The teaching of addition in Chaddlewood Primary School

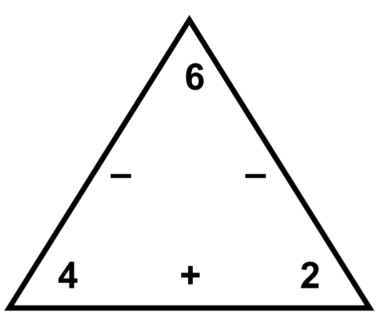
This calculation policy outlines the progression in mathematical strategies and skills from Foundation to Year 6, and the typical year group children will be in when they are first introduced to particular concepts. This calculation policy is to be used flexibly, as children in each year group may draw from year groups above and below their own, according to their ability.

It is 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 rich problem solving activities and word problems.
- approached in a cross curricular manner wherever possible.

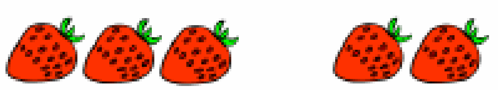
Children will also be given many different types of problems, often which will look very different to what they are used to. This is true for all of the mathematical strategies throughout the calculation policy. For example, in calculating problems involving a missing number (for example 10 + 3 = ☐), children will also consider:
☐ + 3 = 13   10 + ☐ = 13   13 = 10 + ☐   13 = ☐ + 10.

2 + 7 = 9
7 + 2 = 9
9 – 7 = 2
9 – 2 = 7

To help to develop the links between addition and subtraction the children will also use ‘number trios’. Number trios demonstrate to the children that when they choose a ‘trio’, they can make four number sentences with them, by covering up particular numbers. These will be used even further by considering what would happen if we multiplied or divided each of the numbers by 10 or 100.

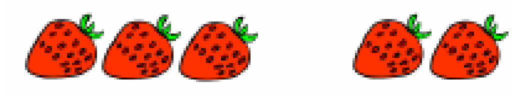


2 + 4 = 6
4 + 2 = 6
6 – 2 = 4
6 – 4 = 2

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.	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 and songs to help develop their understanding. At this stage the children will count and point using objects, whilst physically moving them. Whenever possible we will use real life experiences to develop their understanding of addition, and how it relates to subtraction. Children will need lots of these experiences before moving onto more abstract forms of addition.
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? 	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.

These physical representations are then linked to number sentences.

Example



3 + 2 = 5

Example

2 + 3 = 5

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’)

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Example

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

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Children will start to gain an understanding of 2 digit numbers, and why it is more efficient to start on the higher numbers 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

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

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

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

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).

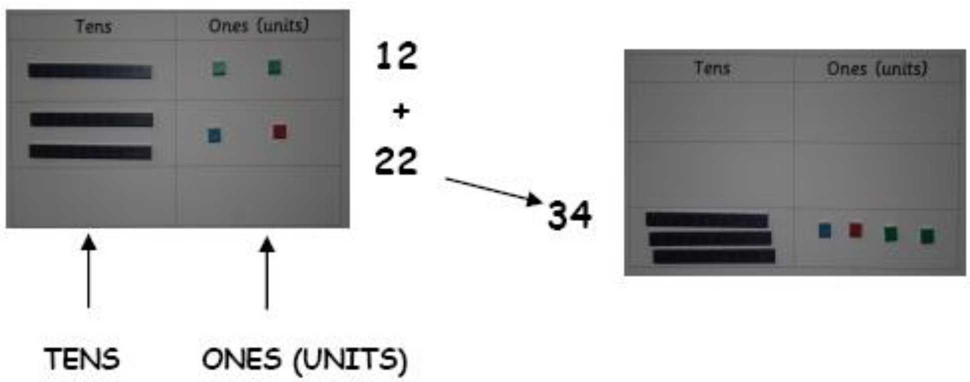
Introducing partitioning (2 digit numbers)

Children will learn that numbers 10 or over (and under 100) are made up of TENS (left hand digit) and 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 'Deines' (which comprise of sticks representing 'tens', and cubes representing 'units').

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. This is called **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.

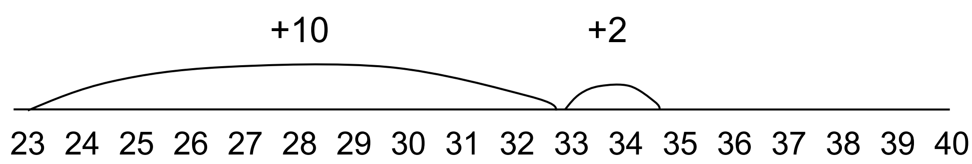
Marked number lines

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.

