GRESHAM PRIMARY SCHOOL
MATHS CALCULATION POLICY

Policy Updated: April 2022
Date for Next Update: April 2024

INTRODUCTION

This calculation policy has been written in line with the programmes of study taken from the revised National Curriculum for Mathematics. It provides guidance on appropriate calculation methods and progression. The content shows progression between years under the following headings: addition, subtraction, multiplication and division.

Gresham's maths curriculum (available on the school website) also highlights the progression between these key skills and when they will be introduced and taught.

Children will use mental methods as their first port of call when appropriate, but for calculations that they cannot do in their heads, they will need to use an efficient written method accurately and with confidence.

As a school, we value very highly any support you, as parents, are able to offer your child at home; this document has therefore been written to provide you with the guidance you will need in order to assist your child with the appropriate mental and written calculation strategies they are using in class.

The emphasis, initially, is on mental calculations skills, but progresses to the written strategies that your child is expected to become familiar with. Whilst this document has been organised into the expected outcomes for each year group, it is important to recognise that children develop their mathematical skills at different rates and that you should work with your child, using a combination of practical, mental and written activities, at a level that is suitable to them.

With this said, it is also important to recognise that the maths curriculum aims to develop reasoning and problem solving skills. These are developed through carefully planned lessons and home learning and also the result of children adhering to the content of their year group. Children who are highly proficient at maths will be challenged appropriately, but always through extending their knowledge of the content for their year group. Rapid progression through the curriculum does not allow for a clear mathematical understanding of what is 'happening' and whilst children can remember rules and patterns, they will not develop their problem solving and reasoning skills.

AIMS OF THE POLICY

- To ensure consistency and progression in our approach to calculation.

- To ensure that children develop an efficient, reliable, formal written method of calculation for all operations.
- To ensure that children can use these methods accurately with confidence and understanding.
- To give parents/carers the confidence to support children in maths at home.

CPA (Concrete, Pictorial, Abstract)

As a result of an overview of the National Curriculum, in 2013 there was a shift in focus. The term 'mastery' was introduced following the success of programmes such as Shanghai Maths and Singapore Maths.

Mastery refers to children acquiring a deep-rooted and secure understanding of maths. Children are introduced to a concept and once embedded they are then encouraged to rationalise and reason. This promotes a deeper understanding and moves away from children having to learn by rote.

With maths mastery in mind, schools will typically use some variation of the CPA approach.

CPA stands for:

- Concrete
- Pictorial
- Abstract

The CPA approach underpins the aims of the National Curriculum. Historically, there has perhaps been a tendency to show progression in maths by rapidly moving children from topic to topic. However, this can lead to a superficial understanding where children rely on learning by rote or following rules or patterns to achieve success. It does not lend itself to gaining a deep understanding.

CPA focuses on the three key stages of mathematical learning and show how children are taught to build upon existing knowledge.

Concrete refers to the physical objects that children may use to count and order. These could be counters, cubes or other physical apparatus. This physical representation of a number helps children to 'see' what is happening when they are calculating.

Physical representations follow this. This will include children starting to use number-lines, times tables grids, hundred squares and similar. The children have a secure understanding of number and are now able to represent it visually, without needing physical objects in front of them.

Abstract is the final stage. At this point children are very secure and familiar with number and can now use written methods to calculate. This will involve more

traditional written methods including the column method for addition, subtraction and multiplication and long and short division. Children will be able to explain how these methods work as throughout their time at primary school they will be encouraged to make links between the three stages.

It is of paramount importance to allow children to progress through these stages equally. Abstract written methods are generally introduced and taught in KS2 where they have spent the majority of EYFS and KS1 focussing on concrete and pictorial examples.

Children who are introduced to abstract concepts too early, without a secure grasp of the concrete and pictorial stages can result in children 'learning by rote' where they can remember a set of rules to find an answer, but they cannot explain how or why their answer is correct.

The following pages offer visual examples of how the four operations (addition, subtraction, multiplication and division) are taught throughout Gresham.

Early Years

A key priority of any Primary School maths curriculum is to ensure that children develop a strong sense of number and place value. Children will continually encounter numbers in the world around them, whether that be on the bus they took to school this morning or on their front door at home. But the ability to recognise the symbol 5, and name it, is very different from understanding the 'fiveness' of it, and it is the development of this latter skill that is crucial to a child's mathematical ability.

