All Saints' School Calculation Policy

The following calculation policy is based around the requirements and expectations of the National Curriculum 2014.

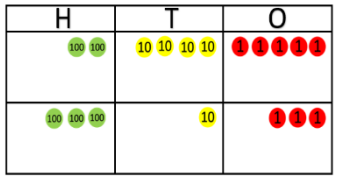
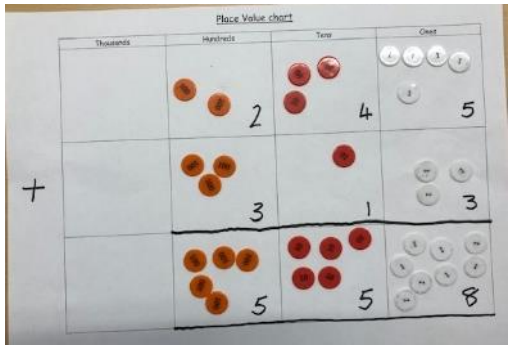
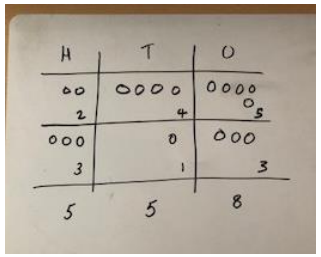
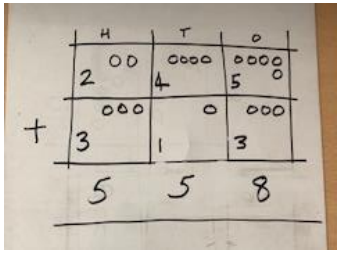
Its aim is to provide a smooth progression between year groups and teacher helping children to build on the skills that they develop during their time at All Saints'.

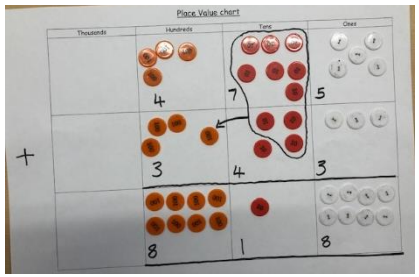
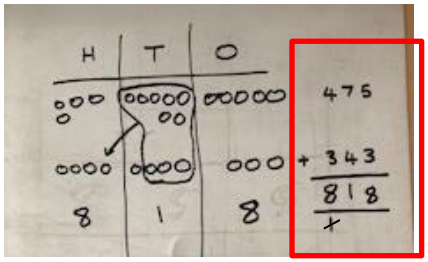
The National Curriculum for mathematics aims to ensure that all pupils:

- 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

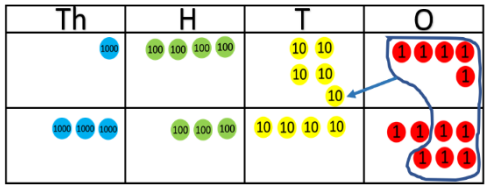
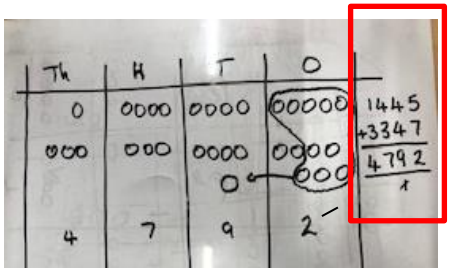
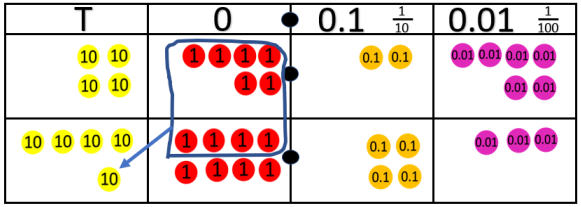
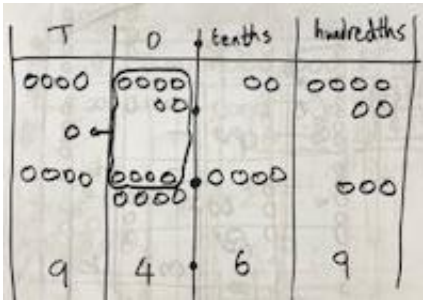
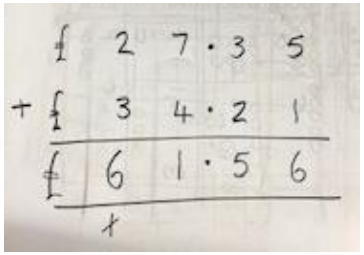
The National Curriculum 2014 requires all children to master the skills that they are developing before moving onto the next stage of their learning. So whilst the following information will be set out by year group it is important to remember that all children will need to be taught relative to their current level of attainment before moving on to the next objective.

Addition - Year 3

Objective	Concrete	Pictorial	Abstract
add with up to three digits, using formal written methods of columnar addition **Without Regrouping**	Using manipulatives such as place value counters, Cuisenaire rods, place value blocks, Numicon children line up hundreds, tens and ones.  245 + 313 = 558 Children are encouraged to write the calculation alongside the representation  	Children are encouraged to write down the calculation similar to how it has been modelled  They can then move on to using a layout similar columnar addition  	They move on to just using the formal method, they may need to use an expanded step before being completely secure with their understanding of the concrete method. $$\begin{array}{r} 200 + 40 + 5 \\ + \quad 300 + 10 + 3 \\ \hline 500 + 50 + 8 \end{array}$$ $$\begin{array}{r} 245 \\ + \quad 313 \\ \hline 558 \end{array}$$

<table>
<tr>
<td>With Regrouping</td>
<td>475 + 343 = 818
 
Once the counters are combined, the children can exchange 10 tens counters for a hundred counter giving them the information they need to complete the addition calculation. Being able to see this in front of them helps in their understanding.</td>
<td>Children are given the opportunity to model the calculation without counters circling the counters and then showing where they can be exchanged
 
