This calculation policy has been devised to meet the requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a consistent and smooth progression of learning in calculations across the school. Please note that early learning in number and calculation in the Foundation Classes follows the 'Development Matters' EYFS document, and this calculation policy is designed to build on progressively from the content and methods established in the Early Years Foundation Stage.

Age stage expectations

The National Curriculum 2014 **suggests** the stage children should be working at in each year group however, **it is vital that pupils are taught according to the stage that they are currently working at,** being moved onto the next level as soon as they are ready, or working at a lower stage until they are secure enough to move on.

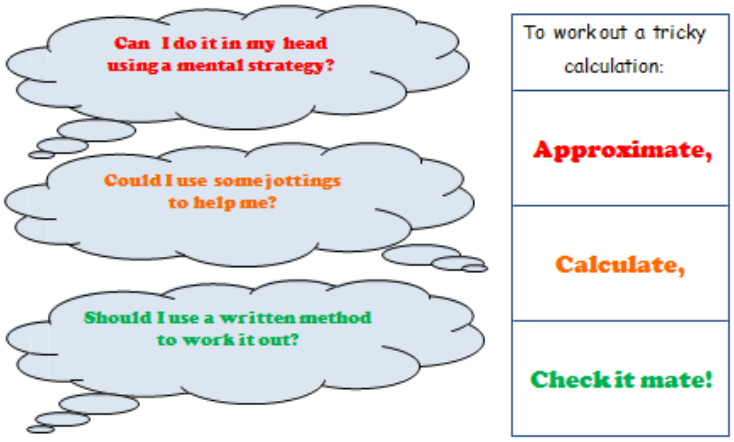
Providing a context for calculation:

It is important that any type of calculation is given a real life context or problem solving approach to

help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods when faced with problems. This must be a priority within calculation lessons.

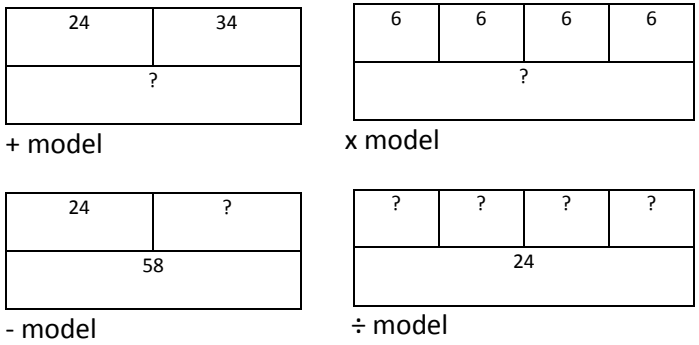
Choosing a calculation method:

Children need to be taught and encouraged to use the following processes when deciding what approach they will take to a calculation, to ensure they select the most appropriate method for the numbers involved:



R	Read
U	Underline
C	Calculate
S	Solve
A	Answer
C	Correct

RUCSAC



Bar models

Addition-To show progression through understanding of Addition, progression is shown as a 'stage' not a year group.

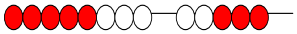
Stage 1

From the start teachers use bar model practical building and illustrations alongside calculations being created.

Encourage children to put the **larger** number in their head and count on.

Use number tracks to support one more. Use numberlines and practical resources to *support* calculations (abacus, bead strings, numicon, Dienes, Cuisinaire, multilink, compare bears).
Teachers *demonstrate* the use of the numberline and bar model diagrams alongside practical resources.

Children then begin to use numbered lines to support their own calculations using a numbered line to count on in ones.
Bead strings or bead bars are useful to illustrate addition including bridging through ten by counting on 2 then counting on 3.



Read and write the addition (+) and equals (=) signs within number sentences.

15 + 4 = ☐ 5 + 3 + 1 = ☐
☐ + ☐ = 6
This builds on from prior learning of adding by embedding 2 sets of objects into one group (5 cubes and 3 cubes) in Early Years.

Stage 2

Take this opportunity to illustrate the drawing of bar models and making bar models by using Dienes and Cuisinaire rods to show the bar models practically.

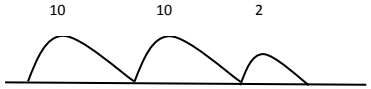
Children will begin to use 'empty number lines' themselves starting with the larger number and counting on.

Number Lines
For this, we draw an empty line with the largest number in the question on the left hand side.

56 + 22

56

Then, we **add on** the smallest number to the largest number. We can partition the smallest number, add the tens followed by the units:



56 66 76 78

And then look at where we land after adding the whole number on

56 + 10 + 10 + 2 = 78

Encourage children to do this mentally then with encouragement to do a 'jotting'

Stage 3

Word problems to be given so putting maths in a context. Bar models to be used alongside for identification of the calculation method to be used.