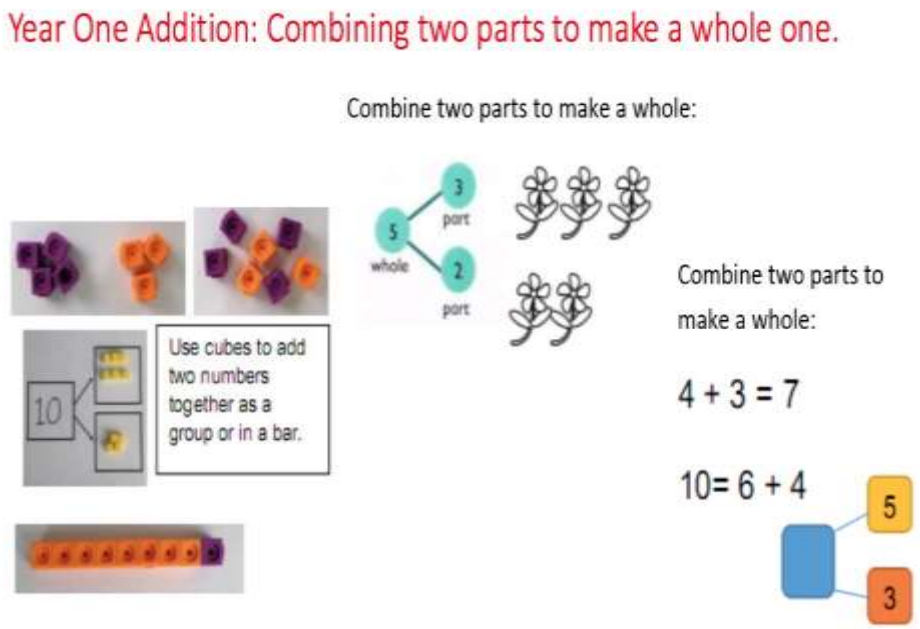
Furthermore, it is important to recognise that just because a child can recite number names in order, does **not** necessarily mean that they can count. As with learning the alphabet, children can recall a sequence of numbers by rote without any real grasp or understanding of what they mean (hence young children often omit numbers as they count). Gaining familiarity with number names through songs and rhymes is of course helpful, but emphasis should be placed on helping children make links between these number names and the number of objects they equate to.

In the Foundation Stage, as well as teaching the children to count objects, significant attention is given to cultivating number recognition and the development of mental representations. In order to do this, much of their experience with number play in the early years will involve concrete, movable objects. In the Foundation Stage, this secure knowledge of number and place value underpins all calculation that may be taught later in children's school lives.

Constant repetition, embedding and teaching of these key skills ensure the children's deep understanding of number and in the Foundation Stage this can be taught in a number of ways including:

- Writing numbers
- Accurate 1-1 correspondence (touch it, move it, count it).
- A secure understanding of 'what' a number is.
- Recognising numbers visually.
- Use of concrete materials (Dienes and numicon)
- Counting forwards and backwards through a number-line.

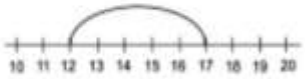
Addition – Year One



Year One Addition: Starting at the larger number and counting on.

Starting at the larger number and counting on:

12 + 5 = 17



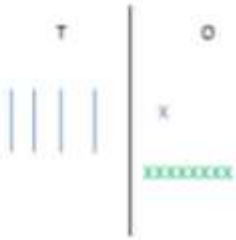
Start at the larger number on the number line and count on in ones or in one jump to find the answer.

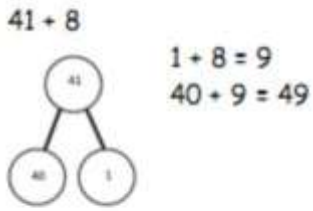
Start with the larger number on the bead string and then count on to the smaller number 1 by 1 to find the answer.

Addition – Year Two

Year Two Addition: Starting at the larger number and counting on using partitioning.

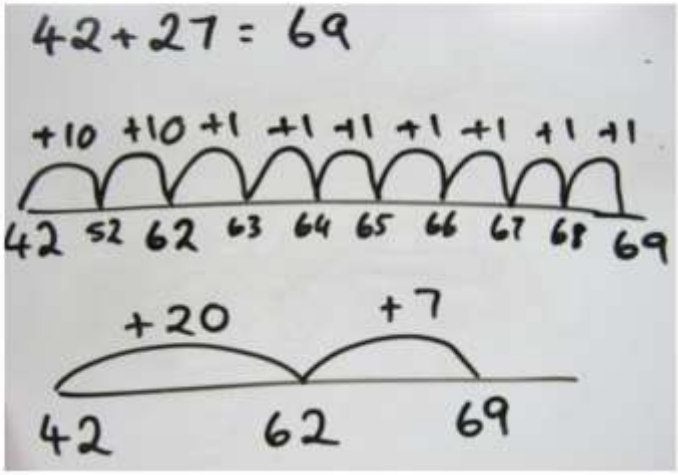
41 + 8



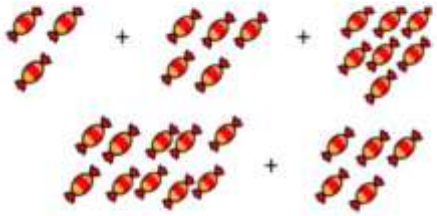


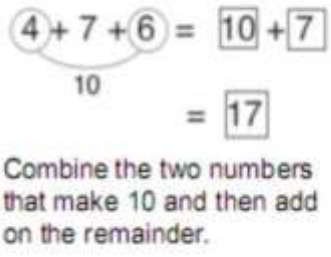
Year Two Addition: Starting at the larger number and counting on using partitioning.