This can then be extended to modelling the written method alongside the calculation</td>
<td>Children may require an expanded step before moving onto the concrete method
$$\begin{array}{r} 400 + 70 + 5 \\ +\ 300 + 40 + 3 \\ \hline 700 + 110 + 8 \end{array}$$
Children complete the formal method with exchanging where necessary.
$$\begin{array}{r} 475 \\ +\ 343 \\ \hline 818 \\ \hline \overset{1}{\not{1}} \end{array}$$</td>
</tr>
<tr>
<td colspan="4">Calculations can be provided to the children where exchanging can happen in one or all of the columns. Usually children progress from exchanging with the one to tens to hundreds and then multiple columns.</td>
</tr>
<tr>
<td colspan="4"><u>VOCABULARY</u>
addition add, more, and make, sum, total, altogether, double, near double, half, halve, one more, two more … ten more … one hundred more, how many more to make …? how many more is … than …? how much more is …? equals, is the same as, number bonds/pairs/facts, missing number, tens boundary, hundreds boundary, addend</td>
</tr>
</table>

Addition - Year 4

Objective	Concrete	Pictorial	Abstract
add numbers with up to 4 digits using the formal written method of columnar addition	Using manipulatives such as place value counters, Cuisenaire rods, place value blocks, Numicon children line up hundreds, tens and ones.  1445 + 3347 = 4792 Children are encouraged to write the calculation alongside the representation	Children are given the opportunity to model the calculation without counters circling the counters and then showing where they can be exchanged to  This can then be extended to modelling the written method alongside the calculation	Children complete the formal method with exchanging where necessary. 1445 + 3347 4792 1
including decimals	 46.26 + 48.43 = 94.69 This can also be related to money.	 Again children should be encouraged to model the written calculation alongside their working.	

VOCABULARY

addition add, more, and make, sum, total, altogether, double, near double half, halve one more, two more… ten more… one hundred more how many more to make …? how many more is … than …? how much more is …? equals, is the same as, number bonds/pairs/facts, missing number, ones boundary, tens boundary, hundreds boundary, thousands boundary, tenths boundary, addend

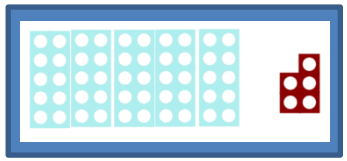
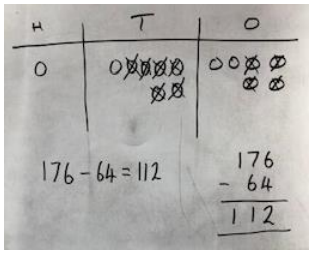
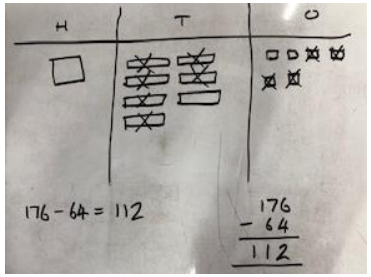
Addition - Year 5/6

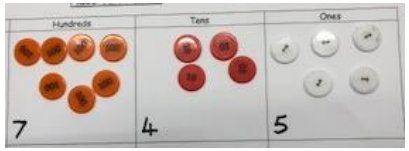
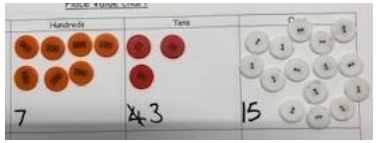
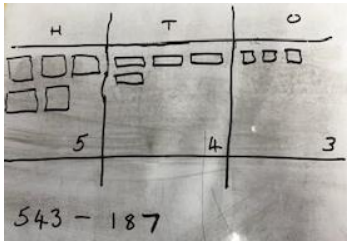
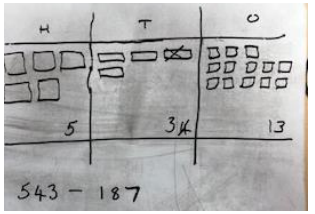
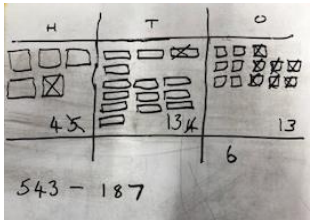
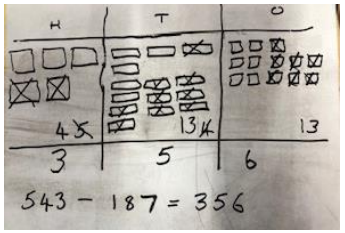
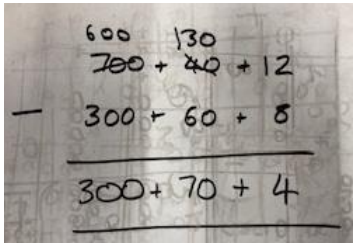
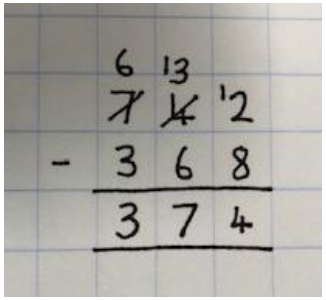
Objective	Concrete	Pictorial	Abstract
add whole numbers with more than 4 digits using formal written methods	See Year 4 and extend columns where necessary	See Year 4 and extend columns where necessary	144 562 + 502 489 547 051 *1 11*
add several numbers of increasing complexity, including adding money, measure and decimals with different numbers of decimal points	See Year 4 and extend rows if necessary	See Yr 4 and extend rows here necessary	Children can apply the formal method to suit the needs of the calculation £ 14.45 £ 3.47 + £ 524.89 £ 542.82 *1 1 2* 218.452 73.820 + 1524.800 1817.072 *1 1 2* Children can insert place holders to aid with the lay out of the calculation

VOCABULARY

addition add, more, and make, sum, total, altogether, double, near double half, halve one more, two more… ten more… one hundred more how many more to make …? how many more is … than …? how much more is …? equals, is the same as, number bonds/pairs/facts, missing number, ones boundary, tens boundary, hundreds boundary, thousands boundary, etc … tenths boundary, hundredths boundary, addend

