

Langstone Infant School



Calculation Handbook

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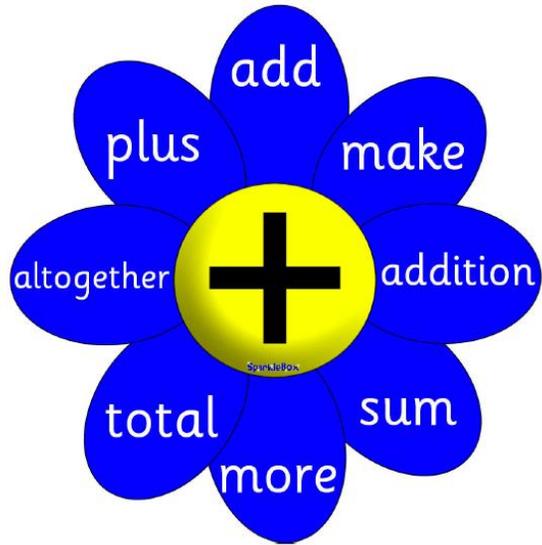
Rationale

The purpose of this document is to make the community of Langstone Infant School aware of the progression and development of calculation strategies used in the teaching of mathematics.

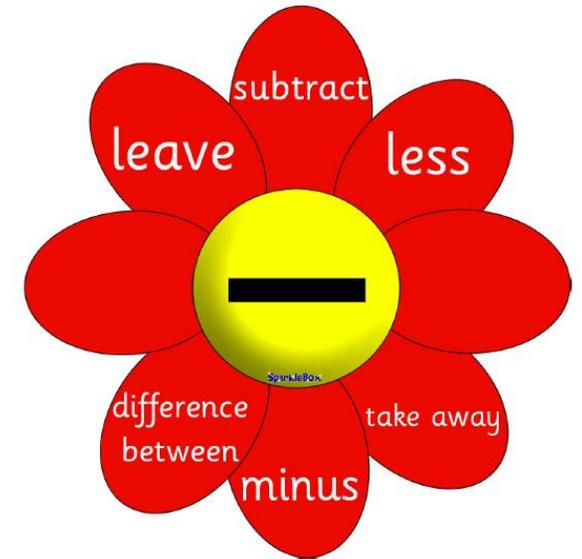
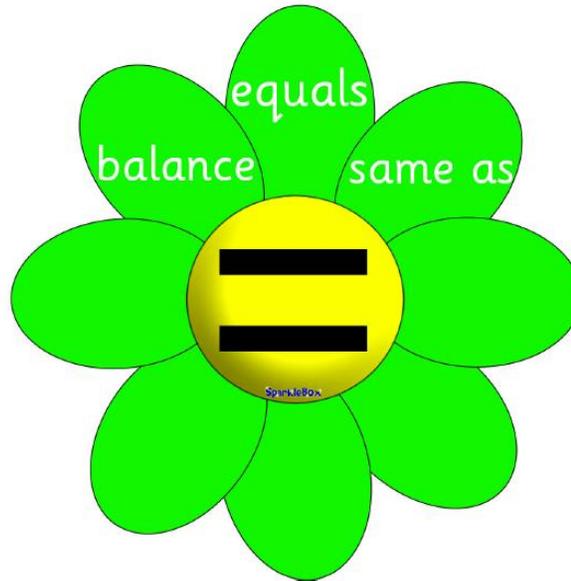
Many of the methods of calculation used today are considerably different to those many adults were taught when they were at school. The focus has shifted from just being able to calculate, to being able to calculate and understand what is being done to the numbers and why.

This handbook is designed to enable the adults of the school community to have confidence in supporting the children to reach their potential by applying their learning both in the classroom and their wider environment.

