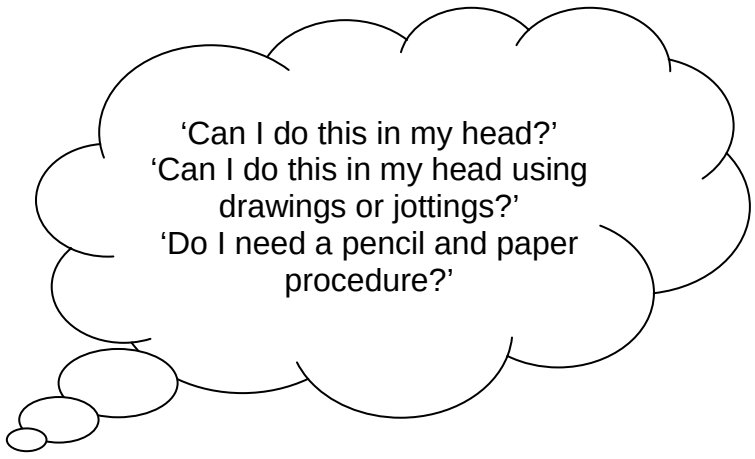
Progression in Addition

At Cobham Primary School, we have developed a consistent approach to the teaching of written calculation methods in order to establish continuity and progression through the school.

This calculation policy outlines the progression in mathematical strategies and skills from Foundation to Year 6, and the typical year group children will be in when they are first introduced to particular concepts. However, this calculation policy is to be used flexibly, as children in each year group may draw from year groups above and below their own, according to their ability. It is imperative that visual images and manipulates are used alongside the teaching of each stage.

It is essential that, in all year groups, addition is:
- taught alongside its inverse subtraction, as these important links will assist children in mastering the operation.
- involved in situations with real life, rich problem solving activities and word problems.

We aim for all children to be able to use a reliable and efficient written method for each operation with confidence and understanding by Upper Key Stage 2. Children will be encouraged to consider the calculation and the most efficient method to reach the answer.



Strategy	Rationale
Using Songs and number rhymes Teachers will use common songs and number rhymes to build up an understanding of pattern and vocabulary, and to develop fine motor skills. Addition vocabulary is built in. This includes 'add', finding 'one more' than a quantity, and establishing which quantity is 'more than' another. At this stage the children will count and point using objects, whilst physically moving them. Whenever possible real life experiences will be used to develop their understanding of addition, and how it relates to subtraction. This is essential before moving onto more abstract forms of addition.	Children use their counting skills to find one more than a quantity, using their fingers to help them to count (from 10) They will use objects, pictures, stories, songs and to help develop their understanding.
Combining sets of objects Children will count out a quantity, and will then be asked 'How many do you have altogether? ***Example*** Count out 3 strawberries. Count out 2 strawberries.  How many strawberries altogether? ***Example*** At a party I eat 2 cakes and my friend eats 3. How many cakes did we eat altogether?  These physical representations are then linked to number sentences. ***Example***  3 + 2 = 5 ***Example***  2 + 3 = 5 Children will learn that addition can be done in any order.	Early addition is about combining 2 sets of objects physically. This may include the use of fingers. As children become confident they combine the numbers to find an answer without using physical apparatus and objects, and by increasingly being able to manipulate numbers mentally.

Using a number line

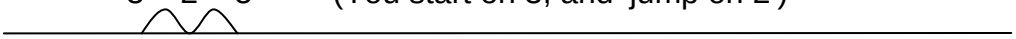
Children will be asked to solve addition calculations with totals of less than 20.

The children will therefore start to develop an understanding of 2 digit numbers, and what these represent.

Initially, children use a marked number line to calculate addition problems.

Example

3 + 2 = 5 (You start on 3, and 'jump on 2')



Example

7 + 6 = 13 (You start on 7, and 'jump on 6')

Children will start to gain an understanding of 2 digit numbers, and why it is more efficient to start on the largest number before 'jumping on'.

Children are encouraged to use a large number line, and to count on in ones (often using a finger or pen to mark each jump). Initially this method would be used alongside previous methods until the children are confident in using a number line.

Use of physically resources to make this visual is essential.

Introducing a hundred square

Children will move to using a hundred square to 'jump on'. They will initially start on the larger number, and then jump on.

Example

5 count on 2 = 7

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

5 + 2 = 7

Example

38 count on 10 = 48

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

38 + 10 = 48

They will then move to a more efficient method of adding 10 to a number (jumping vertically rather than horizontally).

Children begin to use 100 squares as a tool to aid counting on in small steps (eg. in 1s or 2s)

Once secure they begin to use the 100 square to count on in tens.

Children learn that, as they move down a row, they add on 10 each time.

Careful attention is given to possible misconceptions at this stage, especially 'jumping on' their starting number (instead of always moving horizontally with each move).

