

Calculation progression and strategies

Year One

Record in the context of practical activities and when solving simple number problems e.g. using conventional signs and symbols in number sentences to record mentally adding 11 and 12; recording the results of a survey of children's favourite toys.

Year Two

Develop recording in the context of practical work and in explaining how problems were solved e.g. recording how much money could be in a box if there are five coins; recording the results of working on the 'handshake' problem.

Use paper and pencil methods (with emphasis on number line) to support, record and explain mental addition and subtraction of numbers up to 100 e.g. recording what happens when 10 is added to any number up to 100; writing an explanation of how $93 - 89$ was calculated mentally; using correct signs and symbols to record number sentences such as $46 + 20 = 66$.

Year Three

Use informal paper and pencil methods to support, record and explain mental addition and subtraction of numbers up to 1000 e.g. using an empty number line to show how $301 - 45$ was calculated mentally.

For addition children partition numbers moving towards adding the least significant digit first.

$$36 + 45 =$$

$$30 + 40 = 70 \text{ moving to}$$

$$6 + 5 = 11$$

$$70 + 11 = 81$$

Explain methods and reasoning, where appropriate, in writing e.g. explaining how the missing number in a calculation such as $47 + ?? = 55$ or $704 - ?? = 698$ was found.

Year Four

Develop and refine written method for column addition using the expanded method,

adding least significant digit first

Use a number line to solve subtraction calculations (finding the difference/complementary addition method)

Approximate first. Use informal pencil and paper methods to support record or explain multiplications and divisions.

For multiplication use the grid method

For division use complementary addition (method used for subtraction) on a number line, explaining that 96 ÷ 6 is how many 6's in 96.

Choose and use appropriate ways of calculating (mental, mental with jottings, pencil and paper) to solve problems.

Year Five and Year Six

□ Extend written methods to column addition and subtraction of two integers less than

1000 e.g. $454\ 376 + 362 - 169$

□ Grid method for multiplication

□ Short division of HTU by U, using a number line and 'chunking'

□ Choose and use appropriate ways of calculating (mental, mental with jottings, written methods, calculator)

□ Explain methods and reasoning in writing

□ Extend written calculation methods to: column addition and subtraction of numbers involving decimals; short multiplication and division of numbers involving decimals; long multiplication of a three-digit by a two-digit integer

□ In solving mathematical problems and problems involving 'real life', explain methods and reasoning in writing

□ Begin to develop from explaining a generalised relationship in words to expressing it in a formula using letters and symbols

$36+45=$

$6+5=11$

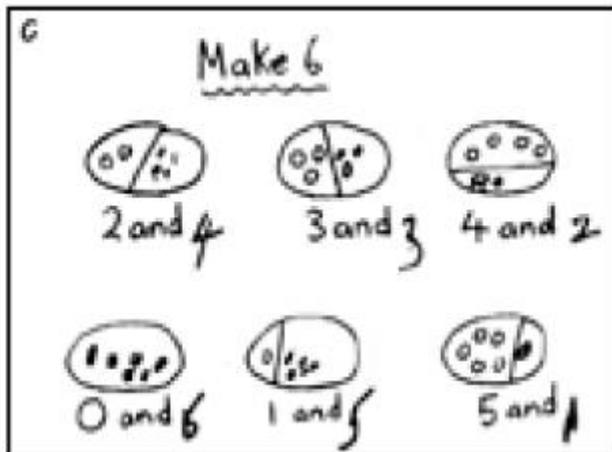
$30+40=70$

Methods

Addition

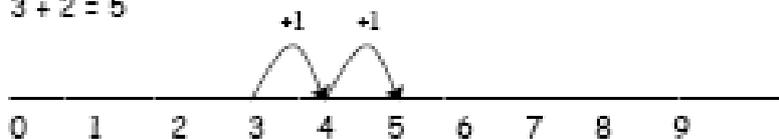
Stage 1

Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures, etc.