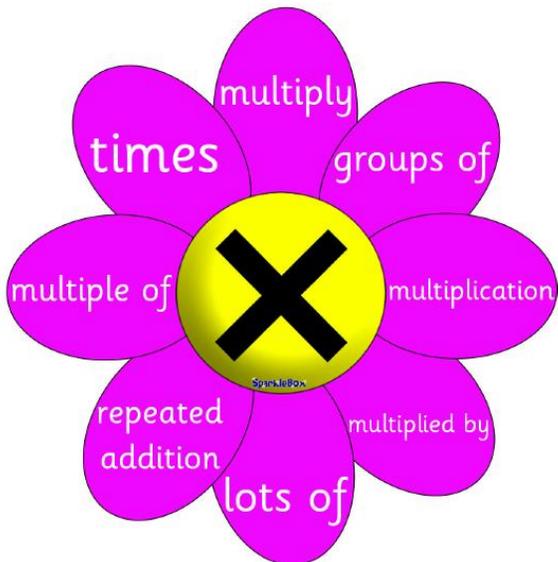
Mathematical Calculation Language



Operations that make numbers bigger.

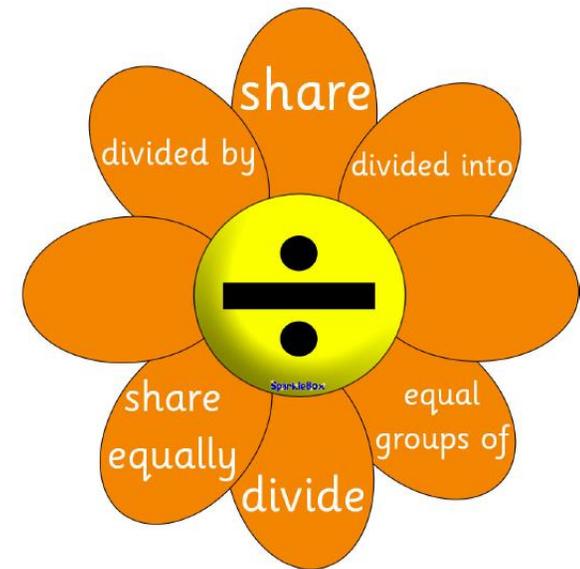


Operations that make numbers smaller.



In order that children don't become confused it is important to use the correct mathematical vocabulary. There are many ways of saying the same thing as is illustrated here.

It is important to note that a sum is an addition calculation.



The National Curriculum 2014

Aims - The national curriculum for mathematics aims to ensure that all pupils:

- become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.
- **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language
- can **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

Addition and Subtraction – in the National Curriculum

Foundation	Year 1	Year 2
<p>Early Learning Goal Using quantities and objects, they add and subtract two single-digit numbers and count on or back to find the answer.</p> <p>Exceeding Statements They solve practical problems that involve combining groups of 2, 5 or 10, or sharing into equal groups.</p>	<p>Statutory requirements Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ read, write and interpret mathematical statements involving addition (+), subtraction (–) and equals (=) signs ▪ represent and use number bonds and related subtraction facts within 20 ▪ add and subtract one-digit and two-digit numbers to 20, including zero ▪ solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as $7 = _ - 9$ 	<p>Statutory requirements Pupils should be taught to:</p> <ul style="list-style-type: none"> ▪ solve problems with addition and subtraction: ▪ using concrete objects and pictorial representations, including those involving numbers, quantities and measures ▪ applying their increasing knowledge of mental and written methods ▪ recall and use addition and subtraction facts to 20 fluently, and derive and use related facts up to 100 ▪ add and subtract numbers using concrete objects, pictorial representations, and mentally, including: <ul style="list-style-type: none"> ▪ a two-digit number and ones ▪ a two-digit number and tens ▪ two two-digit numbers ▪ adding three one-digit numbers ▪ show that addition of two numbers can be done in any order (commutative) and subtraction of one number from another cannot ▪ recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.

Addition

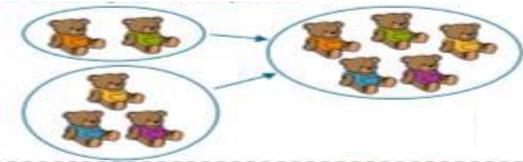
Foundation

30-50 Months

Children look at groups of object and compare them, suggesting whether they have the same number.