Subtraction - Year 3

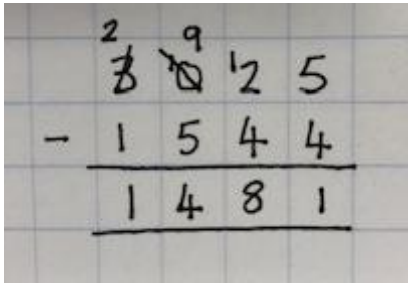
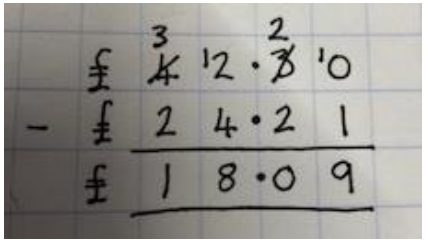
Objective	Concrete	Pictorial	Abstract
To subtract numbers with up to three-digits, using formal written methods of columnar subtraction Column subtraction (without exchanging)	Use base 10 or Numicon to model the subtraction 55 – 22  	Once children are secure with Base 10 / Numicon and PV counters they can move on to recording pictorially  Children are encouraged to write the calculation down alongside their representation They could also draw base ten representations if they wanted to 	Children my need to use an expanded step before being completely secure with their understanding of the concrete method. 58 – 26 = 32 50 + 8 - 20 + 6 30 + 2 5 8 - 2 6 3 2

Column subtraction (with exchanging / regrouping)	Model the process of 745 – 317 using base 10 or PV counters. Ensure the language of exchanging an d regrouping is used. <u>Step 1:</u>  Start with the 1's column. Can 7 be taken from 5 easily? No - then exchange a ten for ten ones and regroup them into the correct column. <u>Step 2:</u>  Once this step is completed children can subtract / take off the relevant counters from each column. **Carefully chosen questions can extend children to exchanging and regrouping next in the tens column, then in both the tens and ones columns as appropriate.** They could also decompose a number	Children to model using their whiteboards: <u>Step 1:</u>  Set up calculation <u>Step 2:</u>  Exchange and regroup 10's for 1's <u>Step 3:</u>  Cross out ones to indicate subtraction has taken place, write new amount of ones underneath and then focus on tens column exchanging and regrouping a hundred for ten tens <u>Step 4:</u>  Cross out the tens to show subtraction, write the amount left underneath and then repeat with the hundreds column to complete the calculation.	Children my need to use an expanded step before being completely secure with their understanding of the concrete method.  

VOCABULARY

minuend, subtrahend, equal to, take, take-away, less, minus, subtract, leaves, distance between, how many more, how many fewer/less than, most, least count back, how many left, how much less is…difference, count on, strategy, partition, tens units, exchange, decomposition, regroup, how many have gone? one less, two less, ten less … one hundred less how many fewer is … than …?

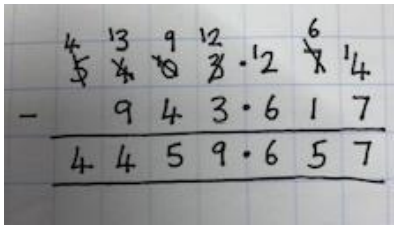
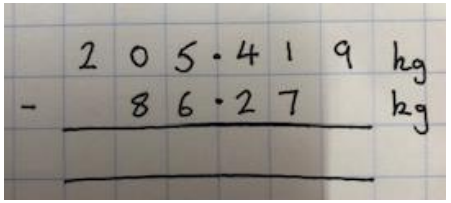
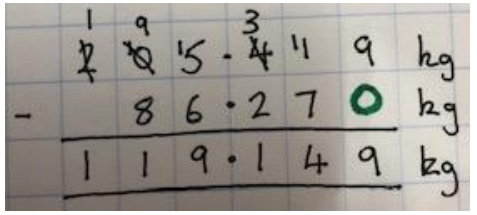
Subtraction - Year 4

Objective	Concrete	Pictorial	Abstract
Subtract numbers with up to 4 digits using the formal written methods appropriate of columnar subtraction where appropriate Year 4 subtraction with up to 4 digits.	See Year 3 with extension into the thousand's column	See Year 3 with extensions into the thousand's columns	
Introduce decimal subtraction through context of money	See Year 3 with extension into the tenths and hundredths columns	See Year 3 with extensions into the tenths and hundredths columns	

VOCABULARY

minuend, subtrahend, equal to, take, take-away, less, minus, subtract, leaves, distance between, how many more, how many fewer/less than, most, least count back, how many left, how much less is…difference, count on, strategy, partition, tens units, exchange, decomposition, regroup, how many have gone? one less, two less, ten less … one hundred less how many fewer is … than …? Inverse, ones boundary, tens boundary, hundreds boundary, tenths boundary

Subtraction - Year 5/6

Objective	Concrete	Pictorial	Abstract
Subtract with at least 4 digits, including money and measures. Subtract with increasingly large and more complex numbers and decimal values (up to 3 decimal place).	See Year 3 with extensions into the relevant columns where necessary	See Year 3 with extensions into the relevant columns where necessary	  When the amount to subtract is different in size then children can put in a 0 to help complete the calculation 

VOCABULARY

minuend, subtrahend, equal to, take, take-away, less, minus, subtract, leaves, distance between, how many more, how many fewer/less than, most, least count back, how many left, how much less is…difference, count on, strategy, partition, tens units, exchange, decomposition, regroup, how many have gone? one less, two less, ten less … one hundred less how many fewer is … than …? Inverse, ones boundary, tens boundary, hundreds boundary etc … tenths boundary, hundredths boundary

Multiplication - Year 3

Objective

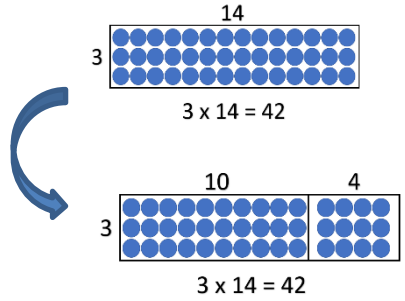
Multiplying two digit number by a one digit number

Grid method progressing to the formal method.

