Hartford Infant School

Calculation Policy 2014 updated 24/11/2014

In light of the Department for Education Mathematics Programmes of study for Key Stage 1-2, the Calculation Policy has been updated in order to reflect new concepts and pedagogy surrounding the teaching of mathematics.

This policy contains the key calculation methods that will be taught within our school. It has been written to ensure consistency and progression throughout the school and reflects a whole school agreement.

In conjunction with the Mathematics Programmes of study: '**Pupils develop confidence and mental fluency with whole numbers, counting and place value. This will involve working with numerals, words and the four operations.**' [Mathematics Programmes of Study for Key Stages 1-2 2014] Children are introduced to the processes of calculation through ***practical***, ***oral*** and ***mental*** activities. As children begin to understand the underlying ideas they *develop ways of recording to support their thinking* and calculation methods, use particular methods that apply to special cases, and learn to interpret and use the signs and symbols involved.

Over time children learn how to ***use models and images***, such as empty number lines, to **support their mental and informal written methods of calculation**. As children's mental methods are strengthened and refined, so too are their informal written methods. These methods become more efficient and succinct and lead to efficient written methods that can be used more generally. Children develop number sense.

They will do this by asking themselves:

Can I do this in my head?

Can I do this in my head using drawing or jottings?

Do I need to use a pencil and paper procedure?

At whatever stage in their learning, and whatever method is being used, it must still be underpinned by a secure and appropriate knowledge of number facts, along with those mental skills that are needed to carry out the process and judge if it was successful.

The National Curriculum for mathematics 2014 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 have conceptual understanding and are able to recall and apply their knowledge rapidly and accurately to problems
- **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.

[Mathematics Programmes of Study for Key Stages 1-2 2014]

Addition of whole numbers

To add successfully, children need to be able to:

- recall all addition pairs to 9 + 9 and complements in 10 e.g. 6 + 4 = 10
- add mentally a series of one-digit numbers, such as 5 + 8 + 4
- subitise [know that 5 dots is five without having to count each one as in one to one correspondence].
- add multiples of 10 [40 + 30] or of 100 [400 + 300] using the related addition fact, 4 + 3 and their knowledge of place value.
- partition two-digit numbers and three-digit numbers into multiples of 100, 10's and 1's and partition in different ways.

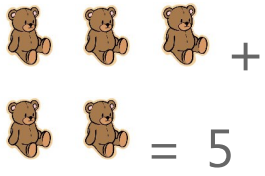
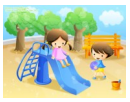
Securing children's knowledge of **Numbers** and **Place Value** is essential before the transition to calculation in all four operations. If children are secure in the areas above then they will be more likely to succeed at addition, subtraction, multiplication and division.

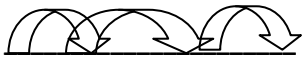
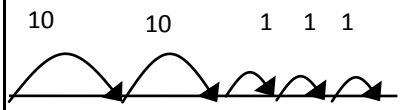
Addition Approaches: teachers will embed conceptual understanding of addition with the children through exploring real life situations which involve;

- **Combining** two or more sets [**aggregation**] See stage 1A
- **Counting on** from the largest number [**augmentation**] See stage 1B
- **Complements of a set** structure—knowing the total number and having to find the difference

This will mean that our children will be able to recognise addition in a variety of situations. The teacher will aid this through ensuring:

- They start with a meaningful context or problem
- Expose children to correct mathematical addition vocabulary
- Represent problems through concentrate practical resources including any mathematical equipment as well as objects, counters and jottings
- Record with mathematical symbols as a number sentence/calculation

Stage 1	Method	Models and Images	Examples
A] Combine [**Aggregation]**	Combine 2 or more groups and count how many there are alto-gether.	Numicon, pictures, Bead String, fingers, jottings and objects.	Joe brings 3 teddies to school. Fred brings two. How many teddies are at school today?  becomes  becomes  becomes 3 + 2 = 5
B] Count on [**Augmentation]**	Count on in steps of one – start with larger number and count on.	Fingers, jottings, number tracks, num-bered number lines, bead strings, itp num-ber line, enl	Three children are playing at the park. 2 more children join them. How many chil-dren are playing at the park?     3 + 2 = 5

