on a dice, without counting). • Know the story of 6 (3 + 3, 2 + 4, 1 + 5, 6 + 0), 5, 4 and 3... • Recognise some 2-digit numbers related to their own experiences. E.g. Daddy is 34, I live at number 56, etc. • Count to 100 in unison.	• Count up to 100 independently. • Understand number values to 20. • Count backwards from 20 independently. • Represent these numbers (eg with objects, dienes, numicon, cuisenaire rods etc). • Recognise, read and write these in numeral form – focusing on 'teen' numbers. • Partition numbers under 30 into 10s and 1s • Find the number on a 100 grid. • Know all number pairs to 12 (eg 6 + 5 = 11; 4 + 7 = 11 etc), including inverses (eg 11 – 4 = 7)	• Count beyond 100 independently. • Understand number values to 100. • Count backwards from 100 independently. • Represent two-digit numbers under 100 (eg with objects, dienes, numicon, cuisenaire rods, number strings etc). • Recognise, read and write these in numeral form. • Partition two-digit numbers into 10s and 1s (and in different combinations). • Given a number, say 10 more and 10 ten less (up to 100). • Know all number pairs to 20 (14: 7 + 7, 8 + 6 etc), including inverses.
Associated vocabulary		
number, digit, all numbers to 20, one more, one less	All numbers to 100, number pairs, number bonds, place value, tens, ones	tens, ones, partition, multiple of 10, inverse

2) Addition and subtraction

Foundation skills:

- Count reliably from 1 to 20.
- Say 1 more and 1 less than a given number for any number to 10.
- Combine 2 single digit numbers using quantities and objects and say the total.
- Take objects away from a bigger set and say how many are left.
- Count on to find an answer (3 apples + 2 apples; start at 3 and count on 2).
- Count back to find the answer.

Stage 1 skills:

- Given a number, say 1 more and 1 less (up to 100).
- Read, write and interpret mathematical statements involving addition (+), subtraction (-) and equals (=) signs.
- Represent and use number bonds within 20.
- Use number bond knowledge to add and subtract one-digit and two-digit numbers to 20, including zero
- Solve one-step problems that involve addition and subtraction, using objects and pictorial representations and missing number problems.
- Add three one-digit numbers by looking for known number bonds and doubles.

Stage 2 skills:

- Have strategies to add and subtract:
  - a two-digit number and ones
  - a two-digit number and tens
  - 2 two-digit numbers.
- Recall and use addition and subtraction facts to 20 fluently, and derive facts to 100.
- Understand and work with the inverse relationship between addition and subtraction.
- Solve addition and subtraction problems, including missing number problems.

Associated vocabulary

how many…? count, count (up) to, count on (from, to), add, more, and, altogether, is the same as

add, more, plus, and, make, altogether, total, equal to, equals, is the same as, balances with, double, most, numberline, count back, take, take away, minus, subtract, difference between, how many fewer is…than..?, how much less is..?

tens, ones, partition, put together, addition, column, tens boundary, difference, difference between

3) Multiplication, division and fractions

Foundation skills:

- Count repeated groups of the same size.
- Understand what doubling is and make doubles of numbers to 6.
- Understand what halving is and share even numbers to 10 into 2 equal groups.
- Share objects into equal groups and count how many in each group.

Stage 1 skills:

- Solve one-step problems involving multiplication and division, by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher.
- Know doubles of all numbers to 6.
- Recognise, find and name a half as one of two equal parts of an object, shape or quantity.
- Recognise, find and name a quarter as one of four equal parts of an object, shape or quantity.
- Recognise odd and even numbers and link to counting in 2s.

Stage 2 skills:

- Recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables.
- Calculate statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs.
- Show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot.
- Solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.
- Recognise, find, name and write fractions 1/3 , ¼, 2/4, and ¾ of a length, shape, set of objects or quantity.
- Write simple fractions (½ of 6=3) and recognise the equivalence of 2/4 and 1/2.

