

Harmondsworth Primary School



Progression in Calculation New Curriculum 2014

E.Read

Aims

This booklet is designed to reflect the changes in calculation with the coming of The New Curriculum.

As a school, we wish to ensure that consistency throughout the years is achieved and that teachers are supported in their differentiation of lessons.

Methods of calculations are therefore set out below, also with reference to intended Year Groups, according to the New Curriculum.

It is intended to be a working document, which can be consulted and referred to. Methods have been collated in association with The New Curriculum.

We recognise that not all children are working at the same level and whilst The New Curriculum now indicates year group specific methods, we have included these as a guide only, within brackets.

(Content of Year Groups are required to be taught by the end of each Key Stage, allowing 'freedom' to accelerate some children as necessary.)

Key Stage 1 - Years 1 and 2

The principal focus of mathematics teaching in Key Stage 1 is to ensure that pupils develop confidence and mental fluency with whole numbers, counting and place value. This should involve working with numerals, words and the four operations, including with practical resources [for example, concrete objects and measuring tools]. At this stage, pupils should develop their ability to recognise, describe, draw, compare and sort different shapes and use the related vocabulary. Teaching should also involve using a range of measures to describe and compare different quantities such as length, mass, capacity/volume, time and money.

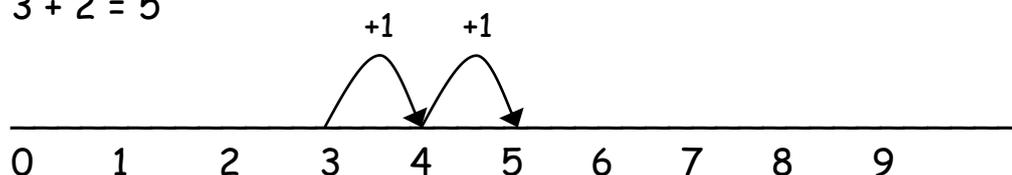
By the end of year 2, pupils should know the number bonds to 20 and be precise in using and understanding place value. An emphasis on practice at this early stage will aid fluency.

Pupils should read and spell mathematical vocabulary, at a level consistent with their increasing word reading and spelling knowledge at key stage 1.

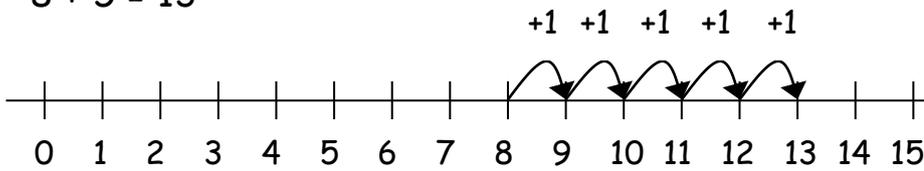
Addition and Subtraction

In early years, children will use oral methods, counting objects or fingers. Later, they will use a number line (*Year One*) or number square to work out answers in different ways.

$$3 + 2 = 5$$



$$8 + 5 = 13$$



Opportunities should be given to support children in learning simple number facts eg $5+3=8$ and children will become proficient with their number bonds within 20 (*Year One*)

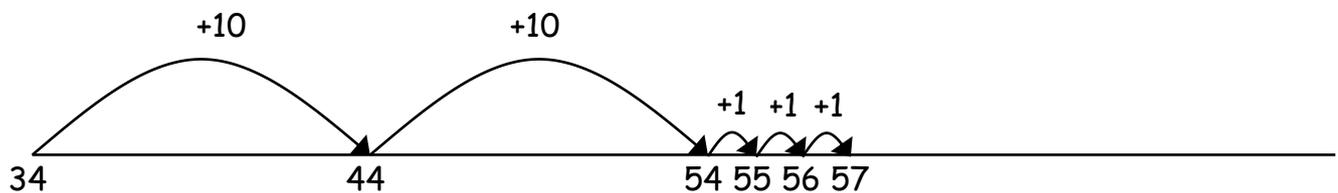
These first stages are not however at the exclusion of written recording. Sums such as $5+8 = ?$ and $13 = ? + 5$ should be used. A horizontal format should be used and children work to apply their increasing knowledge of mental and written methods in order to develop strategies eg.

$$3 + 7 = 10; 10 - 7 = 3 \text{ and } 7 = 10 - 3 \text{ to calculate } 30 + 70 = 100; 100 - 70 = 30 \text{ and } 70 = 100 - 30.$$