Children begin to add/count on mentally using rhymes and begin to record in the context of play or practical activities.

Children begin to separate a group of objects into 3 or 4 groups but recognise they still have the same number of objects.



Children will compare 2 groups of objects saying which groups have the same; they may separate these into groups and say that the total is the same.

40-60 Months

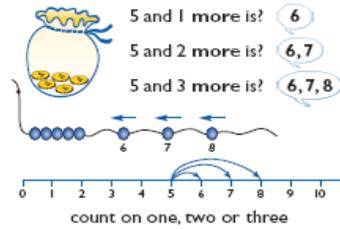
They may record with marks, stamps or objects

Combine 2 groups of objects to find a total, by counting all the objects.

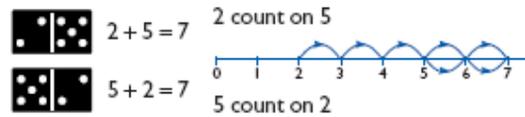
Use the language of 1 more by adding one to a group e.g tower of cubes

Year 1

Adding by counting on. First by finding 1 more, then in steps of 1.



Children can count on from the first number using fingers, objects, themselves etc.



Teachers should model drawing jumps on a number line to support understanding of the mental method.

Children learn that addition can be done in any order but that it is more efficient to put the larger number first.

Children need to understand the concept of equality before using the = sign. Calculations should be written either side of the equality sign so that the sign is not just interpreted as the 'answer'. E.g. $2 = 1+1$ and $2+3 = 4+1$

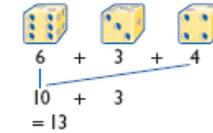
Teachers should model jottings of calculations, including those that feature pictorial representation as well as digits.



Children record addition number sentences using + and =.

Year 2

Children add three single digit numbers, initially using concrete objects, pictorial representations and later mentally.



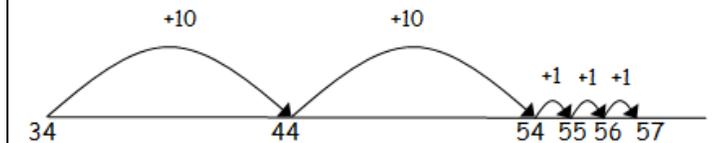
Children begin to add 3 single digit numbers, by looking for pairs of numbers or doubles to aid mental calculation.

Children use number lines to add single digit numbers to a 2 digit number.

Children will begin to use unstructured number lines.

First counting on in jumps of tens and then ones.

$$34 + 23 = 57$$



Children will learn to always add the smaller number to the bigger number.

Children will continue to add 2 digit numbers on the hundred square by counting on in tens down the hundred square and then across in ones/units. See Year 1.

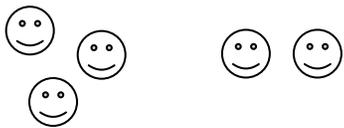


9 and 1 more is 10
9 add 1 equals 10
9 + 1 = 10



Use large number lines (number tiles) to identify one more.

Children combine 2 groups of objects. Through cutting and sticking and picture representation of an addition sentence



3 and 2 makes 5

Show me 5 fingers using both hands.



Children are encouraged to develop a mental picture of the number system in their heads to use for calculation.

Combine 2 groups of objects to find a total.

They develop ways of recording calculations using pictures. That they can explain.

Missing numbers need to be placed in all possible places within the number sentence.

$$4 + \square = 7 \qquad 7 = \square + 5$$

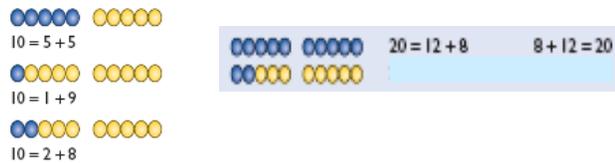
$$\square + 2 = 8 \qquad 14 = 8 + \square$$



$$3 + \square = 5$$

Children use addition in terms of 'how many more' to calculate the difference.