Associated vocabulary

double; count in 2s, 5s, 10s; lots of; groups of; is the same as, halve; count in 2s, 5s, 10s; share; groups of	groups of, lots of, rows of, repeated addition, times, array, multiply, multiple, share, share equally, group, group equally, halve, quarter	multiplied by, X times as big as, once, twice, three times... divide, division, divided by, left, left over, remain

Addition and subtraction (taught together to emphasise the inverse relationship between them)

Foundation: Counting on and combining two parts to make a whole

Children experience adding/counting on, finding 1 more, and counting on to find an answer. They do this through rhymes, play and practical activities e.g;

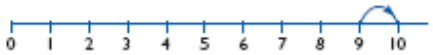
- Finding different ways of putting 5 apples in 2 bowls.
- Combining 2 groups of objects to find a total to develop an understanding of the whole/part model (see Appendix 1).
- Using the language of 1 more by adding one to a group e.g tower of cubes
- Use a large numberline or number tiles to identify 1 more.
- Explore balancing, sameness, equality (and inequality) as a precursor to using the = < and > signs in Year 1.
- Explore the concept of '10' with ten frames and other objects.

Recording might include:

- Cutting and sticking picture representations of an addition sentence:

3 add 2 makes 5

- Moving from describing in words to using numbers and other mathematical vocabulary and symbols, eg:

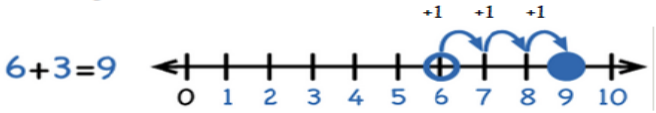


9 and 1 more is10
9 and 1 equals 10
9 + 1 = 10

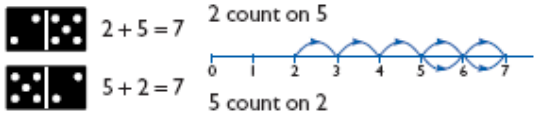
- Teacher models writing number sentences with + and = signs.

Stage 1: Add with numbers up to 20

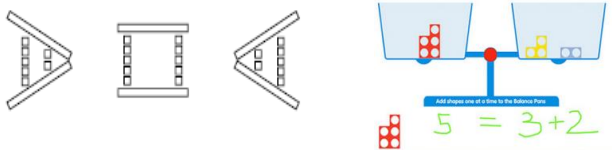
Children move from finding '1 more' to adding in steps of 1. Children use numberlines to add, by counting on in 1s. Children are taught to start with the larger number and count on.



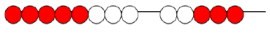
Children learn that addition can be done in any order and that it is more efficient to put the larger number first ("put the big number in their heads and then add the second").



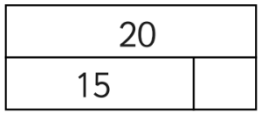
Children experience and explore the concepts of balancing and inequality to develop understanding of the < > and = signs.



With a secure knowledge of bonds to 10, bead strings can be used to help children bridge through 10, eg: to solve 8+ 5 they would calculate 8 + 2 + 3.



Children are introduced to the bar model image to develop confidence and familiarity with number bonds to 20, in particular finding missing numbers and understanding the inverse relationship between addition and subtraction:



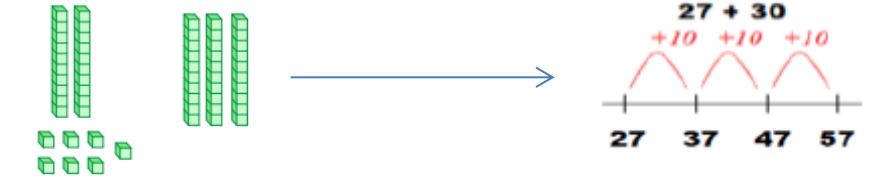
Stage 2: Add with 2 digit numbers

This step develops mental fluency with addition and place then establishes more formal methods. Children will need experience of physically making and carrying out the calculation with dienes base 10 apparatus, then compare their practical version to a numberline form.