Initially record each jump of ten and jump of one. Then lead into one jump of a multiple of ten and one jump of a multiple of one.



Year Two Addition: Adding three numbers together, looking to make 10 first.





Combine the two numbers that make 10 and then add on the remainder.

Addition – Year Three

Year Three Addition: Adding two digits using partitioning.

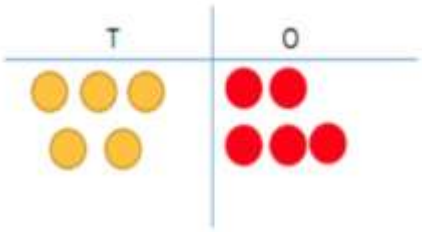
Using empty number lines:

- Build upon adding 2 digit numbers, then 3 digit numbers using a blank number line.

356+427

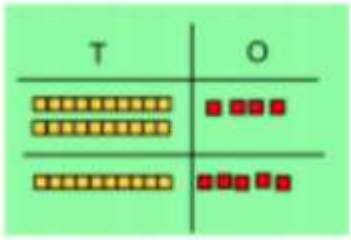
Year Three Addition: Beginning to use the column method without regrouping.

32 + 23 = 55



50 5

24 + 15 = 39



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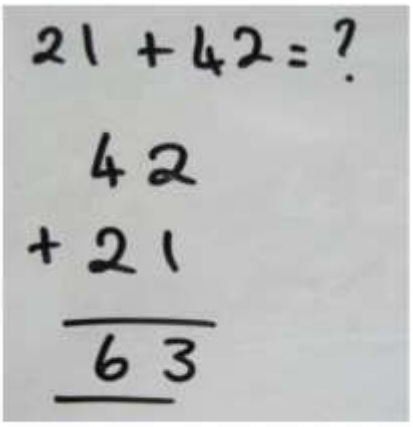
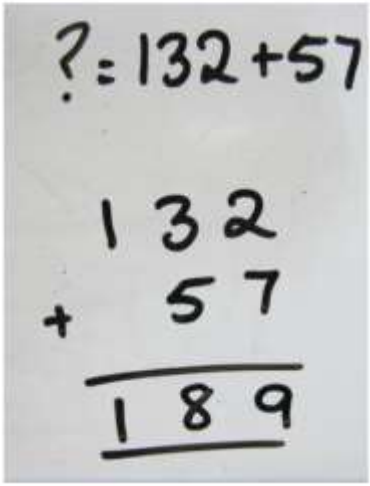
Year Three Addition: Beginning to use the column method without regrouping.

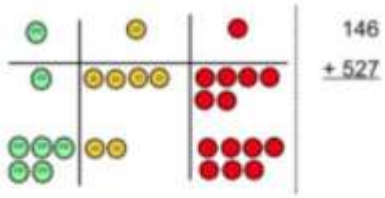




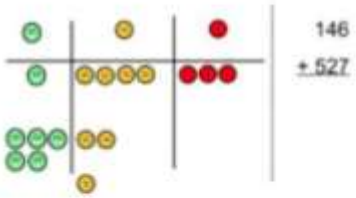
Addition – Year Four

Year Three into Year Four Addition: Beginning to use the column method with regrouping.

Make both numbers on a place value grid.

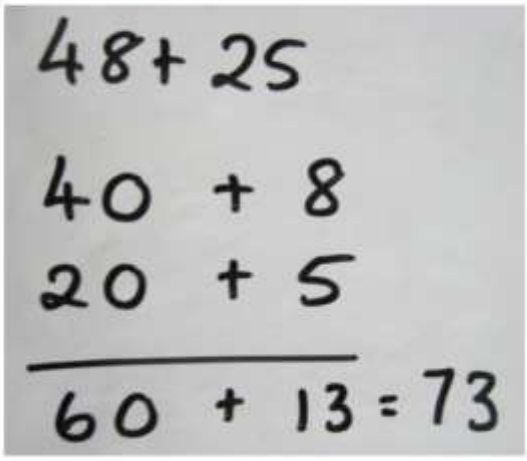


Add up the units and exchange 10 ones for one 10.



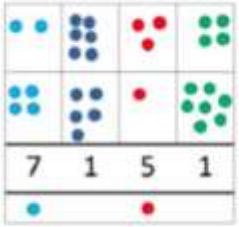
Year Three into Year Four Addition: Beginning to use the column method with regrouping.

Leading onto the standard written method but with partitioning.

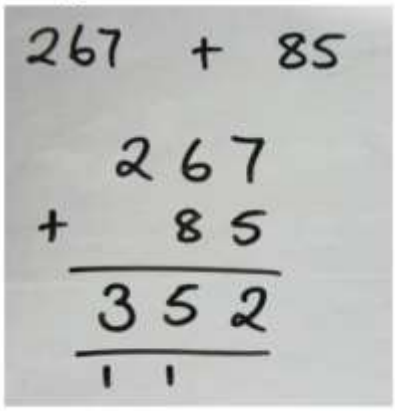


Year Three into Year Four Addition: Beginning to use the column method with regrouping.