Partitioning
Children will begin to use informal pencil and paper methods (jottings) to support, record and explain partial mental methods building on existing mental strategies.

1. **47 + 76 = 123**
   40 + 7 + 70 + 6
   40 + 70 + 7 + 6
   110 + 13
   110 + 13 = 123
   100 +10 +13
   100 + 23

2. 47 + 76 =
   40 + 70 = 110
   7 + 6 = 13
   110 + 13 = 123

   47 + 76 = 123

3. Leading to

   4 0 + 7
   7 0 + 6
   1 1 0 + 1 3 = 123

Stage 4

By this stage the children should be confident in using a bar model to identify in word problems the calculation method that is needed.

The Expanded Column Method
We set the calculation out in a column, rather than a line. We 'partition' each number and add the parts together one step at a time.

56 + 22 =
T U
50 6 +
20 2
70 8
70 + 8 = 78

586.4 + 334.7 =
H T U . 1/10
100 10 1 (Carrying to top of column)
500 80 6 . 4 +
300 30 4 . 7
900 20 1 . 1
900+20+1+0.1 = 921.1

The method is the same whatever the type of number

Compact Columnar Method
Once the children feel more confident with addition and their place value reasoning, they can use the Compact Columnar method. This is another 'vertical' method, but has less steps than the Expanded Column method.

H T U
1
5 9 2
3 3 4
9 2 6

Children should understand why the digit is carried here due to the work on place value and use of the expanded method.

When adding the tens (**T**), we have more than 100, 90 + 30 equals 120 so we have crossed the hundreds boundary. This is when we need to use 'carrying' and carry the extra 100 into the hundreds (**H**) place value column, adding it underneath the calculation and recording the two tens in the tens column.

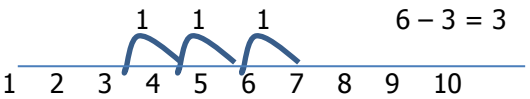
The method remains the same whatever the type of number.

Subtraction-To show progression through understanding of Subtraction, progression is shown as a 'stage' not a year group.

Stage 1

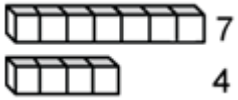
From the start teachers use bar model practical building and illustrations alongside calculations being created.

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 numberlines and practical resources to support calculation. Teachers *demonstrate* the use of the numberline.



The number line should also be used to show that 6 - 3 means the 'difference between 6 and 3' or 'the difference between 3 and 6' and the *difference in value* between the numbers.

Use the language '**find the distance between', 'find the difference between'** and '**how many more?**' in a range of familiar contexts e.g.



'Seven is 3 more than four.'

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

Stage 2

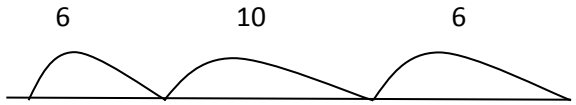
Take this opportunity to illustrate the drawing of bar models and making bar models by using Dienes and Cuisinaire rods to show the bar models practically.

Empty Number Lines
For this, we draw an empty line with the smallest number in the question on the left hand side and the largest on the right
Eg.
56 – 34

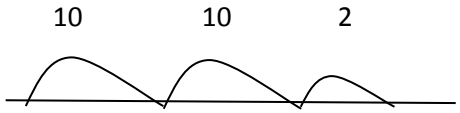
34 **56**

Then, we **count on** from the smallest number to the largest number.

We can **count on** to the next whole ten first, then count on to the next multiple of ten and so on:



And then add together the amounts we have jumped
10 + 6 + 6 = 22
56 – 34 = 22
Or
We can **count on** in tens from the starting number like so, adding the extra units at the end:



10 + 10 + 2 = 22
56 – 34 = 22

Stage 3

By this stage the children should be confident in using a bar model to identify in word problems the calculation method that is needed.

The Expanded Column Method
For this method, we set the sum out in a column, rather than a line. We still **count on** to find the difference, by counting to get to the next whole number, then the next whole ten, the next whole hundred and so on, depending on how big the numbers are!

89 – 23 =

	T	U
	80	9
	20	3 -
	60 + 6 = 66	

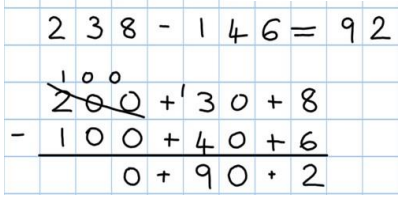
STEP 1: introduce this method with examples where **no exchanging** is required.

STEP 2: introduce 'exchanging' through practical subtraction. Make the larger number with Base 10, then subtract 47 from it.