Stage 1	Method	Models and Images	Examples
C] Count on **[Augmentation]**	Count on in multiples of 2,5, 10 and 1's on an empty number line.	Bead string, number track, numbered number line, empty number line Number squares but not to use as a method i.e jump up and down a row when adding and subtracting ten, as children do not embed the understanding of size of number .	There are 8 cakes on the tray and I add 9 more. How many cakes are there on the tray? **2 5 2**  **8 10 15 17**  **First counting on in tens and ones:** 34 + 23 = 57 Then helping children to become more efficient by adding 20 then the units in one jump (by using the known fact 4 + 3 = 7)
D] Counting on	Record mental methods using partitioning and recombining. Add the tens and then the ones to form partial sums and then add these partial sums.	Written recording ITP's	Explore commutative law with the children- Does it make a difference which way round you solve the calculation? Record steps in addition using partitioning and recombining: 47 + 32 =  40 + 30 = 70 7 + 2 = 9 70 + 9 = 79

Stage E [expanded column method] may be added for some Higher ability or more able children as suggested in the National Curriculum 2014. E.g.

67	67
+ 24	+ 24
80	11
11	80
91	91

Children add the most significant numbers first, then move on very quickly to the least significant.

Other methods that children may use to add 2 numbers

together – knowledge of number facts, knowledge

that addition can be done in any order, near doubles

e.g. 6+7=6+6+1 and adding the nearest multiple of 10 and adjusting (compensating) e.g. 24 + 19 = 24 + 20 – 1 = 43.

Subtraction of whole numbers

The aim is that children **use mental methods when appropriate**, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence. Children are entitled to be taught and to acquire secure mental methods of calculation and use efficient written methods of calculation for subtraction which they know they can rely on when mental methods are not appropriate.

These notes show the stages in building up to using an efficient method for subtraction of two-digit and three-digit whole numbers.

To subtract successfully, children need to be able to:

recall all addition and subtraction facts to 20;

subtract multiples of 10 (such as 160 – 70) using the related subtraction fact,16 – 7, and their knowledge of place value;

partition two-digit and three-digit numbers into multiples of one hundred, ten and one in different ways (e.g. partition 74 into 70 + 4 or 60 + 14).

Note: *It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for subtraction.*

(Extract taken from Primary Strategy Guidance paper on calculation)

Subtraction methods

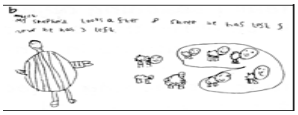
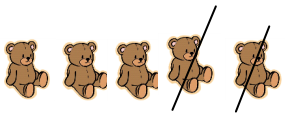
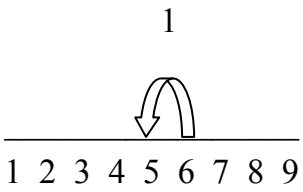
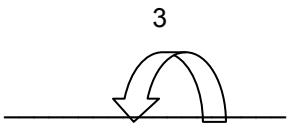
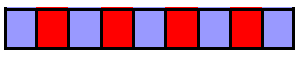
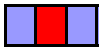
Subtraction Approaches: teachers will embed conceptual understanding of subtraction with the children through exploring real life situations which involve;

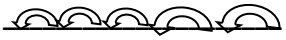
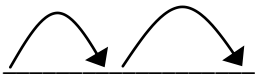
- Taking away by physically removing an amount
- Finding the difference comparison of two amounts
- Recognising subtraction as the inverse of addition [if I have added 3 to a number I can undo the process by subtracting 3]

This will mean that our children will be able to recognise subtraction in a variety of situations. They will see that they are subtracting through recognising a take away and finding the difference situation. They will be knowledgable about subtraction vocabulary and phrases.

The teacher will aid this through ensuring:

- They start with a meaningful context or problem
- They represent a problem by using concentrate practical resources including mathematical equipment as well as objects and counters ensuring that the modelling represents the correct subtraction approach E.g. Emma has 3 sweets, Chole has 9 sweets how many more sweets does Chloe have? [This examples equates to a finding the difference model]
- Represent with mathematical symbols as a number sentence/calculation [see stage 1[b] example.
- Modelling the inverse.

Stage 1	Method	Models and Images	Examples
A] Take away [Reduction]	Relate subtraction to taking away and count how many are left.	Fingers, objects, numicon and pictures. Children may begin to record using pictures or number sentences (as modelled by Teacher).  . Number Track 0 1 2 3 4 5 6 7 8 9	  Five teddy bears are at the park. 2 of them go home for their tea. How many bears are left at the park? 5 - 2 = 3
	Count back in steps of 1. Count back in larger steps E.g -3	Number tracks/lines, bead strings, ITP's.	6 - 1 = 5  1 2 3 4 5 6 7 8 9 8 - 3 = 5  1 2 3 4 5 6 7 8 9
B] Finding the difference	Finding the difference between 2 numbers and beginning to understand that subtraction can be worked out by counting on the difference. How many more?	Cubes, Numicon, bead strings etc Contextual situations in which we are comparing 2 amounts E.g. Height, length, weight, volume, time, money	9 - 3 = 6 3 + 6 = 9   The number line should also be used to show that 9 - 3 means the 'difference between 9 and 3' or 'the difference between 3 and 9' and how far apart they are.