Children can draw a pictoral representation of the columns and place value counters to further support their learning and understanding.

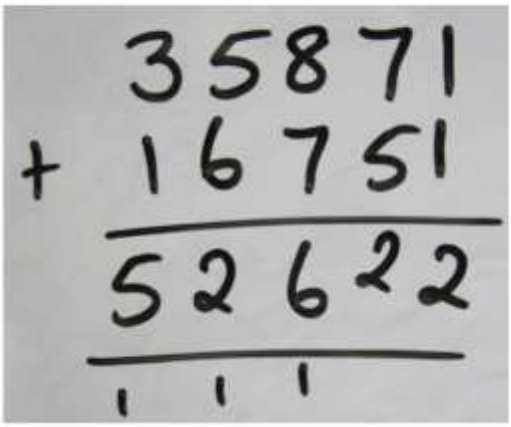


Leading to the standard column method:

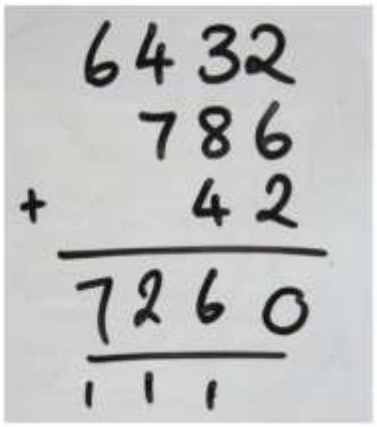


Addition – Year Five/Six

Year Five and Year Six Addition: Confident with standard method and with adding more than one number.



$$\begin{array}{r} 35871 \\ +\ 16751 \\ \hline 52622 \\ \hline {\scriptstyle 1\ 1\ 1} \end{array}$$



$$\begin{array}{r} 6432 \\ 786 \\ +\ \ 42 \\ \hline 7260 \\ \hline {\scriptstyle 1\ 1\ 1} \end{array}$$

Year Five and Year Six Addition: Adding numbers with different lengths, including decimals.

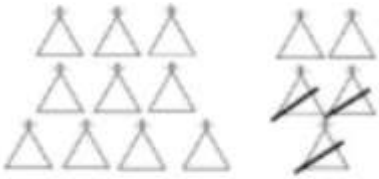
$$\begin{array}{r} 401.20 \\ 26.85 \\ +\ \ 0.71 \\ \hline 428.76 \\ \hline {\scriptstyle 1} \end{array}$$

Subtraction – Year One

Year One subtraction: Physically crossing out ones.

Physically taking away and removing objects from a whole

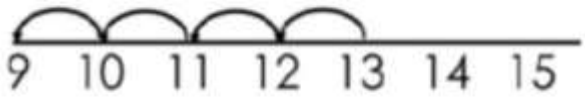
Cross out drawn objects to show what has been taken away



15 – 3 = 12

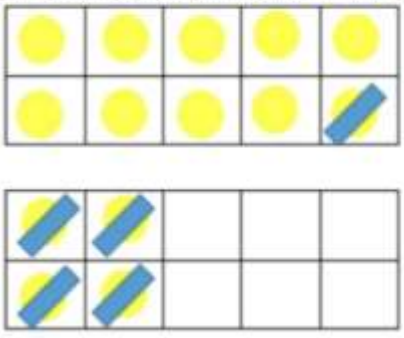
Year One subtraction: Counting back in ones

Count back on a number line or number track



Year One subtraction: Using ten to help count back.

Children to present the ten frame pictorially

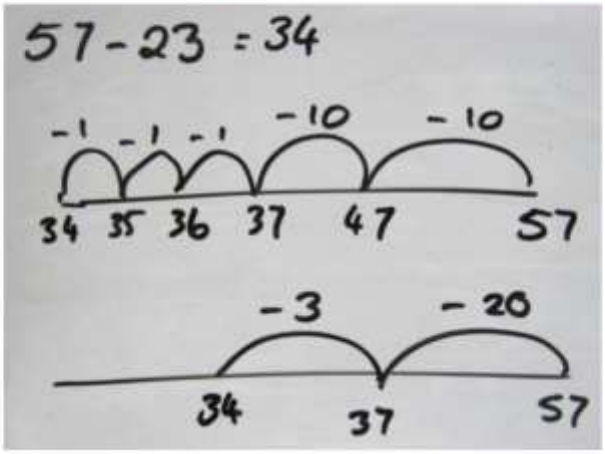


Making 10 (using numicon or ten frames

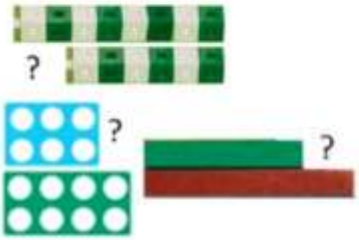
14 - 5

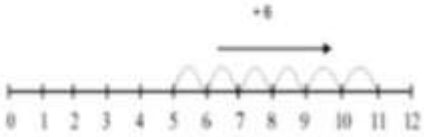
Subtraction – Year Two

Year Two subtraction: Starting at the bigger number and counting back in multiples of ten and multiples of one.