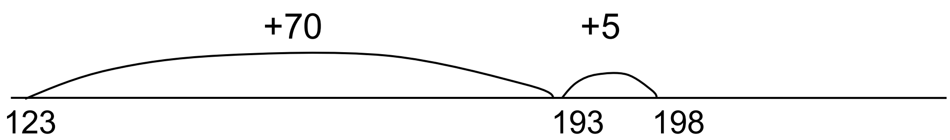
Unmarked number lines

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 bracelet 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.

Breaching ten

Children will continue to develop their mastery of the above number line and hundred square strategies, moving towards breaching multiples of tens.

Introduction of more formal methods (1)

In conjunction with the bracelet method above, the children will be introduced to more formal methods, building on their ability to partition effectively.

Example

23 + 12 = ☐

20 + 10 = 30
3 + 2 = 5

= 35

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.

Introduction of more formal methods (2)

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

Example

28 + 15 = ☐

20 + 10 = 30
8 + 5 = 13

= 43

Preparation for condensed methods

The above methods are then condensed further, including problems which require 'carrying'.

Example

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

$$\begin{array}{r} 587 \\ +375 \\ \hline 2 \\ \hline {\scriptstyle 1} \end{array}$$

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).

$$\begin{array}{r} 587 \\ +375 \\ \hline 62 \\ \hline {\scriptstyle 1\,1} \end{array}$$

Continue until all columns have been totalled.

$$\begin{array}{r} 587 \\ +375 \\ \hline 962 \\ \hline {\scriptstyle 1\,1} \end{array}$$

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'.

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

Concise method for adding decimals

Example

$$\begin{array}{r} 123.9 \\ +\ \underline{\ \ \ 7.25} \\ \underline{131.15} \\ {\scriptstyle 1\ 1\ \ } \end{array}$$

$$\begin{array}{r} 6.72 \\ +\ \underline{8.56} \\ \underline{15.28} \\ {\scriptstyle 1\ \ \ \ } \end{array}$$

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.

Brackets

Children will develop an understanding of how to approach problems which involve the use of brackets, including the mathematical rules underpinning extended number sentences (for example that they should always solve the mathematical calculation within the brackets first, and be able to read problems where mathematical symbols have been omitted).

Example

(4+7) x 3

Example

3(4+7)

In these examples brackets are used to increase the complexity of the calculation.

(4 + 7) is calculated first, which is 11. Then the brackets are replaced with 11, so that the calculation reads 11 x 3.

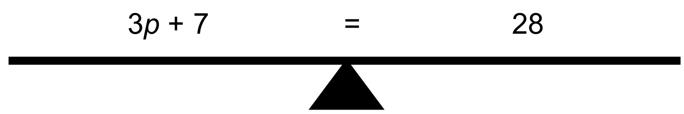
Algebra

The children will learn that algebra involves the use of simplified number sentences, where both sides of the equals sign needs to ‘balance’.

Example

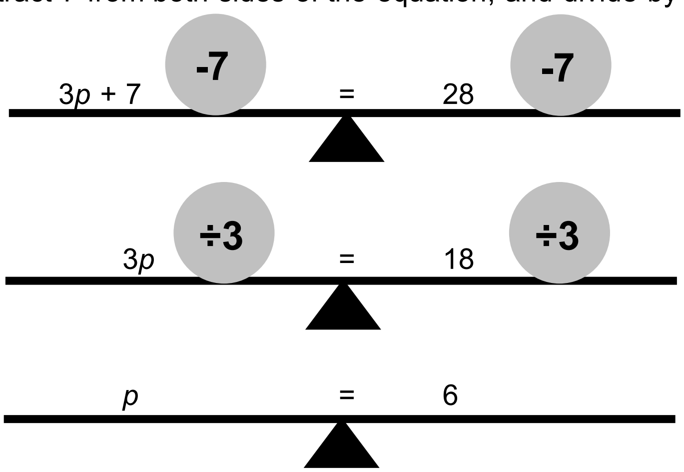
$3p + 7 = 28$

In this case p represents a missing number, but any letter could be used. Imagine the number sentence, balanced on a see-saw.



To keep the see-saw balanced whatever happens to one side must happen to the other. As we need to find the value of p our goal is to isolate this letter, with all of the numbers are on the other side of the equation.

Subtract 7 from both sides of the equation, and divide by 3.



Algebra may look confusing, but it is simply a way of representing a missing number with a letter.

The children have tackled problems similar to this much earlier in their school lives, for example in ‘missing number’ sentences. The missing number boxes are now just replaced with a mathematical symbol.

$\square + 6 = 15$

$f + 6 = 15$

Extended algebra

Example

$4f + 7 = f + 16$	
$4f + 7 – 7 = f + 16 – 7$	(subtract 7 from both sides)
$4f = f + 9$	
$4f – f = f + 9 – f$	(subtract f from both sides
$3f = 9$	
$f = 3$	(divide both sides by 3)

This example is more involved. If you imagine the left and right hand sides of this problem being balanced, like on a see-saw, then you can keep the balance by doing the same to both sides.