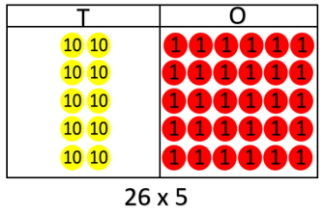
Concrete

Children to make the links between arrays and multiplication building on their knowledge from last year

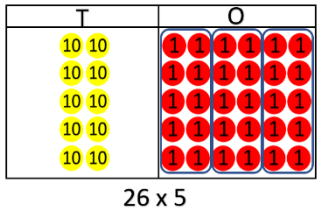
3x14 can be arranged in a grid to make calculating it easier



Children can use place value counters, base 10 or any other resource to calculate groups of a number



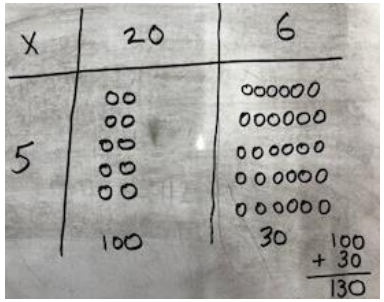
They can then make any exchanges that they need to



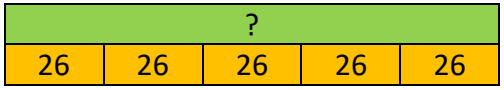
Pictorial

Children can represent their work with place value counters in a way that they understand.

They can draw the counters using colours to show different amounts or just use the circles in the different columns to show their thinking as shown below



Bar Models can also be used as an appropriate representation which may help to cement the relationship with repeated addition and also support learners when solving problems.



Abstract

Children can use the grid method to calculate e.g.

3 x 24

x	20	4
3	60	12

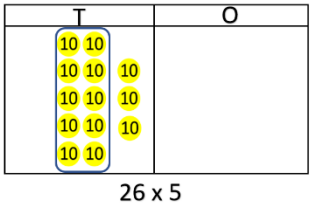
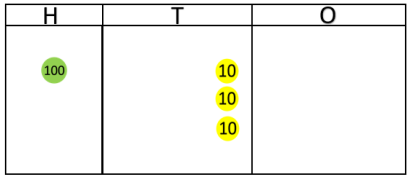
60 + 12 = 72

Before moving on to the expanded method:

$$\begin{array}{r} 24 \\ \times\ 3 \\ \hline 12 \\ 60 \\ \hline 72 \\ \hline \end{array} \quad \begin{array}{l} \\ \\ (4 \times 3) \\ (20 \times 3) \\ \\ \\ \end{array}$$

then the compact method:

$$\begin{array}{r} 24 \\ \times\ 3 \\ \hline 72 \\ \hline \not{1} \end{array}$$

	 26 x 5  26 x 5 = 130 Giving them the final answer		

When introducing any new calculation method, it is always important to start with questions that involve no regrouping before introducing it slowly and only with one column at a time. This will help to build the children's confidence in the method leading to a more secure understanding.

VOCABULARY

multiplication, multiply, multiplied by, multiple, factor, groups of, times, multiplier, multiplicand, product, once, twice, three times … ten times repeated addition, array, row, column, number patterns, multiplication table, multiplication fact,

Multiplication - Year 4

Objective

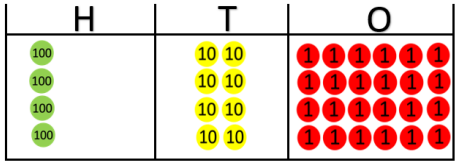
Grid method recap from Year 3 for 2 digits x 1 digit moving on to 3 digit x 1 digit number

Multiplying 3-digit numbers by 1 digit

Multiply two-digit and three-digit numbers by a one-digit number using formal written layout

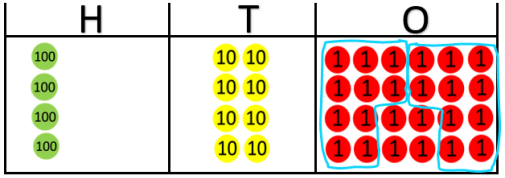
Concrete

Place value counters can be used to explore the calculation.
As the calculation is 126 x 4 then there needs to be 4 rows. The number is partitioned and the rows are created with the place value counters

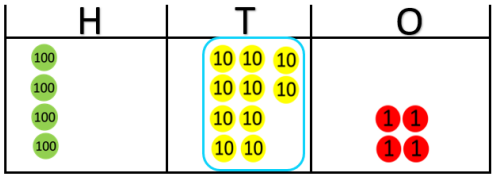


4 x 126

Any exchanges are then made before adding up the rows.

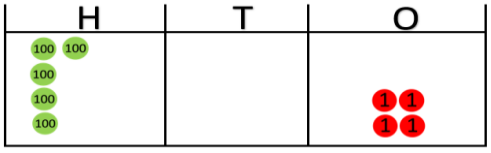


4 x 126



4 x 126

Giving the final answer

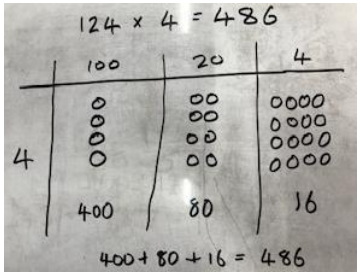


4 x 126 = 504

Pictorial

Children can represent their work with place value counters in a way that they understand.

They can draw the counters using colours to show different amounts or just use the circles in the different columns to show their thinking as shown below
(as an extension of what they learnt in Yr 3)



The grid method can be used to support the expanded form and help children to recognise the links between the two

Abstract

Children can use the grid method to calculate e.g.