Children learn number bonds to 20.



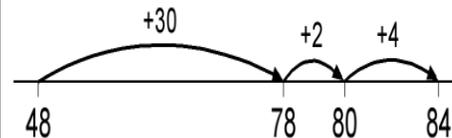
Steps in addition can be recorded on a number line. The steps often bridge through a multiple of 10.

$$8 + 7 = 15$$

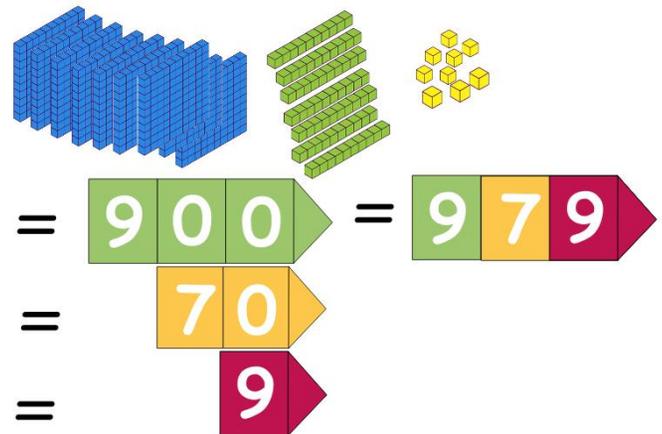
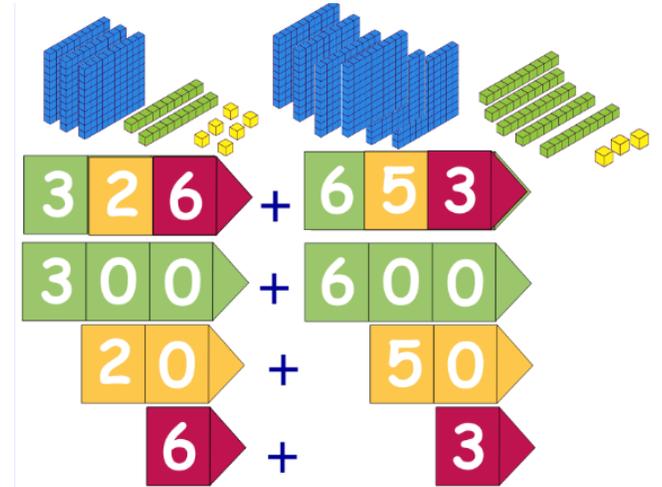


- 1) Partition the smaller number into tens and units.
- 2) Add on the tens.
- 3) Add on the ones/units.

$$48 + 36 = 84$$



Children begin to add larger 3 digit numbers by partitioning and re-combining into hundreds, tens and ones/units.





There were 3 monsters at a party then 2 more came along. Altogether there were 5

Early Learning Goal

Adding stories and role play, encouraging use of language for addition.



9 and 1 more is 10
9 add 1 equals 10
 $9 + 1 = 10$



They record the calculation as a number sentence.

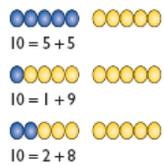
$$9 + 1 = 10$$

Bead Strings can be used to demonstrate addition



And then the calculation is recorded as a number sentence. $8 + 2 = 10$

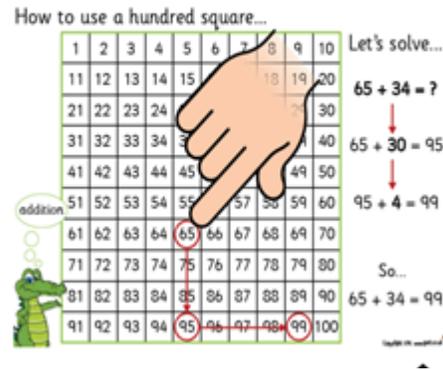
And number lines:



Children use 100 square to add 2 digit numbers. Start at the largest number, add on the 10s by going down the column and add the ones/units by counting on.

