Frenchay C of E Primary School

Calculation Policy

This policy contains the teaching stages of each of the 4 operations: addition, subtraction, multiplication and division, from Reception to Year 6. It also includes key vocabulary to support each method. Being able to talk about their methods and strategy is critical in developing mathematical thinking and an important stepping stone to written methods, alongside a secure understanding of place value.

Calculation vocabulary

Equivalent, is the same as, equals, balance, addition, subtraction, multiplication, division, operations

+ - X ÷ =

By the end of KS2, children should be able to recall multiplication facts up to 12 x 12 and recall related division facts, as well as number bonds to 20. They should have a good understanding of the 4 operations and an efficient, reliable method of calculation for each operation.

It is important that children are able to use the most efficient method to solve a given calculation, whether this is a mental calculation with a jotting or a formal written method.

1. Can I do this in my head?
2. Do I need to use a drawing or a jotting?
3. Do I need an expanded method or a standard written method?
4. Do I need a calculator?

Addition

Children should have a broad mathematical vocabulary which they use to explain, reason and justify their mathematical thinking.

Addition vocabulary

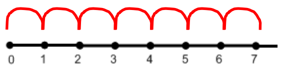
Increase, plus, add, total, addition, count on, sum, altogether, more, +

Learning to add sets together begins before school as children explore the world around them.

- ↓ Understand the concept of more
- ↓ Count a set of objects
- ↓ Combining sets of counters
- ↓ Recording pictorially
- ↓ Recording as a number sentence, reading and writing numerals

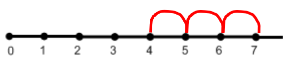
4 + 3 = 7

- ↓ Using a number line to count all



4 + 3 = 7

- ↓ Using a number line to count on



4 + 3 = 7

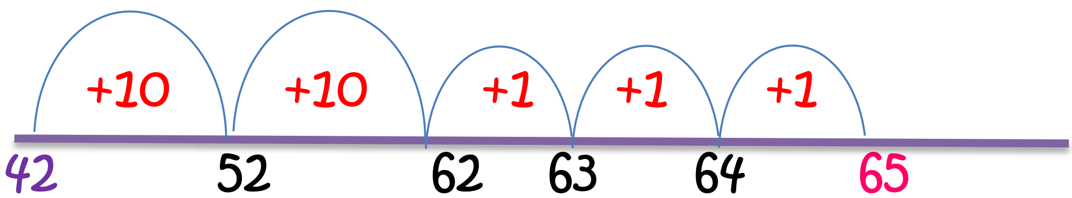
- ↓ Partitioning 2 digit numbers (to 20) into tens and units and being ready for the National Curriculum.

The word 'sum' means add, so we only use this word when adding. When referring to the other operations we use the terms number sentence or calculation. Children will develop their knowledge using whole numbers. By the end of Key Stage 2 they should be able to apply the methods to using decimals. Children will continue to develop their own representations using informal jottings to support their mental strategies.

Blank number line

42 + 23 = 65

20 3



Here children begin by partitioning the number to be added into 10s and 1s. They draw a line, putting the first amount at the start of the line. They hop along the line in 10s then 1s, noting where they land.

Partitioning and understanding place value is the key to developing standard written methods. We begin by partitioning into 10s and units, then move on to partitioning in a number of ways.

$$23 = 20 + 3 = 10 + 13 = 10 + 10 + 3$$

Partitioning

$$42 + 23 = 65$$

$$40 + 20 = 60$$

$$\begin{array}{r} 2 + 3 = \underline{5} \\ 65 \end{array}$$

The children then progress to using a vertical expanded column addition method. They need to line the digits up correctly, thinking about the place value of each digit eg hundreds, tens or units. The units are added first, then the 10s and then the hundreds. The three new units are then added again, starting with the units column to find the answer. It is important to know the value of each digit as it is added.

Expanded column

$$\begin{array}{cccc} & H & T & U \\ & 6 & 5 & 9 \\ + & 2 & 6 & 5 \\ \hline & & 1 & 4 \\ & 1 & 1 & 0 \\ & 8 & 0 & 0 \\ \hline & 9 & 2 & 4 \\ \hline \end{array}$$

This method is then developed into a compact written method and we use carrying. We begin by adding the units.