4 x 124

x	100	20	4
4	400	80	16

400+80+16 = 496
(This could be added using the column method although quick mental additions would be more efficient)

Before moving on to a more formal method:

```
  1 2 4
X   4
-------
  1 6    (4 x 4)
  8 0    (20 x 4)
4 0 0    (100 x 4)
-------
4 9 6
-------
```

then the compact method:

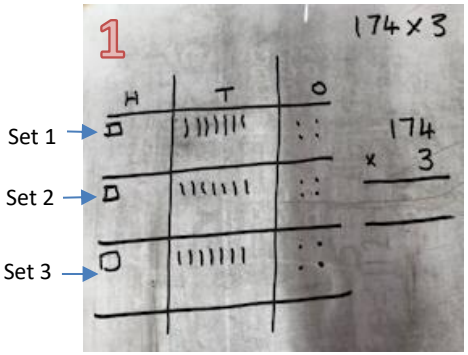
```
  1 2 4
X   4
-------
  4 9 6
-------
  1
```

The concrete and pictorial methods can also be used to further support the compact method. It is important to remind children to calculate first with the ones column and then move up to help support understanding of the compact method.

<u>Step 1:</u>

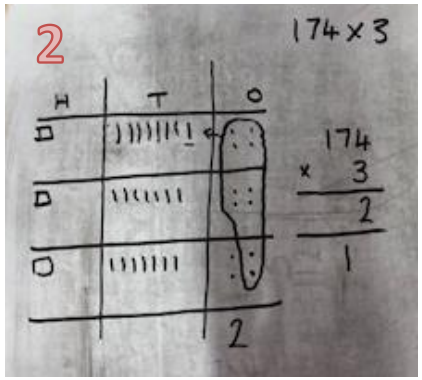
Set out the calculations alongside each other

There are 3 sets of 174



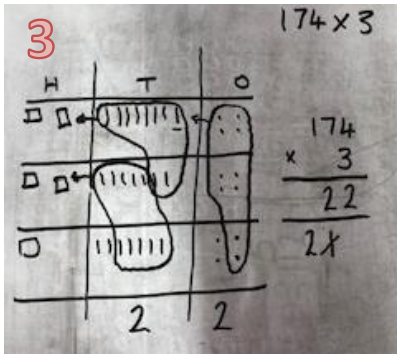
<u>Step 2:</u>

Make the exchange in the ones column (if needed) and show the link between that and the multiplication calculation in the compact method, recording as necessary



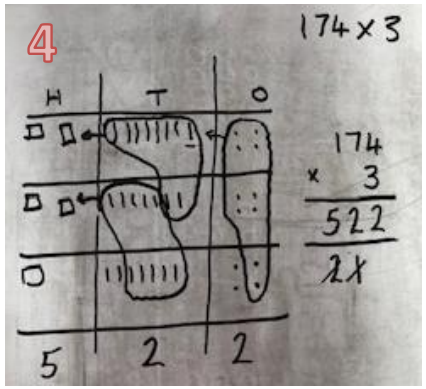
<u>Step 3:</u>

Move on to the tens column and repeat with the exchanges where needed and show the link between that and the multiplication calculation in the compact method recording as necessary

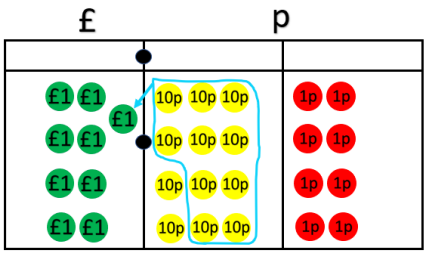


<u>Step 4:</u>

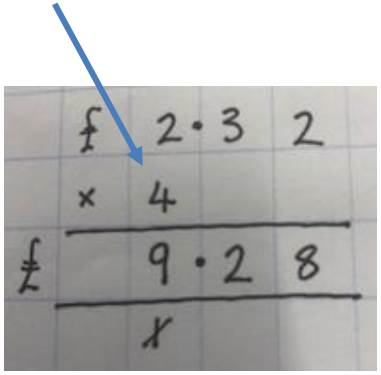
Complete the hundreds column again making the link between the pictorial and the Calculation before recording



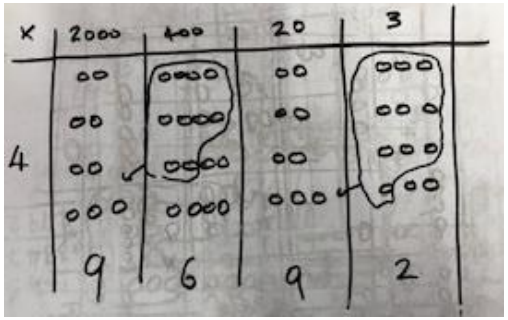
<table>
<tr>
<td>Multiplication involving decimals (inc. money)

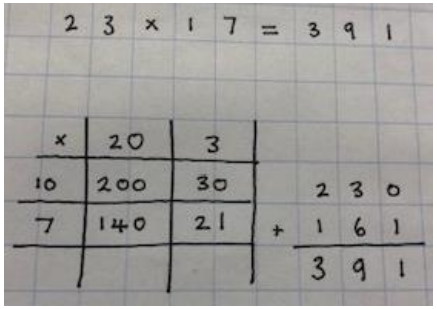
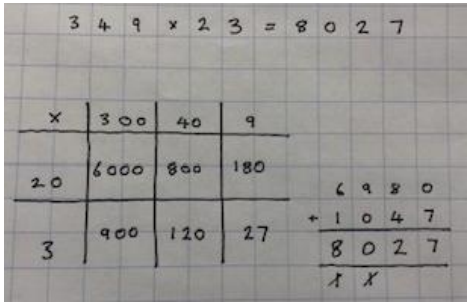
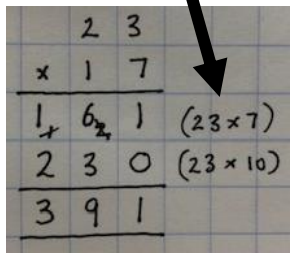
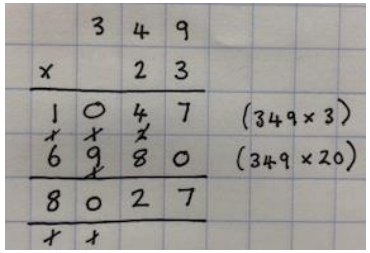
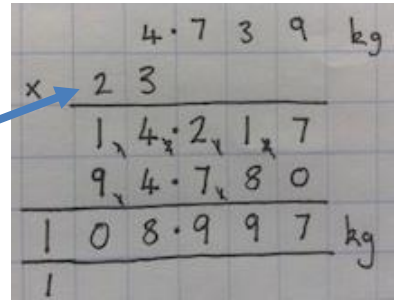
Multiply decimal up to 2 decimal places by a single digit.</td>
<td>Use manipulatives to calculate the amount.
Make exchanges where necessary.
Total up the final amount.
Again, use the written example alongside the manipulative wherever possible.
 