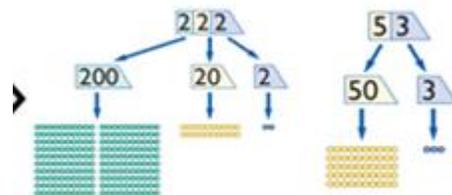
$$65 + 34 =$$

Using a Hundred Square:



Children begin to learn place value of 3 digit numbers to add in hundreds, tens and ones/units.

$$222 + 53 =$$



$$2 + 3 = 5$$

$$20 + 50 = 70$$

$$200 + 0 = 200$$

$$200 + 70 + 5 = 275$$

Children are able to select from the above written methods of calculation to solve word and other problems.

Use partitioning to begin using the column method. For example

$$326 + 653 =$$

$$600 + 50 + 3$$

$$300 + 20 + 6$$

$$900 + 20 + 9 = 929$$

Move on to column addition, including carrying numbers into the next column.

$$\begin{array}{r} 756 \\ +237 \\ \hline 993 \\ 1 \end{array}$$

Know that subtraction is the inverse of addition and use known number facts to calculate mentally, using written methods.

Children will use written methods of addition to solve word and other problems.

Subtraction

Foundation

40-60 Months

Finds one less from a group

Begin to record in the context of play or practical activities e.g; counting rhymes that count back.

Remove objects from a group

'I have 5 apples and I take one, away how many are left?'

Use the language of 1 less by taking 1 from a group e.g tower of cubes.

Early Learning Goal

In take away stories such as role play encouraging use of language of subtraction.



1 less than 10 is 9
10 subtract 1 equals 9
 $10 - 1 = 9$



Use a numbered, large number line (floor tiles) to identify one less.

Picture representation of an subtraction sentence



5 take away 1 leaves 4

Year 1

Subtracting by counting back. First by finding 1 less, then in steps of 1.

Children can count back 1 from the first number using fingers, objects, themselves etc.



Teachers should model drawing jumps on the number line to support understanding of the mental method.

Jottings-

Draw a set of objects and then cross some out.

Learn that subtraction must start with the larger number and count back the smaller number.

$$11 - 4 = 7$$

* * * * *

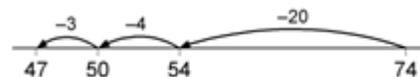
Children record subtraction number sentences using - and =.

Steps in subtraction can be recorded on a number line. The steps often bridge through a multiple of 10.

$$15 - 7 = 8$$



74 - 27 = 47 worked out by counting back:



Year 2

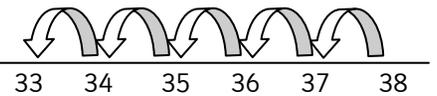
Children subtract single digit numbers,

Children learn to count back in tens and ones on the number line.

Children subtract 2 digit numbers on the hundred square by counting back in tens up the hundred square and then back in ones. See Year 1.

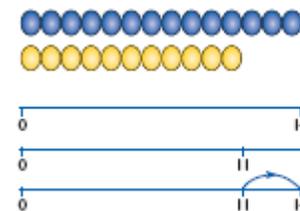
They then draw their own unstructured number lines (blank number lines) and draw how many they are counting back.

$$38 - 5$$



This would then progress to jumping in tens then ones, using the number line.

Children find the difference by counting on with larger numbers on the number line.



The difference between 11 and 14 is 3.

$$14 - 11 = 3$$

$$11 + \square = 14$$

Know that subtraction is the inverse of addition and use known number facts to calculate mentally.

		$20 = 12 + 8$	$8 + 12 = 20$
		$20 - 8 = 12$	$20 - 12 = 8$
		$(10 + 2 + 8 = 10 + 10 = 20)$	

Bead Strings can be used to demonstrate subtraction



$$8 - 2 = 6$$

Children are taught to compare numbers stating which is more/less



Which of your two numbers is more?
Which number is less? Children begin to explain their thinking: why? How do you know?

Missing numbers need to be placed in all possible places within the number sentence.