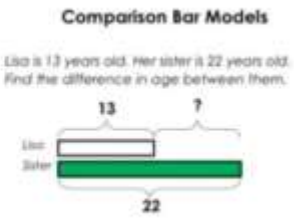
Year Two subtraction: Finding the difference





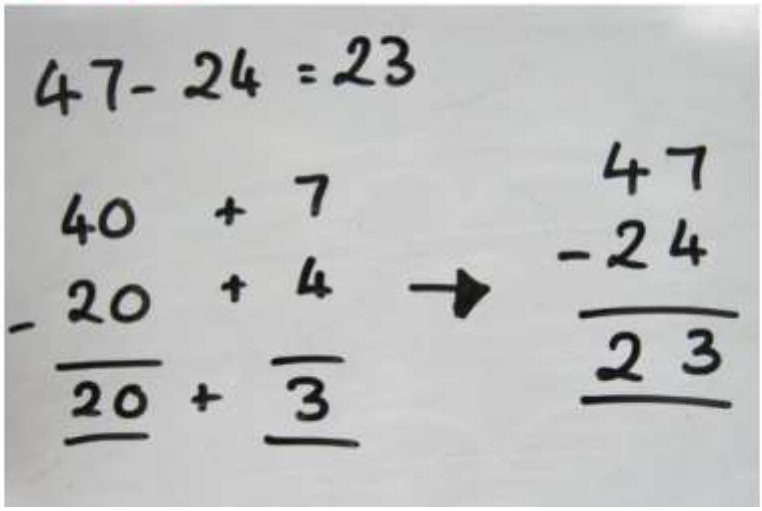
Count on to find the difference.

Draw bars to find the difference between 2 numbers.



Subtraction – Year Three/Four

Year Three subtraction: Partitioning and column method without regrouping.

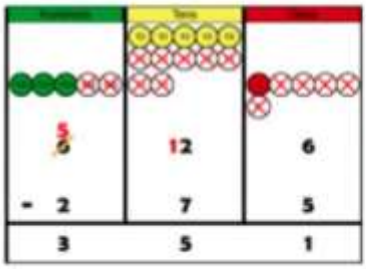


Year Three into Year Four: Column method using exchanging.

Column method (using base 10 and having to exchange)

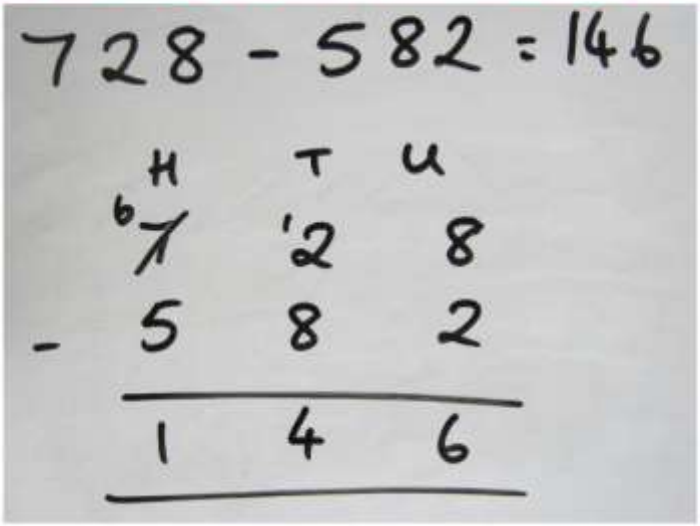
45-26

1) Start by partitioning 45
2) Exchange one ten for ten more ones
3) Subtract the ones, then the tens.



Draw the counters onto a place value grid and show what you have taken away by crossing the counters out as well as clearly showing the exchanges you make.

Year Three into Year Four: Column method using exchanging.



Subtraction – Year Five/Six

Years Five and Six subtraction: Column method including decimals.

$$\begin{array}{r} {}^{6}\cancel{7}\,{}^{1}0\,{}^{6}\cancel{7}\,{}^{1}2 \\ -\ 3\ 2\ 2\ 6 \\ \hline 3\ 8\ 4\ 6 \end{array}$$

$$\begin{array}{r} {}^{2}\cancel{3}\,.\,{}^{13}\cancel{4}\,{}^{1}2 \\ -\ 1\ .\ 7\ 6 \\ \hline 1\ .\ 6\ 6 \end{array}$$

$$\begin{array}{r} {}^{2}\cancel{4}\,{}^{1}1\,{}^{6}\cancel{7}\,.\,{}^{11}\cancel{2}\,{}^{1}0 \\ -\ \ 3\ 4\ .\ 7\ 1 \\ \hline 3\ 8\ 2\ .\ 4\ 9 \end{array}$$

When subtracting decimals with different numbers of decimal places, children should be taught and encouraged to make them the same through identification that 2 tenths is the same as 20 hundredths, therefore, 0.2 is the same value as 0.20.

Multiplication – Year One/Two

Year One multiplication: repeated grouping

4 x 3 can be shown as...

