



Calculation Methods

February 2019

EARLY YEARS NUMERACY

In EYFS and KS1 particularly, children are encouraged to manipulate real objects in learning calculation methods.

They may record calculations in a variety of ways, usually beginning with drawings and arrays.

Addition

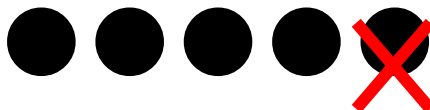
Example $3 + 2 = 5$ may be represented in picture form as:



The child will record the number sentence as $3 + 2 = 5$

Subtraction

Example $5 - 1 = 4$



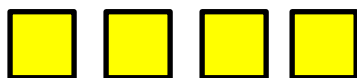
The children will draw five spots then cross one out to find out how many are left.

Children may also count out 5 objects then physically remove one to take it away and find how many are left.

5 units are counted out (units can also be called 1s):



One unit is physically removed as the number sentence asks to subtract one.



The child will then count how many are left: 4.

The child will record the number sentence as $5 - 1 = 4$

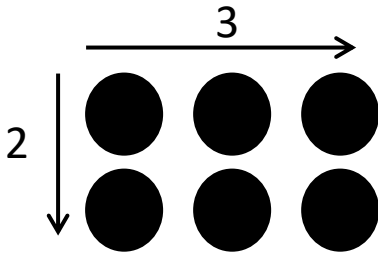
Multiplication

Example $3 \times 2 = 6$

Children will use the language '3 lots of 2' or '3 groups of 2'

Children are taught to solve multiplication problems in the following ways:

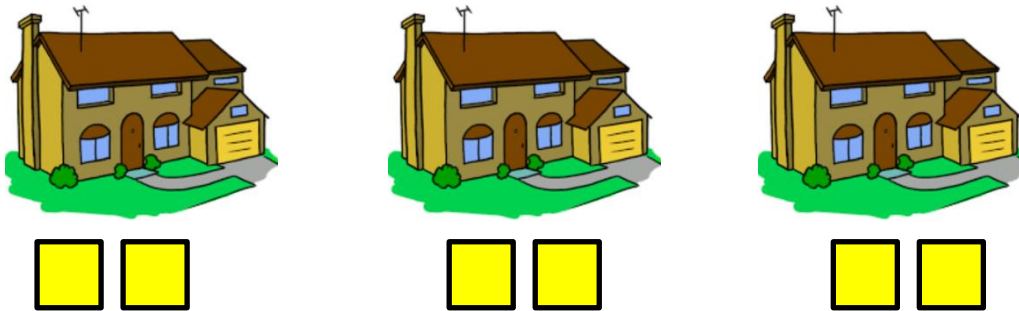
Using an array:



Using objects to represent the amount of groups they need (houses are used in the example).

$$3 \times 2 = 6$$

3 groups (represented in houses)



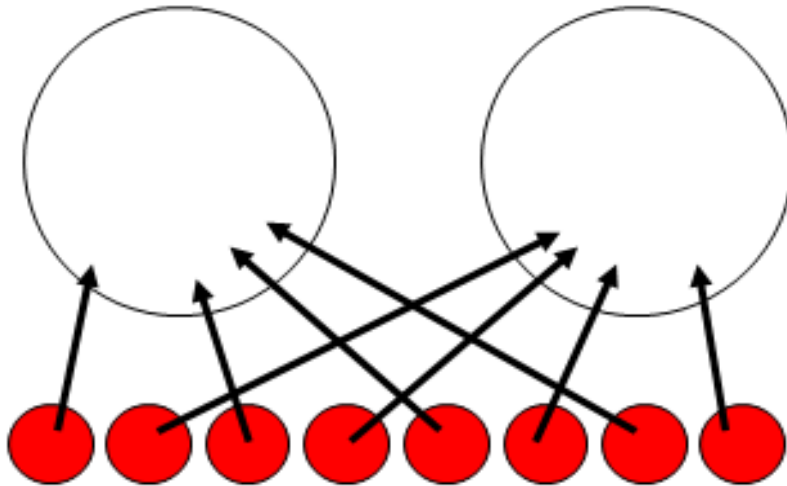
Each object has been given two units. The child will then count the total to find the answer.