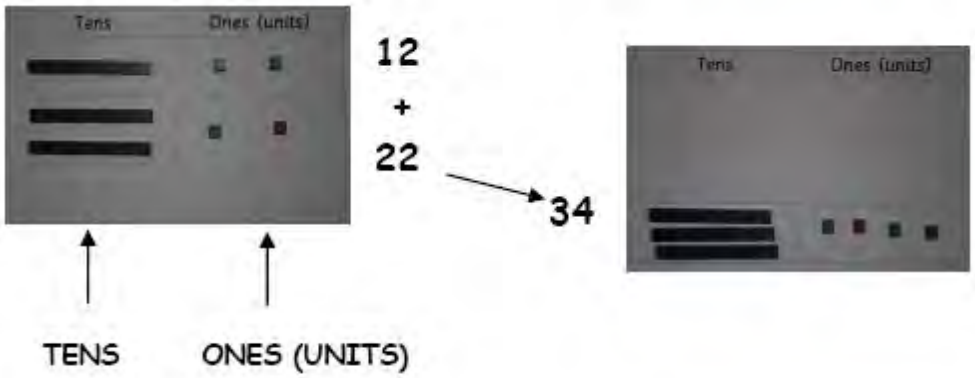
Introducing partitioning (2 digit numbers)

Children will learn that numbers 10 or over (and under 100) are made up of TENS (left hand digit) and ONES/ UNITS (right hand digit).

Partitioning a number involves splitting it up into TENS/UNITS to show the value of each digit.

Numbers can then be added by first combining the TENS and then combining the UNITS.

Example



Initially this will be practically done using **bundles of sticks** before moving onto 'Base 10' (which comprise of sticks representing 'tens', and cubes representing 'ones') which becomes more abstract.

This method is also used when children are introduced to the idea of adding HUNDREDS.

As children become secure they will say the value of each digit without apparatus.

More complex addition using a hundred square

*Prior to using the hundred squares below the children will need to have a secure understanding of the value of each digit in a number, as determined by its position - **place value**.*

Using the hundred square to combine 2 digit numbers

Example

47 + 12 = ☐

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Adding 12 involves moving down a row, and then to the right 2 places.

Children learn to use the hundred square to add 2 digit numbers.

In this example the children will understand that 'one ten' (10) and 'two units' (2) is added to 47. They will therefore move down a row on the 100 square to add 10, and then move two spaces to the right to add 2.

Children will, once again, consider the inverse of addition in doing so.

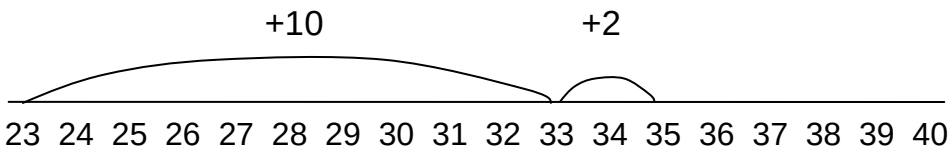
Marked number lines

The children will use number lines to support them in their calculations, whilst consolidating their mental strategies.

This will initially involve a marked number line, with the children jumping on in an appropriate number of tens and units.

Example

23 + 12 = ☐



23 + 12 = 35

It is important for children here to appreciate that number lines go on infinitely, including into negative numbers.

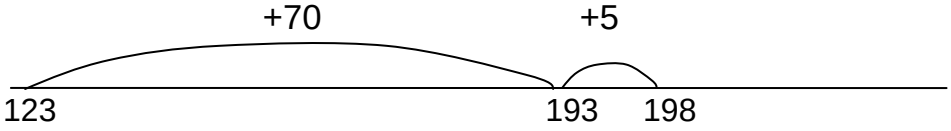
Unmarked number lines

The children will move towards adding larger multiples of tens and units, using unmarked ('empty') number lines.

Explicit links will be made between this and the marked number line method above.

Example

123 + 75 = ☐



123 + 75 = 198

Children will begin to use 'empty' number lines - starting with the largest number and counting on in tens and then units.

Introduction of more formal method

The children will be introduced to more formal methods, building on their ability to partition effectively.

Example	***Example***
23 + 12 = ☐	28 + 15 = ☐
20 + 10 = 30 3 + 2 = 5	20 + 10 = 30 8 + 5 = 13
= 35	= 43

The method on the left is then built upon as the children consider addition calculations which involve the ones/units value totaling more than ten.

Children will be taught written methods for those calculations they cannot do 'in their heads'.

These methods encourage pupils to think about the value of digits, but the addition of the numbers is still done mentally.

Compact addition methods

The above methods and understanding of partitioning and place value will be used to support the step into using compact column methods.

Children are shown to start on the least significant number (the 'units') and add the columns from right to left hence the operation being shown on the right.

Example

In the below example you add the units/ones; 7+5=12. There are 2 units in '12', and 1 ten, hence 2 in the 'units' column, and 1 in the 'tens' column.

587
375+
2
1

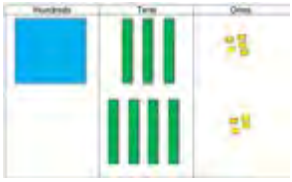
The next stage is to look at the 'tens' column, ensuring that place value is maintained (e.g. verbally stating 80+70, rather than 8+7).

587
375+
62
1 1

Continue until all columns have been totalled.

587
375+
962
1 1

Visual representation using 'Base 10' should be used to reinforce understanding of place value when initially introduced.



Once pupils are confident solving problems up to 1000 using the above method, they are encouraged to use a more concise method, column addition.

This column addition follows the more conventional method must adults are familiar with.

When the total number of units in 2 numbers exceed 9, one ten is carried across to the tens column. This is known as 'carrying' When initially teaching this method this should be shown practical by exchanging the 10 ones for 1 ten.

Concise method for adding decimals

Example

123.9
7.25+
131.15
1 1

6.72
8.56+
15.28
1

Once secure with the previous methods the children will be introduced to adding decimals to decimals (and decimals to whole numbers), ensuring that place value is maintained throughout.

Children may, at this stage, record a '0' in any spare space in order to assist them in maintaining place value.