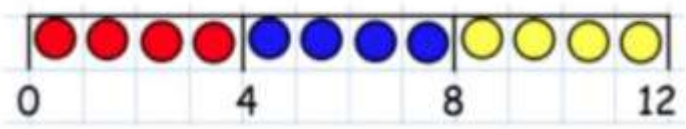
3 x 4 or 3 lots of 4

XX XX XX
XX XX XX

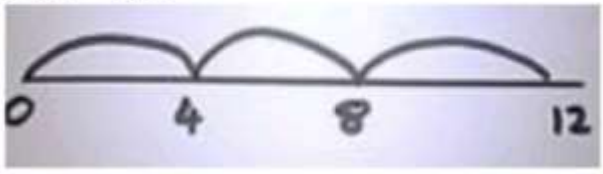
3 x 4

4 + 4 + 4

Year Two multiplication: using number lines to show repeated grouping

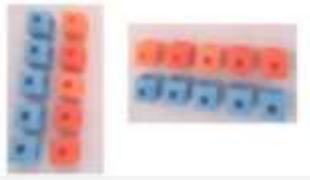


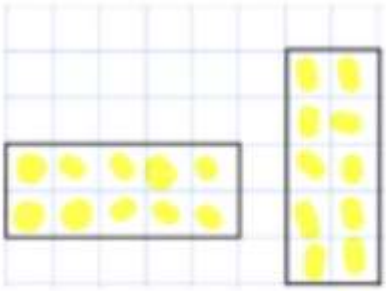
3 x 4 = 12



Year Two multiplication: using arrays

Use arrays to illustrate commutatively (counters and other objects can also be used)
2 x 5 = 5 x 2



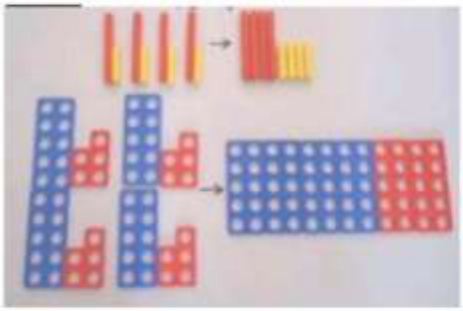


2 x 5 = 10
5 x 2 = 10
2 + 2 + 2 + 2 + 2 = 10
5 + 5 =10

Multiplication – Year Three

Year Three multiplication: using partitioning

4 x 15



4 x 15

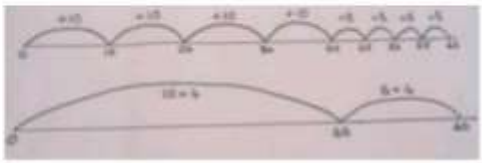
10 5

10 x 4 = 40

5 x 4 = 20

40 + 20 = 60

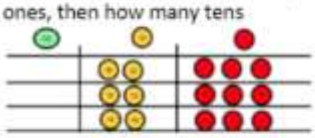
A number line can also be used



Year Three multiplication: using partitioning

Formal column method with place value counters or base 10 (at the first stage-no exchanging) 3 x 23

Make 23, 3 times. See how many ones, then how many tens



Children to represent the counters in a pictorial way

Tens	Ones
6	9

Children to record what it is they are doing to show understanding

3 x 23

20 3

3 x 20 = 60

3 x 3 = 9

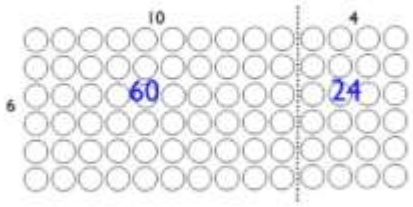
60 + 9= 69

$$\begin{array}{r} 23 \\ \times\ 3 \\ \hline 69 \end{array}$$

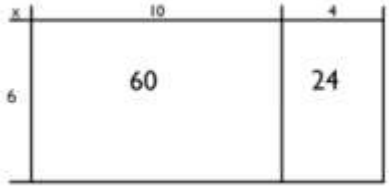
Multiplication - Year Four

Year Four multiplication: partitioning and grid method

Using practical resources e.g. counters, children can use previous knowledge of arrays to make the grid method:

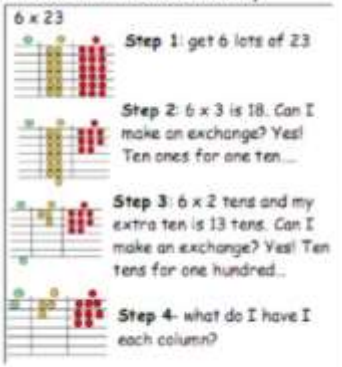


By placing a box around the array, as in the example below, and by removing the array, the grid method can be seen.

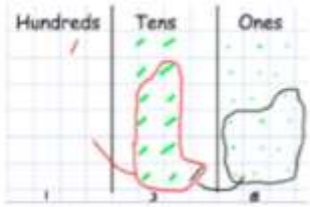


Year Four multiplication: moving into a formal method.