The children will record the number sentence as: $3 \times 2 = 6$

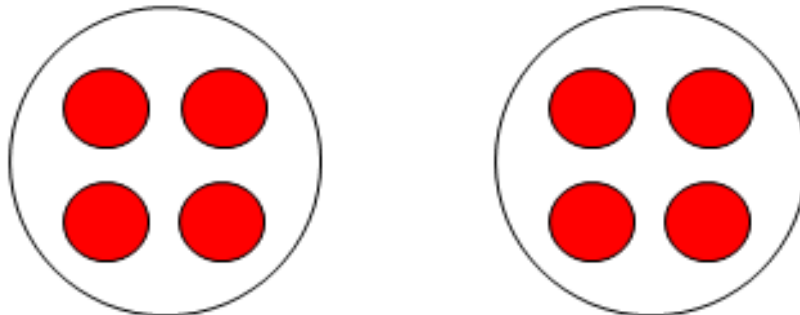
Division

Example $8 \div 2 =$

(Children will use the language 8 shared between 2)



The children will count out eight objects and then share them between two groups. Children will say "one for you," "one for you" as they share.



The children will then count how many objects are in each group to give the answer. It is important that they touch the objects as they count them.

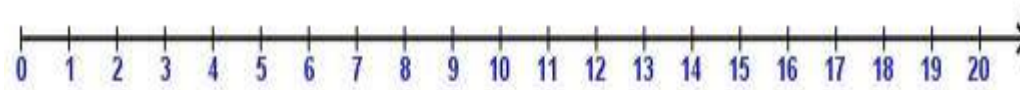
The children will record the number sentence as: $8 \div 2 = 4$

KS1 AND KS2 NUMERACY

Addition

The Number Line

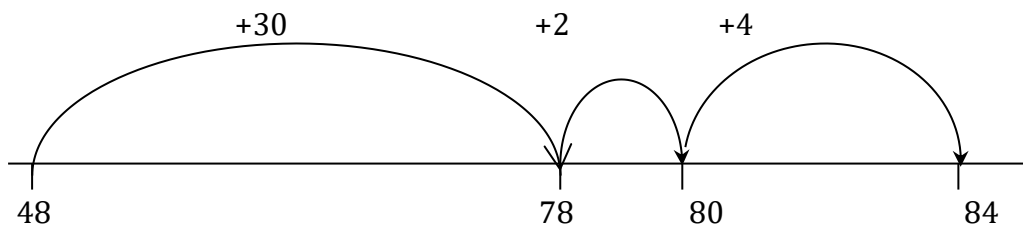
Example 1 $8 + 7 = 15$



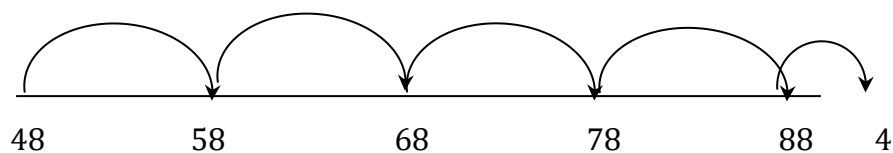
In the above example use language such as: If I add 7, what number do I get to?

Example 2 $48 + 36 = 84$

The number line helps to record the steps on the way to calculating the total.



These methods can be broken down into smaller steps i.e.



It is advisable to start by counting on in 10s.

The Number Square

Children are encouraged to use a number square to add by counting on, initially in units, then in tens and units.

$$3 + 4 = 7$$

Start at 3 and count on 4

It is important for children to recognise that moving across the rows one step at a time increases in units and moving down the columns 1 step at a time increases in tens.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Partitioning

The next stage is to record mental methods using partitioning. Add the tens and then the units to form partial sums and then add these partial sums.

Example $76 + 47 = 123$

$$76 + 47$$

Partition the numbers first.

$$70 + 6 + 40 + 7$$

Regroup the numbers in size order to add them mentally.

$$70 + 40 + 7 + 6$$

$$70 + 6$$

$$40 + 7$$

$$110 + 13 = 123$$

Which is then recorded in a shorter form below:

$$76 + 47 = 110 + 13 = 123$$

Expanded method in columns

Move on to a layout showing the addition of the tens to the tens and the units to units separately. **At this stage, ask the children to start by adding the units first always.** This is very important as it will need to be done in this order when moving to the compact method.