Column addition

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

Subtraction

Subtraction vocabulary

Take away, less, minus, subtract, count back, fewer, difference between

- ↓ Understand the concept of less
- ↓ Taking away from a set of objects
- ↓ Recording pictorially
- ↓ Recording as a number sentence, reading and writing numerals

6 - 2 = 4

- ↓ Using a number line to count back

6 - 2 = 4

- ↓ Partitioning 2 digit numbers into tens and units and being ready for the National Curriculum

Subtraction can be seen as taking away and finding the difference Children will continue to be taught to use a number line to find the difference especially for finding change and when numbers are close together, eg 1002 – 997. They will always be looking to use the most efficient method for each calculation. As with addition they may use a blank number line, jumping back in 10s and 1s.

The standard written method relies on children having a good understanding of place value and partitioning. Each number in the calculation is partitioned and recorded. Starting with the units, if it is not possible to take away, we exchange 1 ten from the tens column and add it to the units column. We do the same to exchange 100s for 10s.

Expanded Subtraction

735 – 349 = 386

	H	T	U
	600	120	1
	~~700~~	~~30~~	5
-	300	40	9
	300	80	6

When children have developed a good understanding of the process they will then work towards using a compact method or decomposition method.

Column subtraction

	H	T	U
	6	12	1
	~~7~~	~~3~~	5
-	3	4	9
	3	8	6

Multiplication

Multiplication vocabulary

Groups of, product, multiply, times, double, lots of, multiply, repeated addition

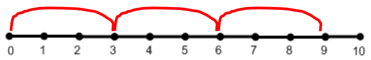
↓ Counting and combining sets of counters of the same size

↓ Recording as a number sentence using repeated addition

3 + 3 + 3 = 9

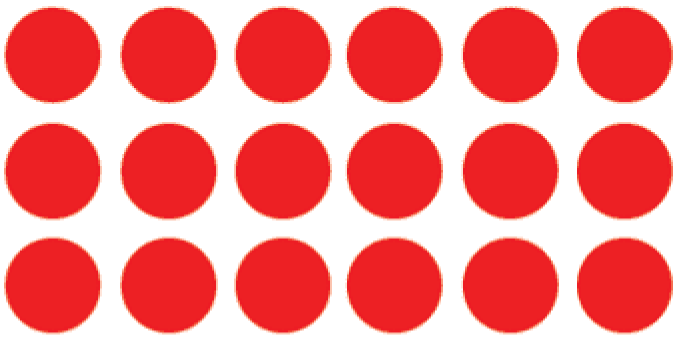
↓ Using a number line to hop along in steps of the same size

3 + 3 + 3 = 9



We develop understanding of multiplication by using an array, counting rows and columns, introducing the x symbol.

Arrays



3 × 6 = 18 or 6 × 3 = 18

Children build on their learning from Key Stage 1 by consolidating their knowledge of times tables and number patterns, as well as partitioning. They will begin by using informal jottings on a number line to understand multiplication as repeated addition.

This is then developed further by using larger numbers and larger jumps. Knowledge of partitioning and times tables facts are the key. The next step is to introduce the grid method. The numbers are partitioned and each multiplied. Each amount is then added to find the answer.

Grid method short multiplication

12 × 5 = 60

×	10	2
5	50	10

50 + 10 = 60

In the example below, both numbers need to be multiplied. Knowledge of times tables facts and place value is vital here.

Grid method long multiplication

43 × 65 = 2,795

×	40	3
60	2,400	180
5	200	15

2,400 + 180 + 200 + 15 = 2,795

Some children will continue to use the grid method as their efficient and reliable method. For some children an expanded column method will be introduced. This involves multiplying each digit and stacking the amounts underneath. Having a secure understanding of place value is crucial for this method to be successful.