Formal column method with place value counters (children need this stage, initially, to understand how the column method works)



Children to represent the counters/base 10, pictorially e.g. the image below.



The aim is to get to the formal method but the children need to understand how it works.

$$6 \times 23 = \begin{array}{r} 23 \\ \times\ 6 \\ \hline 138 \\ \hline 1\ 1 \end{array}$$

Year Four and Year 5: short multiplication

Children on step four will then progress onto using a formal standard written method for multiplication:

- TU x U (units first) * Leading to HTU x U

$$\begin{array}{r} 23 \\ \times\ 7 \\ \hline 161 \\ \hline 2 \end{array} \qquad \begin{array}{r} 452 \\ \times\ 6 \\ \hline 2712 \\ \hline 31 \end{array}$$

Multiplication - Year Five/Six

Year Four and Year 5: short multiplication

Children on step four will then progress onto using a formal standard written method for multiplication:

- TU x U (units first) * Leading to HTU x U

$$\begin{array}{r} 23 \\ \times\ 7 \\ \hline 161 \\ \hline 2 \end{array} \qquad \begin{array}{r} 452 \\ \times\ 6 \\ \hline 2712 \\ \hline 31 \end{array}$$

Multiplication - Year Five/Six cont.

Year Five and Year Six: multiplication with decimals.

Children should also be using this method to solve problems and multiply numbers in the context of money or measures.

This method will then lead to multiplication of numbers involving decimals. Estimation by rounding will be encouraged first.

4.62 x 3 = ?

```
  4. 62
x    3
 13.86
  1
```

They should also be using this method to solve problems and multiply numbers, including those with decimals, in the context of money or measures, e.g. to calculate the cost of 7 items at £8.63 each, or the total length of six pieces of ribbon of 2.28m each.

Year Five and Year Six: Long multiplication

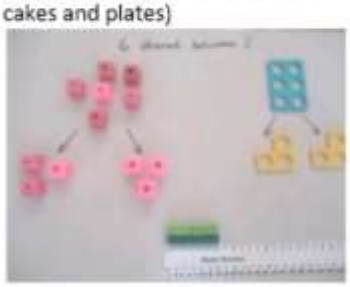
Then multiplying four digit numbers by a two digit number using the long written method e.g.

```
  352
x  27
 2464
7040
9504
 1
```

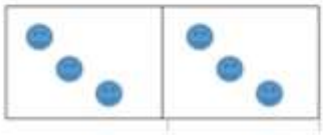
Division – Year One/Two

Year One division: sharing

6 shared between 2 (other concrete objects can also be used e.g. children and hoops, teddy bears, cakes and plates)



This can also be done in a bar so all 4 operations have a similar structure:



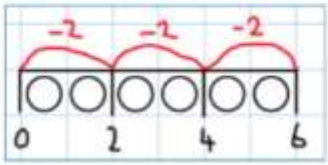
6 ÷ 2 = 3

What's the calculation?

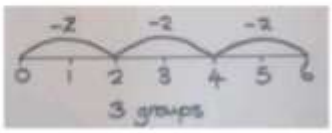
3	3

Year Two division: repeated grouping and subtraction

Understand division as repeated grouping and subtracting
6 ÷ 2



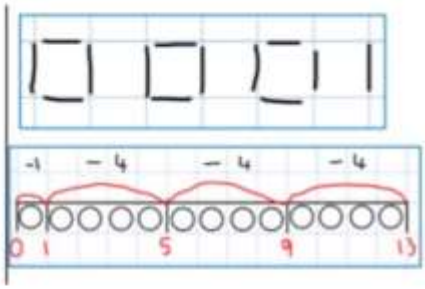
Abstract number line



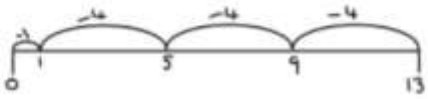
Year Two division: answers with remainders

13 divided by 4 =

Use of lollipop sticks to form wholes



Children to count their times tables facts in their heads



Division – Year Three

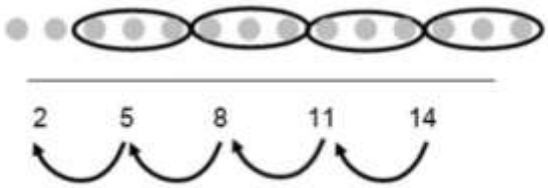
Year Three division

Initially, children will continue to use division by grouping (including those with remainders), where appropriate linked to the multiplication tables that they know (2, 3, 4, 5, 8 and 10), e.g.

43 ÷ 8 =

43 ÷ 8 = 5 remainder 3

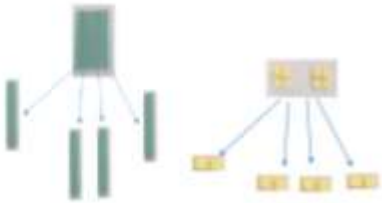
14 ÷ 3 = 4 remainder 2



Year Three division: partitioning

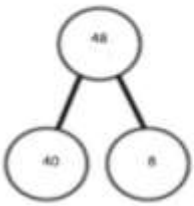
Two digit numbers divided by 1 digit (no remainders) using base 10. Partition the two digit number into tens and ones and then divide by the single digit.