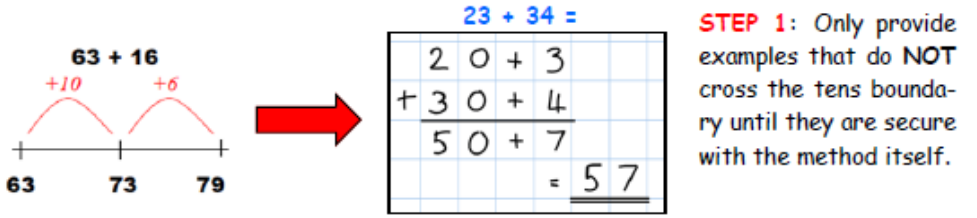
Add a 2-digit number and ones

Children are encouraged to use known number facts (ie. 6 + 7 = 13 to solve 16 + 7 = 23) but to have other strategies involving practical apparatus or numberlines if necessary.

Add 2-digit numbers and tens:



Add pairs of 2-digit numbers, moving to the partitioned column method when secure



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

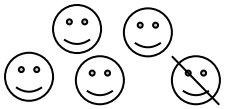
Foundation: Counting back and taking a part from the whole

As with addition, children experience subtraction through rhymes, play and practical activities , eg:

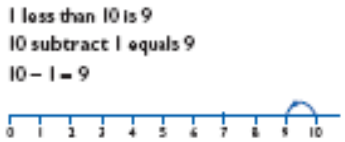
- Removing objects from a group: 'I have 5 apples and I take one away how many are left?' to develop understanding of the whole / part model (Appendix 1).
- Using the language of 1 less by taking 1 from a group such as a tower of cubes.
- Using a numbered, large number line (floor tiles) to identify one less.
- Participating in take away stories such as role play encouraging use of language of subtraction.
- Explore balancing, sameness, equality (and inequality) as a precursor to using the = < and > signs in Year 1.
- Explore the concept of '10' with ten frames and other objects.

Recording might include:

- Picture representation of a subtraction sentence:
  5 take away 1 leaves 4 →



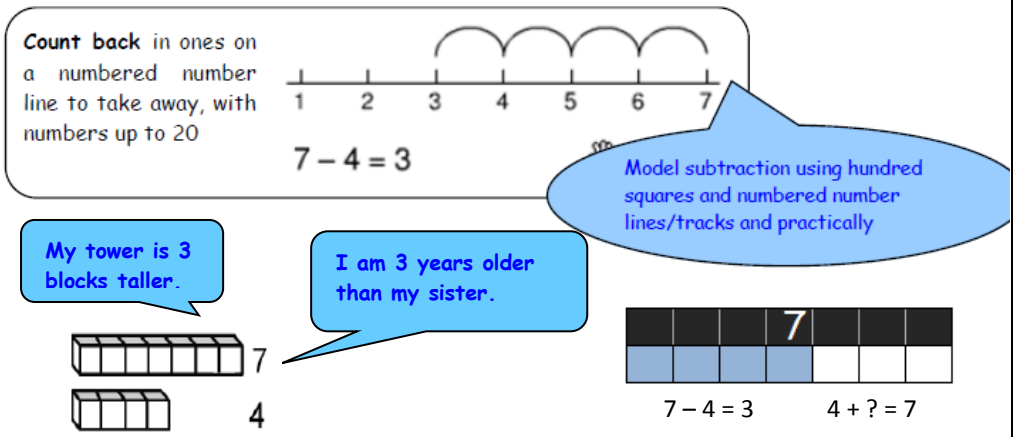
- Moving from describing in words to using numbers and other mathematical vocabulary and symbols, eg:



- Teacher models writing number sentences with - and = signs.