Children will begin to use 'empty number lines' themselves, starting with the larger number and counting on. (*Year Two*)

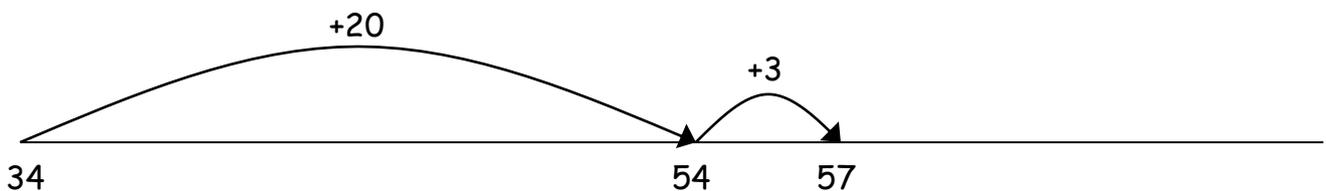
- First counting on in tens and ones.

$$34 + 23 = 57$$



- Followed by adding the tens in one jump and the units in one jump.

$$34 + 23 = 57$$



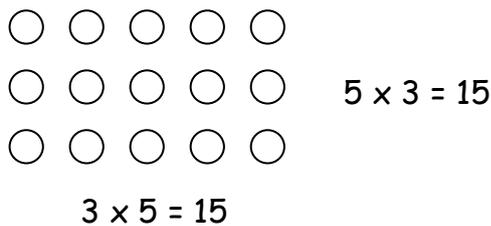
Non - Statutory Guidance recommends recording addition and subtraction in columns in order to support place value and prepare for formal written methods with larger numbers in Key Stage 2.

Multiplication and Division

Non statutory guidance states children should begin to double number and quantities and count in twos, fives and tens (*Year One*) moving on to recall and using multiplication and division facts for the 2, 5 and 10 multiplication tables and counting in groups of 3. (*Year Two*)

Children connect the 10 multiplication table to place value, and the 5 multiplication table to the divisions on the clock face. They begin to use other multiplication tables and recall multiplication facts, including using related division facts to perform written and mental calculations (*Year Two*)

Children should be taught to calculate the answer using concrete objects, pictorial representations and arrays with the support of the teacher (*Year One*)

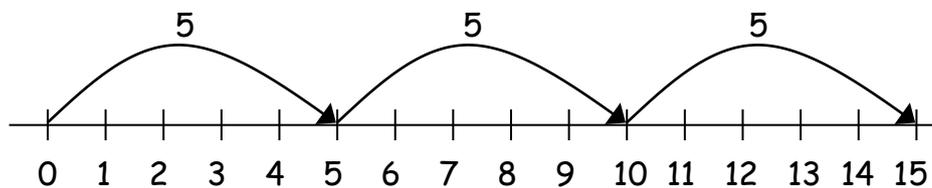


Through the use of repeated addition. (*Year Two*)

3 times 5 is $5 + 5 + 5 = 15$ or 3 lots of 5 or 5×3

Repeated addition can be shown easily on a number line:

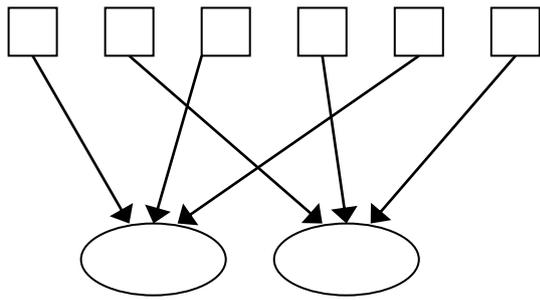
$$5 \times 3 = 5 + 5 + 5$$



Children use commutativity and inverse relations to develop multiplicative reasoning (for example, $4 \times 5 = 20$ and $20 \div 5 = 4$). (*Year 2*)

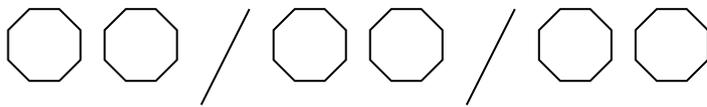
Sharing equally

6 sweets shared between 2 people, how many do they each get? (Year 1)