The addition of the tens in the calculation $47 + 76$ is described in the words 'forty plus seventy equals one hundred and ten'.

Example

$$\begin{array}{r} 47 \\ + 76 \\ \hline 13 \\ 110 \\ \hline 123 \end{array}$$

Compact Column Method

In this method, recording is reduced further. Carried digits are recorded below the line.

Example

$$\begin{array}{r} 47 \\ + 76 \\ \hline 123 \\ \hline 11 \end{array}$$

Later, apply this method to larger numbers.

Example

$$\begin{array}{r} 366 \\ + 458 \\ \hline 824 \\ \hline 1 \quad 1 \end{array}$$

The same method can be applied when adding decimals but it is crucial to reinforce that the decimal point must remain in the same place.

Example

$$\begin{array}{r} 16.4 \\ + 23.5 \\ \hline 39.9 \end{array}$$

Subtraction

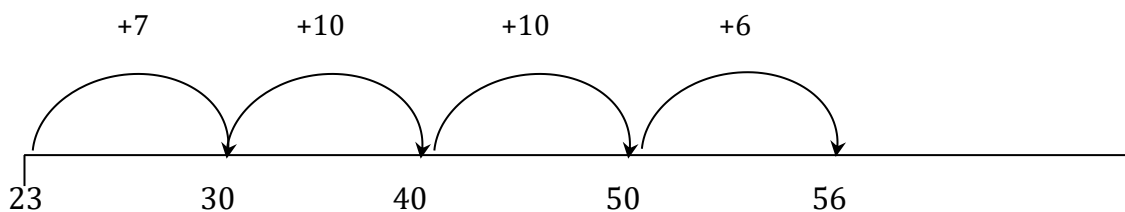
Year 1 onwards, alongside physical resources to remove objects from a group, the children then learn to “find the difference” using a **number line** - we **count on**. Firstly in units, then in 10s.

Counting on method

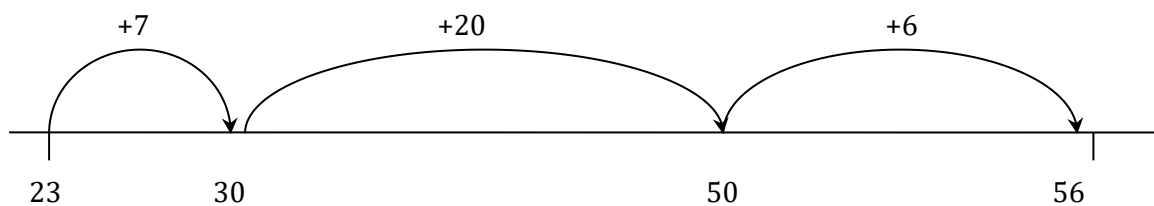
The method of counting on from the smaller number to larger number can be recorded using number lines.

The number of jumps to represent the subtraction will vary. The children are taught to use the number bonds to make the first number into a tens number. They then count on using jumps of ten and then add the units needed. The children will then count the total amount above the jumps.

Example $56 - 23 = 33$



Eventually children will need less jumps, especially when they become confident with the method.



For 3 digit numbers:

Expanded Layout

Partitioning the numbers into tens and units and writing one under the other mirrors the column method, where units are placed under units and tens under tens. The expanded method leads children to the more compact method so that they understand its structure and efficiency.

Example $74 - 27 = 47$

$$\begin{array}{r}
 70 + 4 \\
 - 20 + 7 \\
 \hline
 \end{array}
 \quad \begin{array}{l}
 \text{is the} \\
 \text{same as}
 \end{array}
 \quad \begin{array}{r}
 \begin{array}{r}
 60 \qquad 14 \\
 \cancel{70} + \cancel{4} \\
 - 20 + 7 \\
 \hline
 40 + 7
 \end{array}
 \end{array}$$

Expanded method for 3 digit numbers

Example $741 - 367 = 374$

$$\begin{array}{r}
 700 + 40 + 1 \\
 - 300 + 60 + 7 \\
 \hline
 \end{array}
 \quad \begin{array}{l}
 \text{is the} \\
 \text{same as}
 \end{array}
 \quad \begin{array}{r}
 \begin{array}{r}
 600 \qquad 130 \qquad 11 \\
 \cancel{700} + \cancel{40} + \cancel{1} \\
 - 300 + 60 + 7 \\
 \hline
 300 + 70 + 4
 \end{array}
 \end{array}$$

Children check that each column can be complete before attempting the calculation.