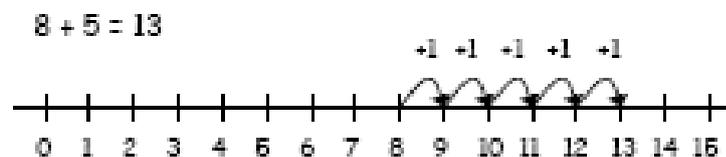


They use number lines and practical resources to support calculation and teachers demonstrate the use of the number line.

$$3 + 2 = 5$$

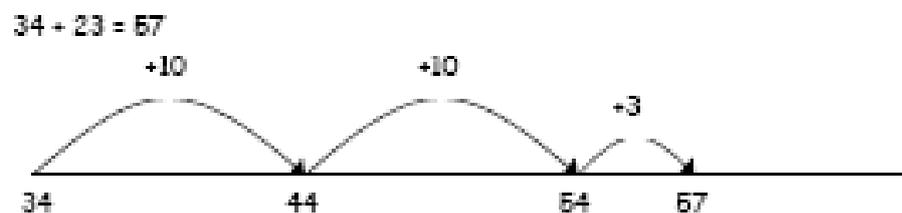


Children then begin to use numbered lines to support their own calculations using a numbered line to count on in ones.



Stage 2

Children will begin to use 'empty number lines' themselves starting with the larger number and counting on.



Column Method 1

Adding the least significant digits first.

$$\begin{array}{r}
 67 \\
 + 24 \\
 \hline
 11 \text{ (} 7 + 4 \text{)} \\
 \underline{80} \text{ (} 60 + 20 \text{)} \\
 \hline
 91
 \end{array}$$

$$\begin{array}{r}
 267 \\
 + 85 \\
 \hline
 12 \text{ (} 7 + 5 \text{)} \\
 \underline{140} \text{ (} 60 + 80 \text{)} \\
 \hline
 200 \\
 \hline
 352
 \end{array}$$

Column Method 2

From the above, children will begin to carry below the line.

$$\begin{array}{r}
 625 \\
 + 48 \\
 \hline
 673 \\
 \hline
 1
 \end{array}$$

$$\begin{array}{r}
 783 \\
 + 42 \\
 \hline
 825 \\
 \hline
 1
 \end{array}$$

$$\begin{array}{r}
 367 \\
 + 85 \\
 \hline
 452 \\
 \hline
 11
 \end{array}$$

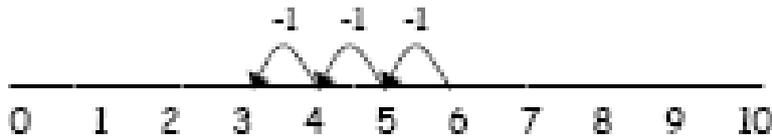
Subtraction

Stage 1

Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures etc.

They use number lines and practical resources to support calculation.

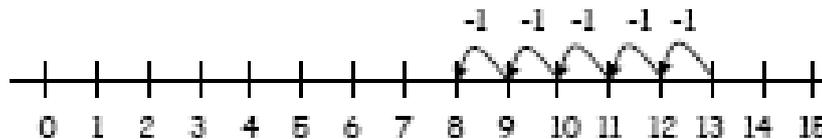
$$6 - 3 = 3$$



Teachers demonstrate the use of the number line.

Children then begin to use numbered lines to support their own calculations - using a numbered line to count back in ones.

$$13 - 5 = 8$$



Stage 2

Children will continue to use empty number lines to support calculations.