48 ÷ 4 = 12



Start with the tens.

48 ÷ 4



4 tens ÷ 4 = 1 ten
8 ones ÷ 4 = 2 ones

10 + 2 = 12

Division – Year Three cont.

Year Three division: partitioning

Partition the numbers into tens and ones and then divide by the single digit:

Moving onto abstract calculations with partitioning using known number facts e.g.

42 ÷ 3

42 = 30 + 12

30 ÷ 3 = 10

12 ÷ 3 = 4

10 + 4 = 14

Division – Year Four/Five

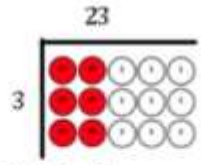
Year Four division: linking to arrays and grid method to move onto the short method.

Use place value counters and set out in short division form e.g.

69 ÷ 3 = 23

Check using multiplication inverse:
23 x 3 = 69

Extending divisions to resemble written method of short division.



69 ÷ 3 = 23

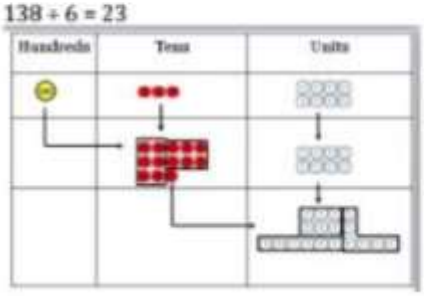
Short division.

$$3\overline{)69}\quad 23$$

Year Four and Year Five division: moving onto short method with exchanging.

Grouping and sharing using place value counters.
Exchanging counters which cannot be grouped.

138 ÷ 6 = 23



Short division methods.

$$6\overline{)138}\quad 023$$

(1 carried from the hundreds, 1 carried from the tens)

138 ÷ 6 = 23

432 ÷ 5 becomes

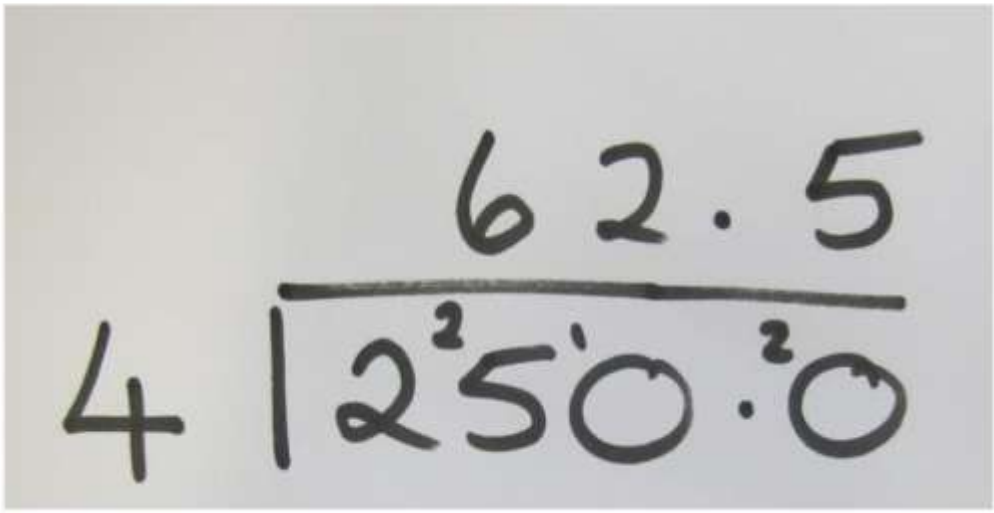
$$5\overline{)432}\quad 86\ r2$$

(3 carried from the hundreds)

Answer: 86 remainder 2

Division – Year Six

Year Six division: Short method showing the remainder as a fraction and a decimal.



Year Six: long division

$$\begin{array}{r} 0 \\ 12\overline{)2544} \end{array}$$

Step one- exchange 2 thousand for 20 hundreds so we now have 25 hundreds.

$$\begin{array}{r} 02 \\ 12\overline{)2544} \\ 24 \\ \hline 1 \end{array}$$

Step two- How many groups of 12 can I make with 25 hundreds? The 24 shows the hundreds we have grouped. The one is how many hundreds we have left.

$$\begin{array}{r} 021 \\ 12\overline{)2544} \\ 24 \\ \hline 14 \\ 12 \\ \hline 2 \end{array}$$

Exchange the one hundred for 10 tens. How many groups of 12 can I make with 14 tens? The 14 shows how many tens I have, the 12 is how many I grouped and the 2 is how many tens I have left.

$$\begin{array}{r} 0212 \\ 12\overline{)2544} \\ 24 \\ \hline 14 \\ 12 \\ \hline 24 \\ 24 \\ \hline 0 \end{array}$$

Exchange the 2 tens for 20 ones. The 24 is how many ones I have grouped and the 0 is what I have left.