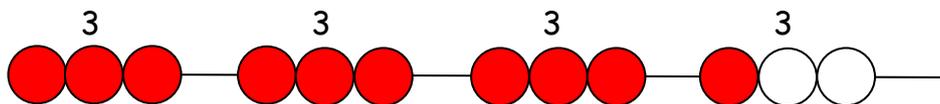
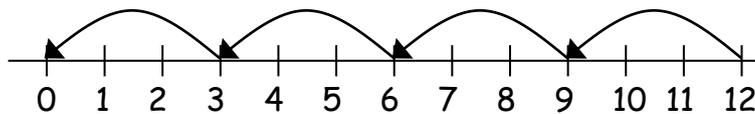
✓ **Grouping or repeated subtraction**

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



✓ **Repeated subtraction using a number line or beads**

$$12 \div 3 = 4$$



Lower Key Stage 2 -Years 3 and 4

"The principal focus of mathematics teaching in lower key stage 2 is to ensure that pupils become increasingly fluent with whole numbers and the four operations, including number facts and the concept of place value. This should ensure that pupils develop efficient written and mental methods and perform calculations accurately with increasingly large whole numbers. At this stage, pupils should develop their ability to solve a range of problems, including with simple fractions and decimal place value. Teaching should also ensure that pupils draw with increasing accuracy and develop mathematical reasoning so they can analyse shapes and their properties, and confidently describe the relationships between them. It should ensure that they can use measuring instruments with accuracy and make connections between measure and number.

By the end of year 4, pupils should have memorised their multiplication tables up to and including the 12 multiplication table and show precision and fluency in their work.

Pupils should read and spell mathematical vocabulary correctly and confidently, using their growing word reading knowledge and their knowledge of spelling." 2014 National Curriculum

Addition and Subtraction

Children develop more formal methods, relying on their understanding of place value and addition.

Adding most significant digits first

$$\begin{array}{r} 53 \\ + 27 \\ \hline 70 \quad (50 + 20) \\ 10 \quad (3 + 7) \\ \hline 80 \quad (70 + 10) \end{array}$$
$$\begin{array}{r} 162 \\ + 226 \\ \hline 300 \quad (100 + 200) \\ 80 \quad (60 + 20) \\ 8 \quad (2 + 6) \\ \hline 388 \quad (300 + 80 + 8) \end{array}$$

Moving to adding the least significant digits first in preparation for 'carrying'.

$$\begin{array}{r} 67 \\ + 24 \\ \hline 11 \quad (7 + 4) \\ 80 \quad (60 + 20) \\ \hline 91 \end{array}$$
$$\begin{array}{r} 267 \\ + 85 \\ \hline 12 \quad (7 + 5) \\ 140 \quad (60 + 80) \\ \hline 200 \\ \hline 352 \end{array}$$

Children will continue to develop their mental recall of facts and now move on to adding and subtracting numbers with up to three digits, using formal written methods of columnar addition and subtraction without crossing over a multiple of ten or needing to use decomposition. (Year 3)

124 + 243 becomes

$$\begin{array}{r} 1 \quad 2 \quad 4 \\ + 2 \quad 4 \quad 3 \\ \hline 3 \quad 6 \quad 7 \end{array}$$

462 - 131 becomes

$$\begin{array}{r} 4 \quad 6 \quad 2 \\ - 1 \quad 3 \quad 1 \\ \hline 3 \quad 3 \quad 1 \end{array}$$

Standard written methods are reliable and efficient procedures for calculating, which, once mastered, can be used in many different contexts. But they are of no use to someone who applies them inaccurately and who cannot judge if the answer is reasonable.

It is therefore appropriate for children at this point to begin to estimate answers by rounding up or down numbers. These should be recorded so children can refer back to them later.

This skill is used increasingly in practical contexts and missing number problems, moving on to adding and subtracting numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate. (Year 4) Children make decisions as to when to use such methods and are able to solve two step word problems.

Non Statutory guidance recommends that these methods are practised and applied to increasingly larger numbers in order to aid fluency.

Multiplication and Division

In year 3 children are expected to know the multiplication and division facts for the 3,4 and 8 times tables, by the end of Year 4, children are expected to know the multiplication and division facts up to 12×12 . They write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods.