Compact Column Subtraction

Example $74 - 27 = 47$

$$\begin{array}{r} 6 \quad 14 \\ \cancel{7} \quad \cancel{4} \\ - \quad 2 \quad 7 \\ \hline 4 \quad 7 \end{array}$$

Example $741 - 367 = 374$

$$\begin{array}{r} 6 \quad 13 \quad 11 \\ \cancel{7} \quad \cancel{4} \quad \cancel{1} \\ - \quad 3 \quad 6 \quad 7 \\ \hline 3 \quad 7 \quad 4 \end{array}$$

Example $1000 - 784$

$$\begin{array}{r} 9 \quad 9 \quad 10 \\ \cancel{1} \quad \cancel{0} \quad \cancel{0} \quad \cancel{0} \\ - \quad 7 \quad 8 \quad 4 \\ \hline 2 \quad 1 \quad 6 \end{array}$$

Multiplication

Multiplication tables are a fundamental part of Mathematics and should be learned by heart so that they can be applied into all areas of the Maths curriculum.

Grid Method

Example $23 \times 8 = 184$

x	20	3	
8	160	24	then add them up

	1	6	0	
+		2	4	
	1	8	4	

Example $346 \times 9 = 3114$

x	300	40	6	
9	2700	360	54	

	2	7	0	0	
+		3	6	0	
+			5	4	
	3	1	1	4	
		1	1		

This method can be used for larger numbers simply by increasing the number of rectangles in the grid.

So far we have used the grid method for multiplying by a single digit number, but the method can easily be used for multiplying by larger numbers simply by adding an extra row to the grid. A two digit by two digit multiplication can be performed by using a two by two grid, and splitting both number as before :

Example A completed grid for working out 73 x 54

$$\begin{array}{r}
 \text{x} \quad 70 \quad 3 \\
 50 \quad \boxed{\begin{array}{|c|c|} \hline 3500 & 150 \\ \hline \end{array}} \\
 4 \quad \boxed{\begin{array}{|c|c|} \hline 280 & 12 \\ \hline \end{array}} \\
 \hline
 \end{array}
 \quad + \quad
 \begin{array}{r}
 3650 \\
 292 \\
 \hline
 3942
 \end{array}$$

The grid method is an efficient written method for multiplication which builds upon the children's mental methods and provides an effective mental image for multiplication.

Expanded Short Multiplication

The next step is to represent the method of recording in a column format, but showing the working. Draw attention to the links with the grid method.

$$\begin{array}{r}
 \quad \quad \quad \text{H} \quad \text{T} \quad \text{U} \\
 \quad \quad \quad \quad \quad 3 \quad 8 \\
 \text{x} \quad \quad \quad \quad \quad 7 \\
 \hline
 \quad \quad \quad 5 \quad 6 \quad (7 \times 8) \\
 2 \quad 1 \quad 0 \quad (7 \times 30) \\
 \hline
 \end{array}$$

 266 **Expanded Long Multiplication**

	T	H	T	U	
			5	6	
x			2	7	
			<hr/>		
			4	2	(7x6)
		3	5	0	(7x50)
		1	2	0	(20x6)
	1	0	0	0	(20x50)
	<hr/>				
	1	5	1	2	
	<hr/>				
		1			

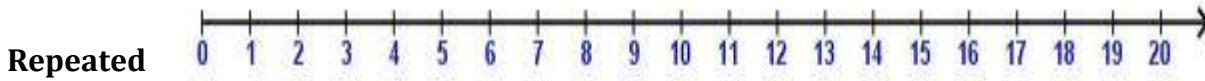
Compact Short Multiplication

The recording is reduced further, with carried digits recorded below the line. If, after practice, children cannot use the compact method without making errors, they should return to the expanded format.