Operations as well as numbers may be hidden within number sentences.

$$17 \square 12 = 5 \quad 65 - 13 \square 52$$

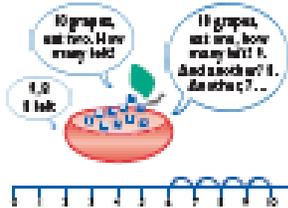
Children should be taught to find the difference using subtraction.



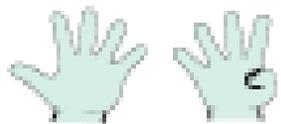
The difference is?

What is the difference between 5 and 8?

Children begin to subtract to solve simple word problems.



Recognise that subtraction is the inverse of addition, with number facts to 20.



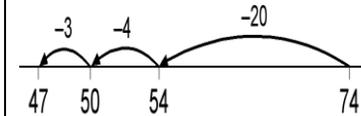
$$\begin{array}{ll} 9 + 1 = 10 & 1 + 9 = 10 \\ 10 - 9 = ? & 10 - 1 = 9 \end{array}$$

Children begin to subtract larger 2 digit numbers by partitioning the second number only.

$$\begin{aligned} 37 - 12 &= 37 - 10 = 27 \\ &= 27 - 2 \\ &= 25 \end{aligned}$$

Using a number line

$74 - 27 = 47$ worked by counting back:



Children partition the number being subtracted.

$$\begin{aligned} 74 - 27 & \\ 74 - 20 &= 54 \\ 54 - 4 &= 50 \\ 50 - 3 &= 47 \end{aligned}$$

Children partition bigger numbers to subtract.
For example:

$$648 - 416 =$$

$$\begin{array}{r} 600 + 40 + 8 \\ 400 + 10 + 6 \\ \hline 200 + 30 + 2 \end{array}$$

Move on to column subtraction, including borrowing numbers from the next column.

$$\begin{array}{r} 5 \\ 564 \\ -457 \\ \hline 107 \end{array}$$

Know that addition is the inverse of subtraction and use known number facts to calculate mentally, using written methods.

Children will use written methods of subtraction to solve word and other problems.

The National Curriculum 2014

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Multiplication and Division - in the National Curriculum

Foundation

Early Learning Goal

They solve problems, including doubling, halving and sharing.

Exceeding Statements

They solve practical problems that involve combining groups of 2, 5 or 10, or sharing into equal groups.

Year 1

- 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.

Year 2

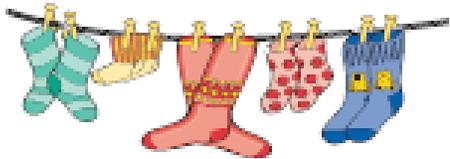
- Recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers
- Calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (\times), division (\div) and equals ($=$) signs
- Solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in context

Multiplication

Foundation

30-50 Months

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



Early Learning Goal

Links are made to problem solving activities.

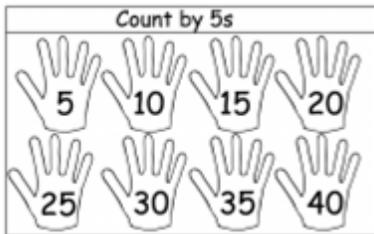
Children double groups of objects:



Double the bugs legs.

Exceeding Statement

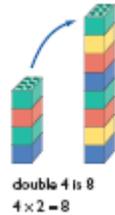
Children begin to count in groups of 2, 5 and 10 using objects.



Year 1

Children group and count objects in 2s, 5s and 10s.

Practically double numbers to 20 and link this with multiplying by 2.



Multiply using concrete objects. E.G. $2 \times 3 =$

(Get 2 cups 3 times)

Represent this pictorially and using jottings.



$$3 \times 2 = 6$$



$$3 \times 4 = 12$$



$$2 \times 6 = 12$$



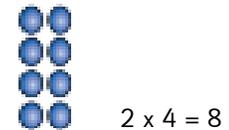
$$4 \times 2 = 8$$

Use practical equipment to represent arrays.