£2.32 x 4 = £9.28</td>
<td>The grid method could be used to provide extra support however teachers and children must be wary of how the children record the amounts, or convert amounts, to ensure mistakes are not made.

<table><tr><td>x</td><td>£2</td><td>30p</td><td>2p</td></tr><tr><td>4</td><td>£8</td><td>120p
or
£1.20</td><td>8p</td></tr></table></td>
<td>Teachers to ensure the correct placement of the 4 in terms of a decimal caclulation
 
</td>
</tr>
<tr>
<td colspan="4"><u>VOCABULARY</u>
multiplication, multiply, multiplied by, multiple, factor, groups of, times, multiplier, multiplicand, product, once, twice, three times … ten times repeated addition, array, row, column, number patterns, multiplication table, multiplication fact, square, squared, cube, cubed</td>
</tr>
</table>

Multiplication - Year 5/6

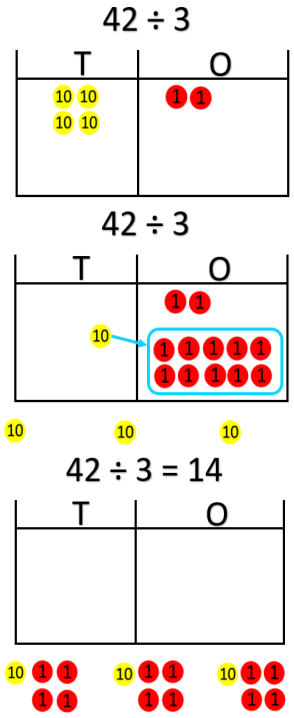
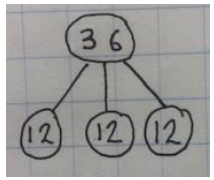
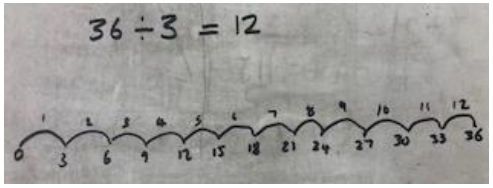
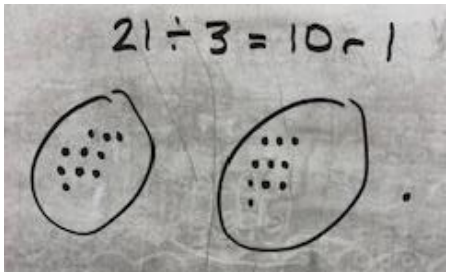
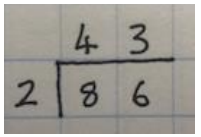
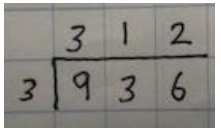
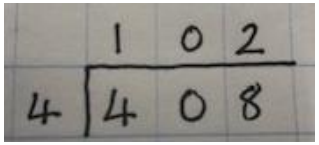
Objective	Concrete	Pictorial	Abstract
Column multiplication for 3 and 4 digits x 1 digit Multiply numbers up to 4-digits by a one-digit number using the format written method, *(including long multiplication for 2-digit numbers – see below)*	Children can represent their work with place value counters in a way that they understand. It is important to remind children to calculate first with the ones column and then move up to help support understanding of the compact method. (see Yr 4)	They can draw the counters using colours to show different amounts or just use the circles in the different columns to show their thinking as shown below (as an extension of what they learnt in Yr 4) 	Children can use the grid method to calculate e.g. x | 2000 | 400 | 20 | 3 4 | 8000 | 1600 | 80 | 12 8000 + 1600 + 80 + 12 = 9692 (This could be added using the column method or mentally) Before moving on to a more formal method: 2 4 2 3 x 4 1 2 (3 x 4) 8 0 (20 x 4) 1 6 0 0 (400 x 4) 4 0 0 0 (2000 x 4) 9 6 9 2 then the compact method: 2 4 2 3 x 4 9 6 9 2 1 1

Column multiplication (long multiplication)	Manipulatives can still be used to support calculations – but should always be used alongside the multiplication model	The grid method can be used to support the understanding of the rows alongside the method for long multiplication   Children will also complete calculations involving decimals. See how multiplier obeys the value of the column it is in, in relation to the multiplicand.	Here the rows from the grid method are shown using the brackets. Eventually these will not be needeed.   

VOCABULARY

multiplication, multiply, multiplied by, multiple, factor, groups of, times, multiplier, multiplicand, product, once, twice, three times … ten times repeated addition, array, row, column, number patterns, multiplication table, multiplication fact, square, squared, cube, cubed

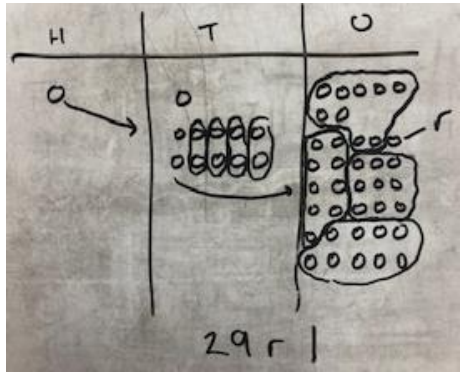
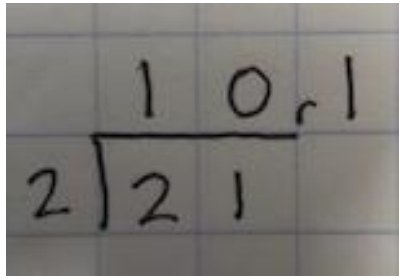
Division - Year 3