	H	T	U		H	T	U			
		3	8			3	8			
			7		x	1	7			
x			<hr/>							
	2	6	6		2	6	6			
		5				5				
					3	8	0			
					<hr/>					

$$\begin{array}{r} 646 \\ \hline 1 \end{array}$$

Division



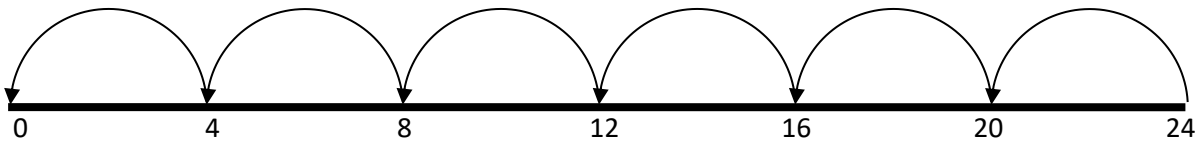
subtraction using a number line.

Example $12 \div 3 = 4$



Children will use an empty number line to support their calculation. How many 4s go into 24? They should count backwards from 24 in 4s to show that division can be completed by repeated subtraction.

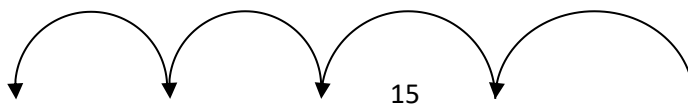
Example $24 \div 4 = 6$

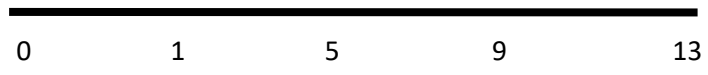


Children should also move onto calculations involving remainders.

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

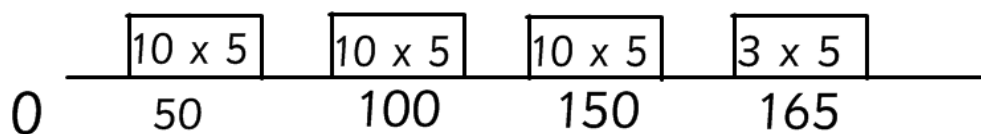
r1 -4 -4 -4



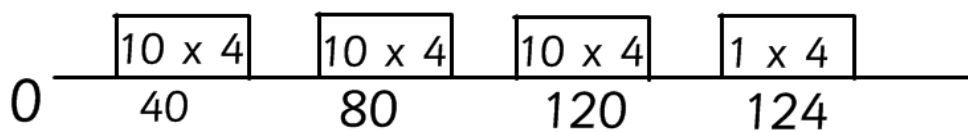


Chunking on a number line

$$165 \div 5 = 33$$



$$124 \div 4 = 31$$

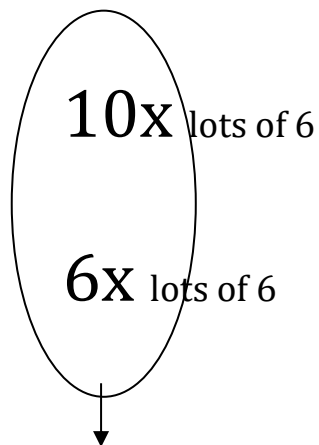


Chunking

Chunking is division by repeated subtraction using a column format. It requires the children to take away 'chunks' of the divisor. It is advisable to teach to the children to begin by removing chunks of '10 lots' first.

Example $96 \div 16$

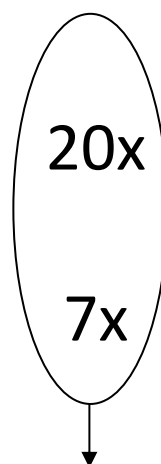
$$\begin{array}{r} 16 \\ 6 \overline{) 96} \\ - 60 \\ \hline 36 \\ - 36 \\ \hline 0 \end{array}$$



Answer : 16

Example $972 \div 36$

$$\begin{array}{r} 27 \\ 36 \overline{) 972} \\ - 720 \\ \hline 252 \\ - 252 \\ \hline 0 \end{array}$$



Answer : 27