Stage 1: Subtract from numbers up to 20

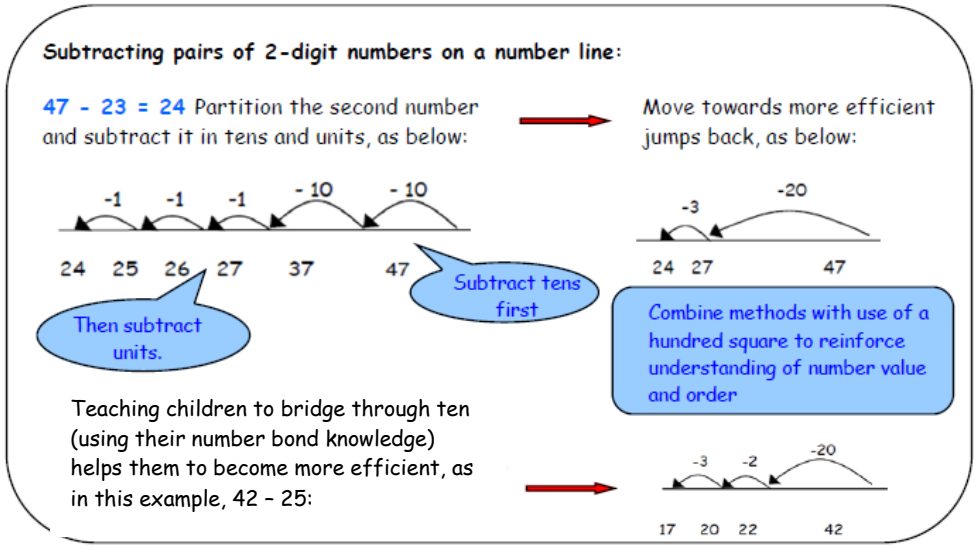
Children consolidate their understanding of practical subtraction, showing it on bead strings, with cubes and in familiar contexts. Through this they are introduced to more formal recording using numberlines.



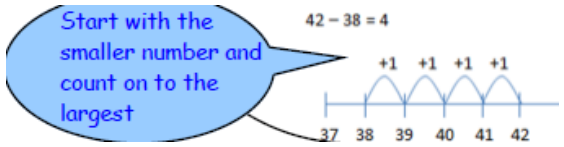
- Children are introduced to the concept of 'difference' in a range of practical and familiar contexts, e.g. with the language 'find the distance between' and 'how many more?'.
- Children learn to memorise and reason with number bonds to 20 in several forms (for example, 6 + 3 = 9; 9 – 6 = 3; 6 = 9 - 3). This enables them to begin to recognise the inverse relationship between subtraction and addition. Bar modelling supports both concepts well.
- Children begin to record subtraction number sentences using - and =.
- They have opportunities to explore the concept that subtraction is not commutative (you cannot do it in any order). However they should not be taught 'you always start with the larger number' as this will develop the misconception that you cannot take a larger number from a smaller one.

Stage 2: Subtract with 2 digit numbers

Children become more confident to carry out Stage 1 mentally, as they develop their knowledge of number pairs for all numbers to 20. For example, if they know that 9 – 5 = 4, then 29 – 5 = 24. At the same time, they will learn strategies for subtracting 2 digit numbers.



Children will be taught to recognise that when numbers are close together, it is more efficient to count on the difference. To do this, they need to be clear about the relationship between addition and subtraction.

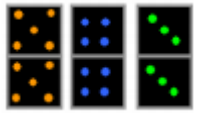


Multiplication and division (taught together to emphasise the inverse relationship between them)

Foundation: Counting repeated groups and doubling

Children begin to count in groups of 2, 5 and 10 using objects, songs and rhymes.

They count related groups of the same size in games and practical activities.



They identify doubles on dominoes and explore doubling amounts (e.g. playdough).

Opportunities for doubling are explored through symmetry and by using mirrors.

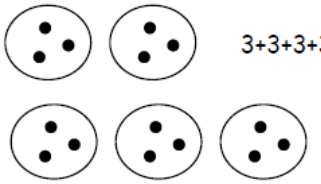
Stage 1: Multiply with concrete objects and representations

Children group objects in 2, 5 and 10, and then start to record visual images as repeated addition.

How many legs will 3 teddies have?

2 + 2 + 2 = 6

There are 3 sweets in one bag. How many sweets are in 5 bags altogether?



3+3+3+3+3 = 15

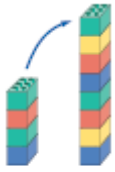
They start to record repeated addition as jumps on a numberline.

5 + 5 + 5 + 5 + 5 + 5 = 30 = 6 jumps of 5 / 6 lots of 5

Children use dienes to develop their understanding of counting in groups of 10 and understanding that, e.g. 3 lots of 10 = 30. This reinforces their understanding of place value.

They solve practical problems involving multiplication such as:
There are 4 bikes, each with 2 wheels. How many wheels altogether?

They practically double numbers to 10 and learn these as number facts.
They link this with multiplying by 2, and the language of 'twice as many as...'