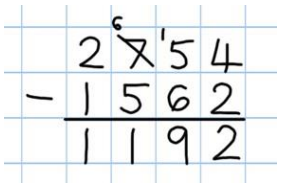
72 - 47

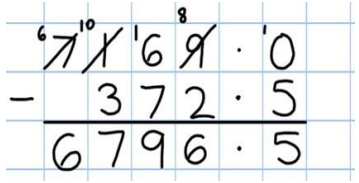
Before subtracting 7 from the 72 blocks, they will need to exchange a row of Ts for 1s then subtract 7 then subtract 4 tens.

STEP 3: Once pupils are Secure with the understanding Of 'exchanging', they can use The partitioned column method to subtract any 2 and 3-digit numbers.



Columnar Method
To introduce the compact method, ask children to perform a subtraction calculation with the familiar partitioned column subtraction then display the compact version for the calculation they have done. Ask pupils to consider how it relates to the method they know, what is similar and what is different, to develop an understanding of it. As they gain confidence increase the integers and then introduce decimals.





Multiplication-To show progression through understanding of multiplication, progression is shown as a 'stage' not a year group.

Stage 1

From the start teachers use bar model practical building and illustrations alongside calculations being created.

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

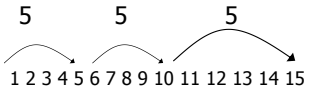
Children will develop their understanding of multiplication and use jottings to support calculation:

Repeated addition

3 times 5 is
5 + 5 + 5 = 15 or
3 lots of 5 or
5 x 3

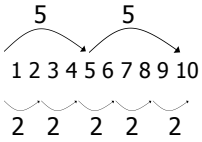
Repeated addition can be shown easily on a number line:

5 x 3 = 5 + 5 + 5



Commutativity

Children should know that 2 x 5 has the same answer as 5 x 2. This can also be shown on the number line.



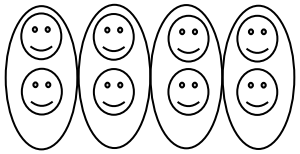
Stage 3

Take this opportunity to illustrate the drawing of bar models and making bar models by using Dienes and Cuisinaire rods to show the bar models practically.

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

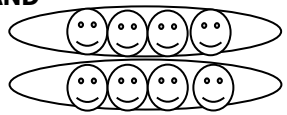
5x3=15

3x5=15



Two multiplied by four equals 8
2 x 4 = 8

AND



Four multiplied by two equals 8
4 x 2 = 8

Stage 4

Continue representing calculations with bar model diagrams alongside

Multiplying and Dividing by 10

Children need to understand how to multiply and divide by ten to help with their general multiplication – this way they can use multiplication facts they know to help work out related facts.

It is easy to remember how to multiply and divide by 10

- When *multiplying* by 10, the digits move one place to the *left* (and a place holder – 0 – is added when it was a whole number being multiplied by 10)
- When dividing by 10, the digits move one place to the right

Scaling

H	T	U	•	1/10s	
	4	2	•	0	
4	2	0	•	0	(42 x 10)
	4	2	•	0	
		4	•	2	(42 ÷ 10)

e.g. Find a ribbon that is 4 times as long as the blue ribbon

5cm

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

☐ x 5 = 20 3 x △ = 18 ☐ x O = 32

Partitioning

For a simple 2-digit x 1-digit question, the children can break down (partition) the 2-digit number into parts (tens and units) to help calculate the answer in smaller steps

13 x 6 =

Tens Units

10 + 3 x 6

60 + 18 = 78

Stage 5

Continue representing calculations with bar model diagrams alongside

The Grid Method

Children will still be using arrays which leads into the grid method

14 x 6 =

X 10 4

OOOOOOOOOOOOO
OOOOOOOOOOOOO
OOOOOOOOOOOOO 6
OOOOOOOOOOOOO
OOOOOOOOOOOOO
OOOOOOOOOOOOO

(10 x 6) + (4 x6)

60 + 24 = 84

Draw a simple grid and break down (partition) the number in the calculation. The numbers in the calculation are partitioned and multiplied in several parts (creating the partial products) and then the parts need to be added together to find the final answer (product) of the original calculation.

23 x 8 x 20 3

8 160 24

160 + 24 = 184

23 x 8 = 184

At this stage children should be given the opportunity to approximate their answers and then compare to the actual answer.

Stage 6

By this stage the children should be confident in using a bar model to identify in word problems the calculation method that is needed.

Grid method: Extended to HTU x U and TU x TU and also decimals e.g. U. 1/10 (4.3 x 7)

43 x 62 = 2666

x	40	3
60	2400	180
2	80	6
	2480	*186*

7.4 x 3

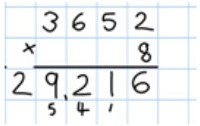
We know 4 x 3 is 12, so 0.4 x 3 will be 1.2 The question was 10 x smaller, so the answer has to be too!