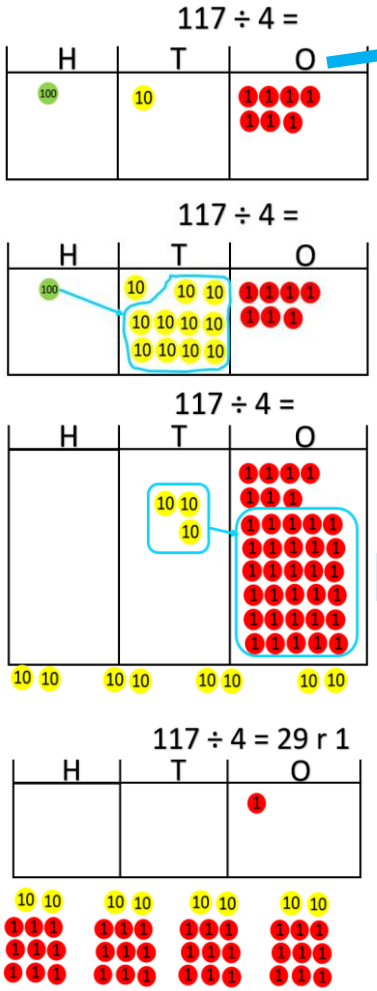
Objective	Concrete	Pictorial	Abstract
division using known multiplication facts	Children can use Numicon/ Base 10/Place value Counters to identify division facts 24 ÷ 4 = 6  Numicon can be used to support known multiplication facts if children are struggling. Children can use place value counters and then split the number up int 3 groups starting with the 10s. They can exchange if necessary and then split up the remaining ones. This can be a big help when moving onto the short division method 	36 ÷ 3 = 12 Children can use the part – whole model  Or draw a number line to help solve the calculation  Children can use the dots in circles method as well to support but should be encouraged to count in multiples and move on to a more efficient method 	Begin with divisions that divide equally with no remainder   Children should be aware that a 0 is used to keep place value, if the number is not divisible. 

VOCABULARY

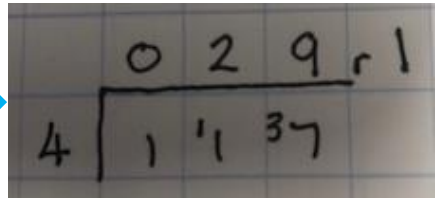
dividend, divisor, quotient, division, dividing, divide, divided by, divided into, left, left over, remainder, grouping, sharing, share, share equally, one each, two each, three each … ten each, group in pairs, threes … tens, equal groups of, doubling, halving, array row, column number patterns, division fact, inverse,

Division - Year 4

Objective	Concrete	Pictorial	Abstract
Divide up to 3 digit numbers by 1 digit. Short Division inc. division with remainders	Children can use PV Counters/base 10 or Numicon to help calculate. Exchanging may be needed to support calculations **Step 1** Create amount **Step 2** Exchange 100's **Step 3** Group 10s and exchange the rest **Step 4** Group 1's identify the remainder Complete calculation		Children can start with remainders that are simple and can be seen in other ways to help make links between calculations they are familiar with and the short division method 



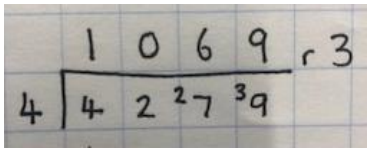
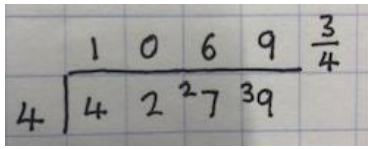
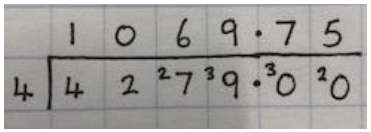
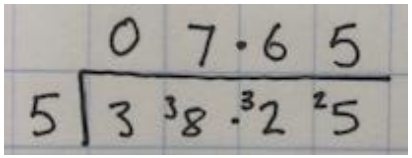
Children can become familiar with exchanging and carrying over any amounts that can not be divided by linking in how the numbers are exchanged to the amount recorded in the new column. It is important that whenever the children are using manipulatives that they are encouraged to write the equivalent calculation alongside to help develop these links and understanding



VOCABULARY

dividend, divisor, quotient, division, dividing, divide, divided by, divided into, left, left over, remainder, grouping, sharing, share, share equally, one each, two each, three each … ten each, group in pairs, threes … tens, equal groups of, doubling, halving, array row, column number patterns, division fact, inverse

Division - Year 5/6

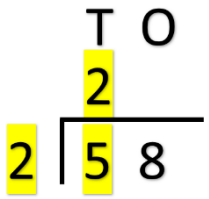
Objective	Concrete	Pictorial	Abstract
divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders	As Year 4	As Year 4	Children understand that remainders can be interpreted in a number of ways depending on the context. They can either be a straight remainder  Presented as a fraction  Or completed as a decimal by extending into decimal places  Children should also be made aware of how decimal numbers can also be divided using this method 

divide numbers up to 4 digits by a two-digit whole number using the formal written method of **long division**, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context

By the time children learn this method they should be secure in their understanding of short division an how to complete calculations quickly and effectively.

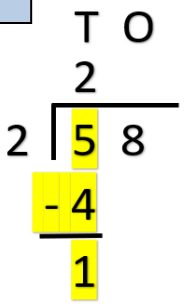
When starting to approach Long division starting with a single digit as the divisor can help children become familiar with the method. Taking out the calculation worries can help to make the children more comfortable

1. DIVIDE



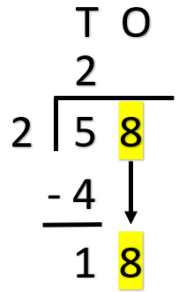
2 goes into 5 2 times or 5 tens
÷ 2 = 2 tens
But there is a remainder!