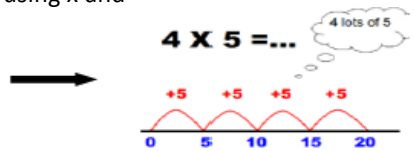


Stage 2: Multiply (at least 2s, 5s and 10s) using the x and = signs

Children continue to use grouping and repeated addition to solve multiplication problems in real life contexts. They use apparatus where necessary (eg dienes to practise counting in 10s) and move on to recording their practical multiplication using x and =

Use repeated addition on a number line:

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



4 X 5 = 20

Use arrays:

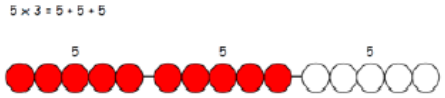
5 x 3 = 15

3 x 5 = 15

5 x 3 = 3 + 3 + 3 + 3 + 3 = 15
3 x 5 = 5 + 5 + 5 = **15**

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

Use practical apparatus:



- Children are also taught to develop an understanding of the trios of numbers that belong together, to work out the missing numbers e.g. 2 x 4 = ☐ 4 x ☐ = 8
- Children have lots of opportunities to use multiplication in real life contexts (e.g. money) so that they can they solve multiplication word problems.
- Children begin to recall multiplication facts for 2, 5 and 10 times tables through practice in counting and understanding of the operation. They double all numbers to 12 x 2 = 24.

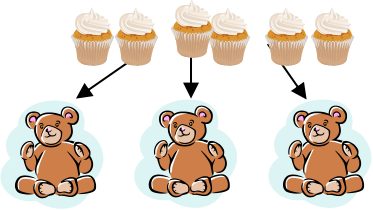
Foundation: Halving, sharing and grouping

Children carry out practical activities and learn vocabulary through songs, rhymes and everyday conversations: halve, share, share equally, one each, two each, three each, twos, threes, tens, equal groups of, left, left over.

Children halve in many contexts – e.g folding paper in half, sharing half with a friend, halving a cake, halving a length, halving an amount of playdough.

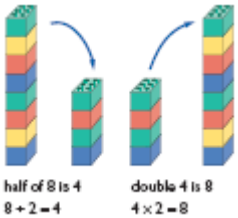
Children experience grouping of objects many contexts, e.g. buttons, beads etc.

Children share objects practically into equal groups e.g;
"Share the 6 cakes between the 3 bears.
How many cakes will they each have?"



Stage 1: Group and share small quantities; halving; quartering

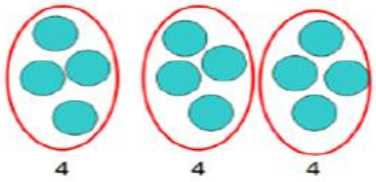
Children have lots of experience of halving to match doubling and understand it is the inverse. They learn the halves of even numbers between 2 and 20 and use this knowledge to reason and problem solve. They begin to understand that a quarter is a half of a half.



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

Grouping:

Sharing:



12 shared between 3 is 4

Example division problem in a familiar context:

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

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

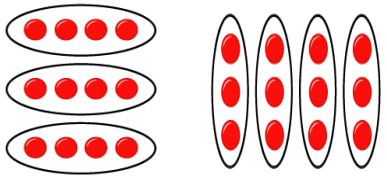
"18 shared between 6 people gives you 3 each."

- Children use lots of practical apparatus, arrays and picture representations.
- They are taught to understand division both as 'grouping' objects ('how many groups of 2 can you make?') and 'sharing' ('share these sweets between 2 people').
- They begin to apply their knowledge of counting in 2s, 5s and 10s to division problems.

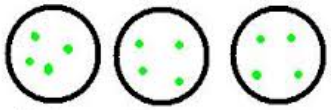
Stage 2: Group and share using the ÷ and = signs

Children are taught to understand and solve division problems primarily using:

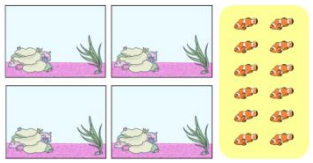
1. Arrays:
Children can show that the same array represents two division statements, 12 ÷ 4 = 3 and 12 ÷ 3 = 4.