Expanded column

$$
\begin{array}{rccc l}
 & H & T & U & \\
 & 1 & 4 & 7 & \\
\times & & & 4 & \\
\hline
 & & 2 & 8 & \rightarrow 4 \times 7 \\
 & 1 & 6 & 0 & \rightarrow 4 \times 40 \\
 & 4 & 0 & 0 & \rightarrow 4 \times 100 \\
\hline
 & 5 & 8 & 8 & \\
\hline
\end{array}
$$

This example shows the compact version of the vertical multiplication where the tens and hundreds are 'carried' as in column addition

Column Multiplication

$$
\begin{array}{rccc}
 & H & T & U \\
 & 1 & 4 & 7 \\
\times & & & 4 \\
\hline
 & 5 & 8 & 8 \\
\hline
 & {\scriptstyle 1} & {\scriptstyle 2} & \\
\end{array}
$$

Division

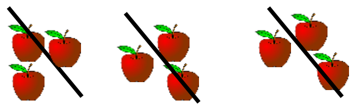
Children will be encouraged to discuss their mathematical learning and will begin by using the vocabulary of 'equal groups' and 'sharing'. Formal written methods of division are based on the concept of grouping.

Division vocabulary

Remainder, group, share , halve, divisor, quotient, divide, equal groups of

↓ Sharing a set of counters equally

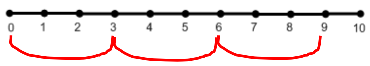
↓ Recording as a number sentence using repeated subtraction



9 - 3 - 3 - 3 = 0

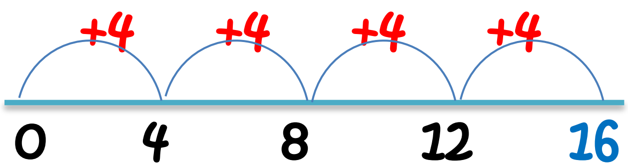
↓ Using a number line to hop back in steps of the same size

9 - 3 - 3 - 3 = 0



Children use their knowledge of number patterns and times tables facts. They will record their method using an informal jotting on a number line.

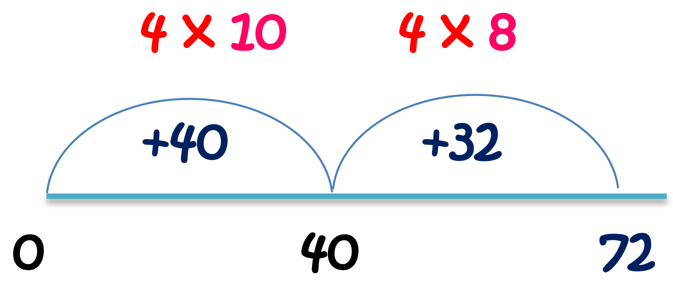
Grouping on a number line



20 ÷ 4 = 16

This strategy will develop further with the children looking for larger jumps based on their knowledge of times tables. This is where the idea of 'chunk' and 'chunking' comes from and being able to work more efficiently.

Chunking jump



$72 \div 4 = 18$

This develops into a vertical written method called 'chunking'. A secure knowledge of times tables facts and place value is needed is needed to reliably use decomposition for subtraction. Children subtract 'chunks' of the number that they are dividing by, using known facts. They continue to subtract 'chunks' until no more can be taken away. We encourage children to start with x 10 and use the number facts that they know.

Chunking

$$
\begin{array}{rrl}
 & 33 & \\
4 & \overline{)\,132} & \\
 & -120 & (4 \times 30) \\
 & 12 & \\
 & -\ 12 & (4 \times 3) \\
\hline
 & 0 &
\end{array}
$$

$132 \div 4 = 33$

To progress further, children will work with a 3 digit number divided by a 2 digit number with and without remainders.

Chunking: long division with remainders

$$\begin{array}{r|l}
 & 26 \text{ r } 21 \\
\hline
37 & 983 \\
 & -\ \underline{370} \quad (37 \times 10) \\
 & 613 \\
 & -\ \underline{370} \quad (37 \times 10) \\
 & 243 \\
 & -\ \underline{222} \quad (37 \times 6) \\
 & 21
\end{array}$$

$983 \div 37 = 26 \text{ r}21$

Bus stop (compact) method

$369 \div 3$

$$\begin{array}{r|l}
 & 123 \\
\hline
3 & 369
\end{array}$$

$423 \div 6$

$$\begin{array}{r|l}
 & 70 \text{ r } 3 \\
\hline
6 & 423
\end{array}$$

$= 70\frac{3}{6}$ $= 70\frac{1}{2}$

The most important development is that children will be able to apply the most appropriate method for that particular calculation. Presenting children with different questions in different contexts, such as time, money and measures will support this.