Non Statutory guidance states that efficient methods include commutativity and associativity are used;

For example, $4 \times 12 \times 5 = 4 \times 5 \times 12 = 20 \times 12 = 240$

multiplication and division facts, for example, using $3 \times 2 = 6$, $6 \div 3 = 2$ and $2 = 6 \div 3$ to derive related facts, for example, $30 \times 2 = 60$, $60 \div 3 = 20$ and $20 = 60 \div 3$

Children are encouraged to use reliable written methods for multiplication and division, starting with calculations of two-digit numbers by one-digit numbers and progressing to the formal written methods of short multiplication and division (Year 3)

Once children are confident in knowing tables facts, informal jottings can support them with calculating more complex sums. **Encourage children to estimate answers first.**

Partitioning larger numbers

Eg. $43 \times 6 = 258$

$$40 \times 6 = 240 \quad 3 \times 6 = 18 \quad 240 + 18 = 258$$

$$\begin{aligned} 38 \times 5 &= (30 \times 5) + (8 \times 5) \\ &= 150 + 40 \\ &= 190 \end{aligned}$$

This can also be transferred to a grid method so answers can be organised

x	40	3
6	240	18

$$240 + 18 = 258$$

$$\begin{array}{r} 300 \times 9 \\ \quad 346 \\ \hline 2700 \end{array}$$

$$\begin{array}{r}
 40 \times 9 \\
 6 \times 9 \\
 \hline
 3114
 \end{array}$$

Ensure children have a solid knowledge of times tables as these are the basis for all further calculations!

$$\begin{array}{r}
 237 \\
 \times 4 \\
 \hline
 948 \\
 \small{1 \quad 2}
 \end{array}$$

At Harmondsworth, we believe in following the same method in order to avoid confusion, so we carry numbers to the bottom of the calculation below the relevant column.

Children write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers \times one-digit numbers, using mental and progressing to formal written methods (Year 4)

The Non - Statutory Guidance states that "Pupils practise to become fluent in the formal written method of short multiplication and short division with exact answers"

Upper Key Stage 2 -Years 5 and 6

The principal focus of mathematics teaching in upper key stage 2 is to ensure that pupils extend their understanding of the number system and place value to include larger integers. This should develop the connections that pupils make between multiplication and division with fractions, decimals, percentages and ratio.

At this stage, pupils should develop their ability to solve a wider range of problems, including increasingly complex properties of numbers and arithmetic, and problems demanding efficient written and mental methods of calculation. With this foundation in arithmetic, pupils are introduced to the language of algebra as a means for solving a variety of problems.

By the end of year 6, pupils should be fluent in written methods for all four operations, including long multiplication and division, and in working with fractions, decimals and percentages.

Pupils should read, spell and pronounce mathematical vocabulary correctly.

Addition and Subtraction

Children should be using formal written methods - column addition and subtraction (Year 5), they add and subtract whole numbers with more than 4 digits, including using formal written methods.

789 + 642 becomes

$$\begin{array}{r}
 789 \\
 + 642 \\
 \hline
 1431 \\
 \hline
 1 \quad 1
 \end{array}$$

Answer: 1431

874 - 523 becomes

$$\begin{array}{r}
 874 \\
 - 523 \\
 \hline
 351
 \end{array}$$

Answer: 351

932 - 457 becomes

$$\begin{array}{r}
 8 \quad 12 \quad 1 \\
 932 \\
 - 457 \\
 \hline
 475
 \end{array}$$

Answer: 475

932 - 457 becomes

$$\begin{array}{r}
 1 \quad 1 \\
 932 \\
 - 457 \\
 \hline
 5 \quad 6 \\
 475
 \end{array}$$

Answer: 475

By Year 6, children should be able to solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.

Multiplication and Division

Children are expected to now be using formal methods or mental calculations including long multiplication for two digit numbers (year 5 and 6).

Long multiplication:

24 × 16 becomes

$$\begin{array}{r}
 2 \\
 24 \\
 \times 16 \\
 \hline
 240 \\
 144 \\
 \hline
 384
 \end{array}$$

Answer: 384

124 × 26 becomes

$$\begin{array}{r}
 1 \quad 2 \\
 124 \\
 \times 26 \\
 \hline
 2480 \\
 744 \\
 \hline
 3224 \\
 \hline
 1 \quad 1
 \end{array}$$

Answer: 3224

124 × 26 become:

$$\begin{array}{r}
 1 \quad 2 \\
 124 \\
 \times 26 \\
 \hline
 744 \\
 2480 \\
 \hline
 3224 \\
 \hline
 1 \quad 1
 \end{array}$$

Answer: 3224

Children divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context.