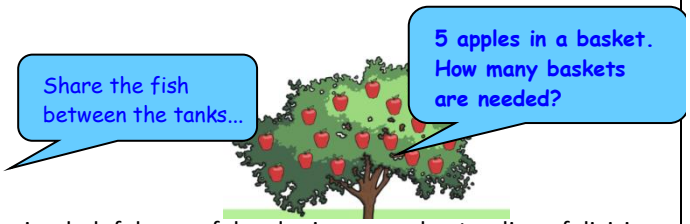


2. Jottings for sharing:
Children are also taught that they can draw circles to represent the number of groups and share the whole into the parts, eg: 12 ÷ 3 = 4

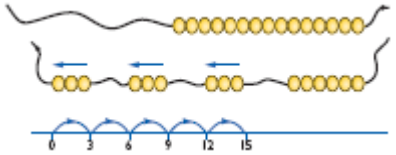


It is important that children recognise when to <u>share</u> and when to <u>group</u>:





Using a numberline or beadstring is a helpful way of developing an understanding of division as <u>grouping</u>, and helps children solve division tables questions mentally:



How many groups of 3 in 15?

15 ÷ 3 = 5

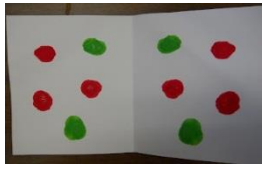
- Children solve division problems in real life contexts. This will sometimes involve division with remainders.
- Children are taught to record their practical division as a written calculation using ÷ and = in a number sentence.
- Children explore the inverse relationship between multiplication and division.

Fractions

Foundation: Finding halves in different ways

Children halve in many contexts – e.g folding paper in half, sharing half with a friend, halving a cake, halving a length, halving an amount of playdough.






Stage 1: Finding half or quarter of a shape or quantity

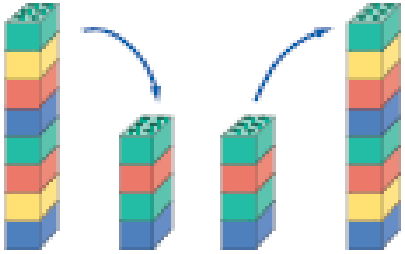
This is part of our overall approach to division (see above). Children begin by thinking about the concept of 'a whole' and using this to find two equal parts - halves:

- Shade half of each object.

They then find four equal parts - quarters:

- Shade a quarter of each shape.

They are encouraged to see the links between fractions of shapes and fractions of numbers, for example using Lego blocks and unifix blocks. They have lots of experience of halving and doubling to understand that they are inverses. They learn the halves of even numbers between 2 and 20 and use this knowledge to reason and problem solve. They begin to understand that a quarter is a half of a half.

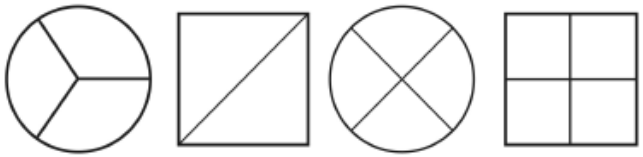


Half of 8 is 4
8 ÷ 4 = 2

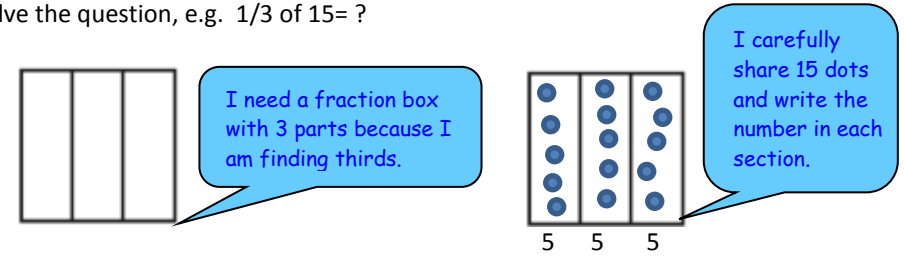
Double 4 is 8
4 x 2 = 8

Stage 2: Find ¼, ½, 2/4, 1/3 and ¾ of shapes and numbers.