Counting on

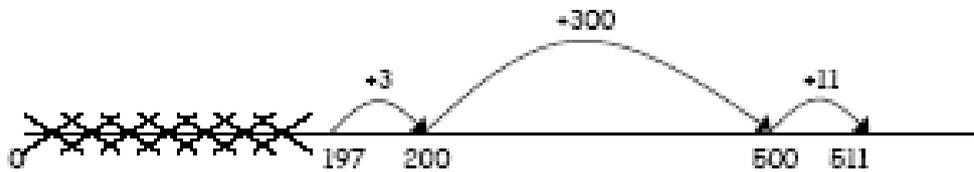
$$82 - 47$$



Stage 3

Children will begin to use empty number lines to support calculations and will count on in larger steps. This will move into a column method when ready, but still using the counting on method.

$$511 - 197 = 314$$



Stage 4

When ready, any pupil from **Year 2 to year 6** will be taught subtraction using the column method, leading to the column decomposition method.

$$\begin{array}{r} 843 \\ - 221 \\ \hline 622 \end{array} \quad \begin{array}{r} 7 \text{ } 23 \text{ } 16 \\ - 2 \text{ } 2 \text{ } 8 \\ \hline 5 \text{ } 0 \text{ } 8 \end{array}$$

By the end of KS2 children should be able to use the column method for subtraction and less able children to use an empty number line.

Multiplication

Stage 1

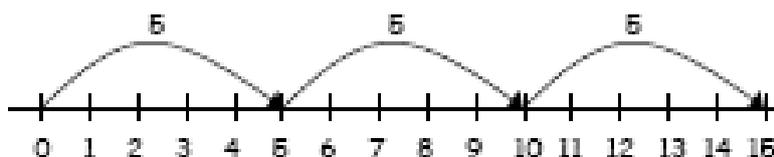
Children will experience equal groups of objects and will count in 2s and 10s and begin to count in 5s. They will work on practical problem solving activities involving equal sets or groups.

Stage 2

Children will develop their understanding of multiplication and use jottings to support calculation:

Repeated addition

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



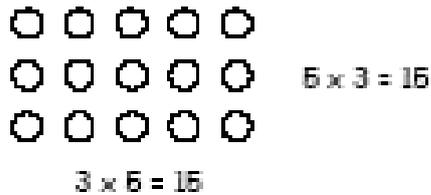
Repeated addition can be shown easily on a number line.

Commutativity

Children should know that 3×5 has the same answer as 5×3 . This can also be shown on the number line.

Arrays

Children should be able to model a multiplication calculation using an array. This knowledge will support with the development of the grid method.



Column Method

$$\begin{array}{r} 16 \\ \times 6 \\ \hline 96 \\ 3 \end{array}$$
$$\begin{array}{r} 14 \\ \times 17 \\ \hline 98 \\ + 2 \\ \hline 140 \\ \hline 238 \\ 1 \end{array}$$

All children should be able to use the column method by the end of KS2. More able children may be able to use the column method for long X.

Division

Stage 1

Children will experience sharing groups of objects. They will work on practical problem solving activities involving sharing.

Stage 2

Children will develop their understanding of division and use jottings to support calculation.

Sharing equally

6 sweets shared between 2 people, how many do they each get?

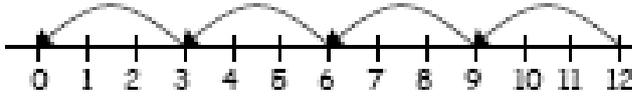
Grouping or repeated subtraction

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



Repeated subtraction using a number line

$$12 \div 3 = 4$$



Using symbols to stand for unknown numbers to complete equations using inverse



$$\div 2 = 4$$

$$20 \div \triangle = 4$$



$$\div$$



$$= 4$$

Stage 3

Children will be taught the 'bus shelter' method for division.

$$644 \div 7 = 92$$

$$\begin{array}{r} 092 \\ 7 \overline{)6414} \end{array}$$

Division with remainders.

$$648 \div 7 = 92 \text{ r}4$$

$$\begin{array}{r} 092 \text{ r}4 \\ 7 \overline{)6418} \end{array}$$

Bus shelter method

All children should be able to use the bus shelter method by the end of KS2.