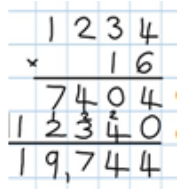
x	7	0.4
3	21	1.2

21 + 1.2 =22.2

7.4 x 3 = 22.2

Long Multiplication:





Division-To show progression through understanding of division, progression is shown as a 'stage' not a year group.

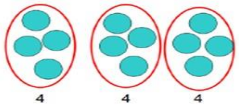
Stage 1

From the start teachers use bar model practical building and illustrations alongside calculations being created.

GROUPING/SHARING:

Through using practical apparatus and informal jottings children will understand equal groups and share items out in play and problem solving. Children need to understand the difference between 'grouping' objects (How many groups of 2 can you make?) and 'sharing' (Share these sweets between 2 people)

How many groups of 4 can be made with 12



12 shared between 3 is 4

Stage 2

Can they use practical apparatus to work out and give a division statement… ?

e.g. There are 6 pupils on this table and there are 18 pieces of fruit to share between us. If we share them equally, how many will we each get?

"18 shared between 6 people gives you 3 each."

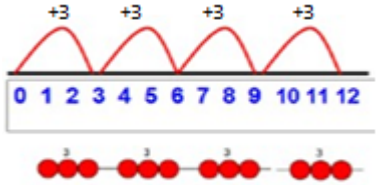
Stage 3

Take this opportunity to illustrate the drawing of bar models and making bar models by using Dienes and Cuisinaire rods to show the bar models practically.

Grouping using a number line:

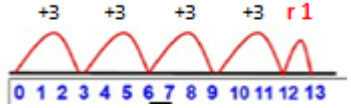
This is an important method to develop understanding of division as grouping.

Step 1: Group from zero in equal jumps of the divisor to find out 'how many groups of _ in _ ?'. Pupils could and using a bead string or practical apparatus alongside a numberline.



12 ÷ 3 = 4

Step 2: Children are now taught the **concept of remainders**. This should be introduced practically and with arrays, as well as being translated to a number line. Children should work towards calculating some basic division facts with remainders mentally for the 2s, 3s, 4s, 5s, 8s and 10s, ready for 'carrying' remainders across within the short division method.



13 ÷ 3 = 4 r 1

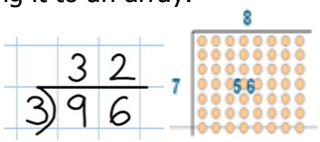
Stage 4

By this stage the children should be confident in using a bar model to identify in word problems the calculation method that is needed.

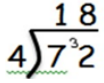
Short division (no remainders):

Once children are secure with division as grouping and
demonstrate this using number lines, arrays etc., short division
for larger 2-digit numbers should be introduced.

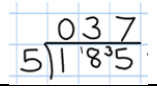
Step 1: Select examples requiring no calculating of remainders at all. Start by introducing the layout of short division by comparing it to an array.



Step 2: Once children demonstrate a full understanding of remainders, and also the short division method taught, they can be taught how to use the method when remainders occur within the calculation (e.g. 72÷4), and be taught to 'carry' the remainder onto the next digit.



Step 3: Dividing numbers with up to **3-digits** by a single digit, however problems and calculations provided should **not result in a final answer with remainder** at this stage**.** When the answer for the first column is zero children could initially write a zero above to acknowledge its place, and must 'carry' the number over to the next digit as a remainder.

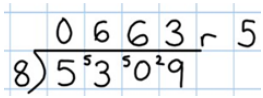


Stage 5

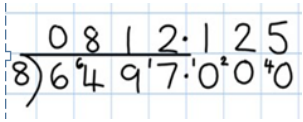
Short division with remainders:

Now that pupils are introduced to examples that give rise to remainder answers, division needs to have a real life problem solving context, where **pupils consider the meaning of the remainder and <u>how</u> to express it,** e.g. as a fraction, a decimal, or as a rounded number or value, depending upon the context of the problem.

The answer to 5309 ÷ 8 could be expressed as 663 and five eighths, 663 r 5, as a decimal, or rounded as appropriate to the problem involved



Calculating a decimal remainder: In this example, rather than expressing the remainder as **<u>r 1</u>**, a decimal point is added after the units because there is still a remainder, and the one remainder is carried onto zeros after the decimal point (to show there was no decimal value in the original number). Keep dividing to an appropriate degree of accuracy for the problem being solved.



<u>Stage 6</u>

Long division by chunking for dividing by 2-digits:

Teach pupils to write a '**useful list**' first at the side that will help them decide what chunks to use. Introduce the method in a simple way by limiting the choice of chunks to 'Can we use 10 lots? Can use 100 lots? As children become confident with the process, encourage more efficient chunks to get to the answer more quickly (e.g. 20x, 5x), and expand on their 'useful' lists.