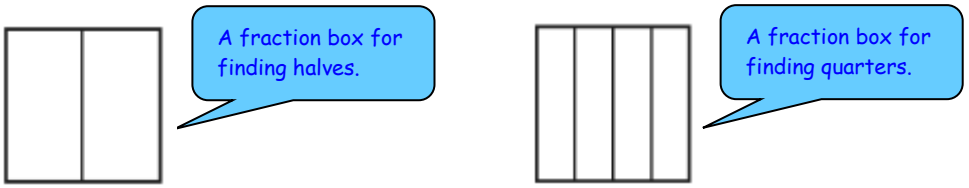
Children are taught that the number on the bottom of a fraction (the denominator) tells us the number of parts in the whole. They initially find fractions of shapes:



- Children continue to build on their number facts so that they can recall and use the doubles and halves of all even numbers to 24.
- Children have opportunities to relate division to fractions – e.g. ½ and ¼ is the same as dividing by 2 and dividing by 4 respectively. Children use their knowledge of halving to be able to find halves and quarters of numbers.
- Where jottings are required, children are taught to draw a 'fraction box' to help them solve the question, e.g. 1/3 of 15= ?

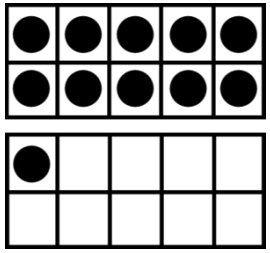
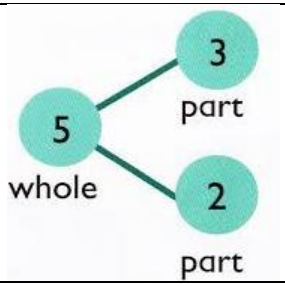
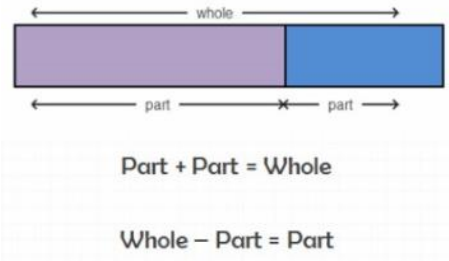
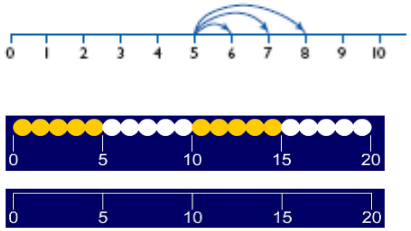


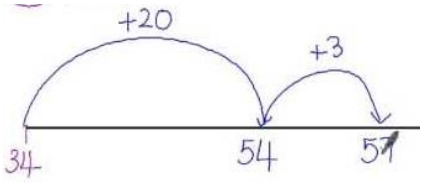
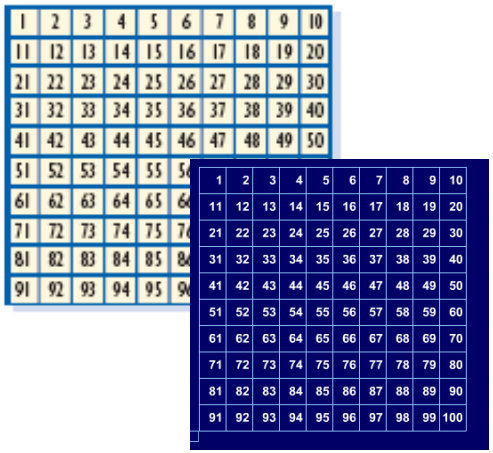
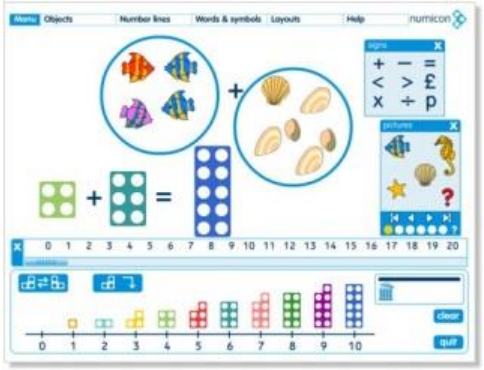
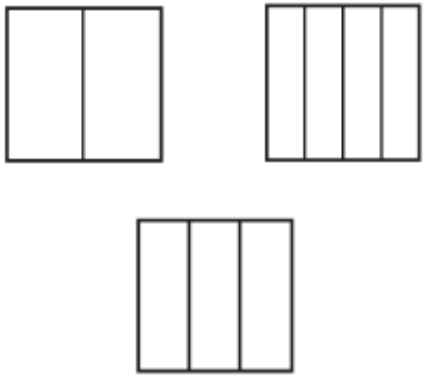
So 1/3 of 15 = 5