2. MULTIPLY AND SUBTRACT



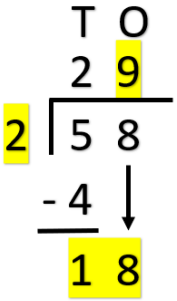
To find the remainder multiply 2 by 2 and get 4. Write that underneath the tens column and subtract it to get the remainder of 1 ten

3. DROP



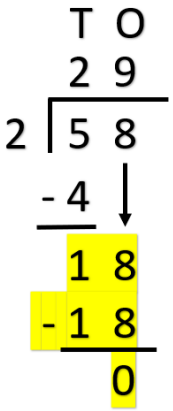
Next drop down the 8 in the ones column and write it next to the 1 in the tens. Combine them and you have 18

1. DIVIDE



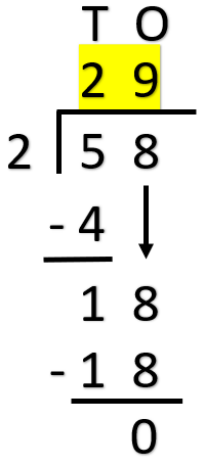
Divide 2 into 18, place 9 in the quotient

2. MULTIPLY AND SUBTRACT



Multiply 9 x 2 = 18
Write that 18 underneath and subtract to get 0

3. DROP



The division is over since there are no more digits in the dividend.
The quotient is 29.

The same method can then be transferred to two digit dividends. Using this link will help children to become more secure with long division.

VOCABULARY

dividend, divisor, quotient, division, dividing, divide, divided by, divided into, left, left over, remainder, grouping, sharing, share, share equally, one each, two each, three each … ten each, group in pairs, threes … tens, equal groups of, doubling, halving, array row, column number patterns, division fact, inverse

Appendix 1: Overview of the calculations and the year group in which they are introduced

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Addition	Solve problems through practical methods use of numberlines/100 squares etc.	Partition numbers to aid addition – start to arrange in columns	Introduce column addition with numbers up to 3 digits and numbers with 1 decimal place	Column method - 4 digits – and numbers with up to 2 decimal places	Column method more than 4 digits	Multi digit calculations
Subtraction	Solve problems through practical methods use of number lines/100 squares etc.	Partition to aid subtraction – use of numberlines and 100 squares	Introduce column subtraction (decomposition) up to 3 digits – and numbers with up to 2 decimal places	Column method 4 digits– and numbers with up to 2 decimal places	Column method more than 4 digits	Multi digit calculations
Multiplication	Solve problems through practical methods and knowledge of tables including using the signs x and = correctly	Use arrays / repeated addition / multiplication facts / practical resources including using the signs x and = correctly	Efficient written method -2 digit by 1 digit column method 38 × 7 266 1 3	Efficient methods 2 and 3 digit numbers by 1 digit number	4 digit numbers by 1 and 2 digits (long multiplication for 2 digits) Introduce long multiplication	Multiply multi-digit numbers up to 4 digits by a 2 digit whole number using long multiplication
Division	Solve problems through practical methods including using the signs = and ÷ correctly	Use arrays / repeated addition and subtraction / division facts / practical resources including using the signs = and ÷ correctly	Introduce the efficient method 1 2 4 ⟌ 4 8 No remainders	Secure the efficient method – no remainders (Can include decimals)	Divide 4 digit by 1 digit numbers and interpret remainders appropriately for context (fractions or whole number remainders) Money as well	Divide up to 4 digits by a two digit whole number using long division

Appendix 2: Grading of Difficulty for questions

Below is a grid that lays out an order in which questions can be given to children looking at the difficulty of working out each operation.

Addition	Subtraction	Multiplication	Division
1.No carrying e.g. 23 315 + 42 + 624 2. Extra digit in answer e.g. 94 561 +73 + 718 3. Carrying ones to T (tens) e.g. 47 237 +25 +516 4. Carrying T to H e.g. 371 293 +485 +541 5. Carrying ones to T and T to H e.g. 376 295 +485 +547 6. More than two numbers to be added e.g. 463 921 +759 7. Different numbers of digits e.g. 23 4756 375 20375 + 48 + 752	1. No adjustment e.g. 47 864 - 23 - 621 2. Adjustment T to ones e.g. 52 432 - 36 -217 3. Adjustment H to T e.g. 437 618 -182 -217 4. Adjustment H to T and T to ones 432 - 187 5. Noughts e.g. 470 700 604 - 142 - 236 - 347	1. No carrying e.g. 32 44 x 3 x 2 2. Extra digit in answer e.g. 32 51 x 4 x 4 3. Carrying but keeping in same decade e.g. 23 x 4 4. Carrying and going into next decade e.g. 78 68 x 7 x 8 5. Noughts e.g. 202 430 x 4 x 6 6. Multiplying by multiples of 10 87 416 x 10 x 60 7. Long multiplication e.g. 47 832 x 23 x 74	1. Single digit division, no remainder, no carrying e.g. 69 ÷ 3 264 ÷ 2 2. Remainder, no carrying e.g. 68 ÷ 3 3. No remainder, carrying e.g. 45 ÷ 3 4. Remainder, carrying e.g. 47 ÷ 3 5. Placing of the quotient e.g. 287 ÷ 7 6. Noughts in quotient e.g. 816 ÷ 4 5608 ÷ 8 **Two-digit division** 7. No remainder e.g. 64 ÷ 32 93 ÷ 31 8. Similar but remainder e.g. 29 ÷ 13 97 ÷ 31 9. Quotient not so apparent e.g. 56 ÷ 22 92 ÷ 41 10. Placing the quotient e.g. 126 ÷ 21 224 ÷ 32 11. No remainder e.g. 483 ÷ 21 736 ÷ 32 12. Remainder e.g. 718 ÷ 33 13. Noughts in quotient e.g. 6834 ÷ 17 14. Divisors like 29, 39, 48 15. Divisors like 45, 37, 24, 56