Solve practical and word problems involving multiplication.

Year 2

Children continue to show multiplication using visual representation of an array.



Children record multiplication number sentences using x and =.

Children use arrays to begin to recognise multiplication as repeated addition.

$$4 + 4 = 8$$

$$2 + 2 + 2 + 2 = 8$$

Children start to use visual images as repeated addition.

$2 \times 5 = 2 + 2 + 2 + 2 + 2 = 10$
Model this as jumps on a number line.



$$5 \times 6 = 5 + 5 + 5 + 5 + 5 + 5 = 30$$

Explore the fact that multiplication, like addition, can be done in any order.

Children use these methods of multiplication to solve word and other problems.

Division

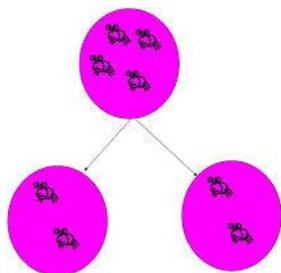
Foundation

30-50 Months

Practical division as grouping e.g. buttons, beads etc

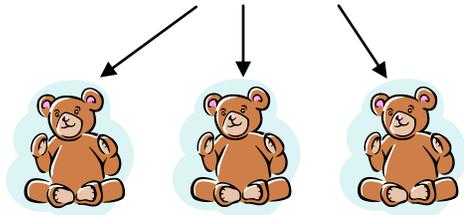
Early Learning Goal

Children share objects into 2 equal groups – half.

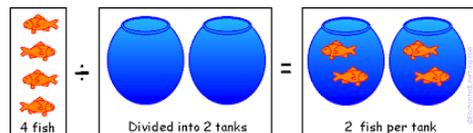


Exceeding Statement

Children share objects practically into equal groups e.g; “Share the cakes between the three bears. How many cakes will they each have?”

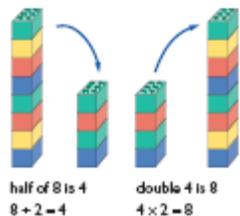


Links are made to problem solving activities



Year 1

Halving to match doubling and understand it is the opposite.



$$4 \div 2 =$$

4 goes into piles of 2.

Represent this using jottings.

$$4 \div 2 =$$



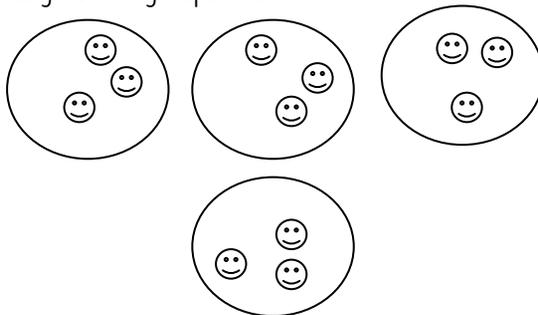
Begin to use practical grouping to solve word problems.

e.g.

“There are 12 daffodil bulbs. Plant 3 in each pot. How many pots are there?”

$$12 \div 3 =$$

12 goes into groups of 3 =



Year 2

Children continue to use the grouping of objects practically and relate to real life situations, including grouping numbers into equal sets with a remainder.

Children record their practical division as a written calculation using \div and $=$ in a number sentence.

Introduce division as repeated subtraction.

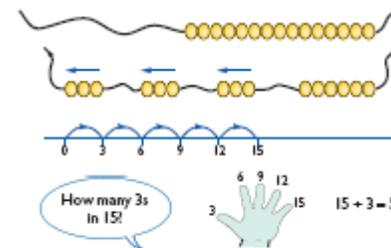
For example:

$$12 \div 3 = 4$$

$$12 - 3 - 3 - 3 - 3 = 0$$

How many times did you take away 3? Answer: 4

Then begin to divide a number by counting back in equal steps, model this on a number line.



Children learn that division cannot be done in any order.

Children use these division methods to solve word and other problems.