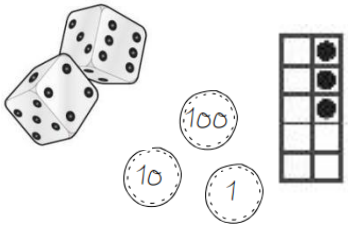
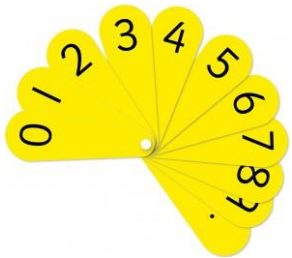
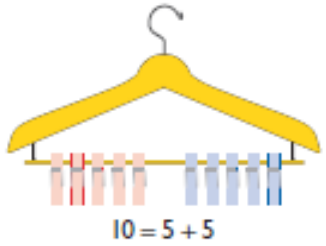
Appendix

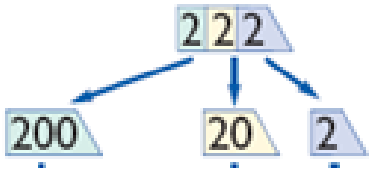
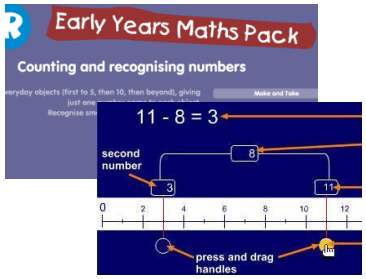
1.Visual models to support calculation

			
Ten frames to enable children to understand the number 10 in a whole / part context.	**Whole / part sorting frames to develop knowledge of number bonds and inverse relationship between addition/subtraction.**	**The bar model is the next step in whole/part modelling. It enables you to show the relative size of numbers and understand inverse relationships.**	**Numberlines: on display and for individual use; numbered in 1s, and with landmark numbers only. Numberlines to 100 on display in all KS1 classrooms.**

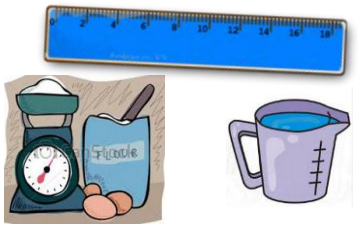
			
Children then progress to being able to draw their own numberline and mark jumps of 10s and 1s.	**100 squares for whole class and individual use. ITP 100 square is accessible on all teachers' laptops.**	**Numicon software used for whole class teaching. Numicon number pictures on display.**	**Fraction boxes are used to find fractions of amounts (where these are not known as number facts).**

2. Important classroom resources

				
Multilink cubes in 2 colours	**Dice, counters, place value counters, ten frames etc**	**Dienes base 10 blocks**	**Number fans**	**Coat hanger and pegs**

				
Numicon tiles and software	**Cuisenaire rods (in two sizes) are available in the Maths Area**	**Place value cards for partitioning**	**Bead strings to 10, 20 and 100**	**Maths pack and Interactive Teaching Programs**

3. Resources to support children at home

Leaflet for parents Hundred square Numberline Part / whole template		 		
Printable resources from our website	**Dice, cards and other games**	**Everyday objects for counting (pasta, beads etc)**	**Money**	**All kinds of measuring equipment**

4. Video clips to support calculation strategies

(To follow the links press CONTROL + CLICK LEFT MOUSE BUTTON)

Addition and subtraction

Stage 1

Counting in steps of 1 and 10
Number bonds to 10
Consolidation and practice of addition and subtraction

Stage 1 and 2

Using resources to develop fluency and understanding
Partitioning in different ways

Stage 3

Subtraction—teaching children to consider the most appropriate methods before calculating
Introducing partitioned column subtraction method, from practical to written

Multiplication and division

Stage 1

Representing fractions

Stage 2

Teaching for understanding of multiplication facts
Practical multiplication and the commutative law
Working with fractions
Whole class sharing and grouping
Paired work sharing and grouping