Stage 1	Method	Models and Images	Examples
B]	Counting back in multiples of tens and units	Empty number line (The empty number line helps to record or explain the steps in mental subtraction.) Bridging through ten can help children become more efficient.	First counting back in tens and ones. **1 1 1 10 10**  **24 25 26 27 37 47** **47—23 = 24** Then helping children to become more efficient by subtracting the units in one jump (by using the known fact 7 – 3 = 4) and the multiples of ten in one jump. **4 20**  **24 27 47**
B]	Counting up from the smaller to the larger number to find the difference particularly where the numbers are close in size.		42 – 39 = 3 1 2  39 40 42 If the numbers involved in the calculation are close together or near to multiples of 10, 100 etc, it can be more efficient to count on.

Stage C] Compensation and adjusting

[to subtract near multiples of 10] Development of number

Other methods that children may use for subtraction: Knowledge of subtraction facts and of place value, subtracting 9 or 11 by subtracting 10 and adjusting by 1 and knowledge that subtraction is the inverse of addition and vice versa. Also, with practice, children will need to decide whether it is efficient to count back or forward depending on the numbers involved.

Multiplication

The aim is that children **use mental methods when appropriate**, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence. Children are entitled to be taught and to acquire secure mental methods of calculation and one efficient written method of calculation for multiplication which they know they can rely on when mental methods are not appropriate. These notes show the stages in multiplication through EYFS and Key Stage 1.

Note: *It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for multiplication*

(Extract taken from Primary Strategy Guidance paper on calculation)

To multiply successfully, children need to be able to:

- Count forwards and backwards in equal steps of differing amounts
- Recognise that doubling is the same as multiplying by 2
- Begin to recall some multiplication facts. E.g x 2, 3, 5 and 10 tables

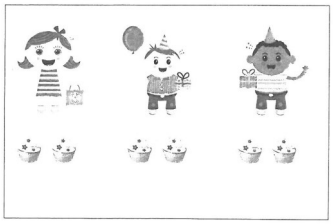
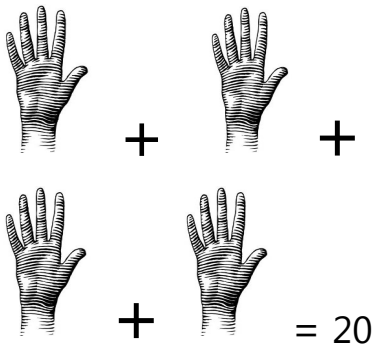
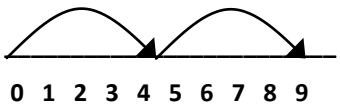
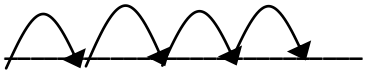
Multiplication Approaches: teachers will embed conceptual understanding of multiplication with the children through exploring real life situations which involve;

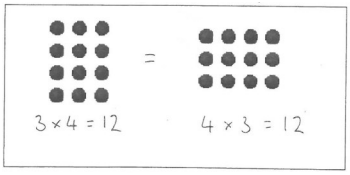
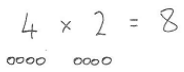
- Repeated addition
- As an array
- Commutative
- Inverse
- Recognising multiplication as the inverse of division

This will mean that our children will be able to recognise multiplication in a variety of situations.

The teacher will aid this through ensuring:

- They start with a meaningful context or problem
- Ensure that you represent that through concentrate practical resources including as mathematical equipment as well as objects, counters.
- Represent with mathematical symbols as a number sentence/calculation ensuring that the number sentence matches the pictorial representation
- Modelling the inverse of division

Stage 1	Method	Models and Images	Examples
A] Repeated addition in groups	Count repeated groups of the same size	Objects, fingers, jottings	If each child has 2 cakes, how many altogether? 
B] Repeated addition	Understand multiplication as repeated addition	Objects, fingers, number lines Use measures context e.g money, time, length, volume, weight	5 + 5 + 5 + 5= 20  **Number Line Jumps**  0 1 2 3 4 5 6 7 8 9 4 + 4 = 8 4 x 2 = 8 *Number line jumps support mental methods*  0 1 2 3 4 5 6 7 8 Or 2 x 4 = 2 + 2 + 2 + 2 **And on a bead bar:** 5 x 3 = 5 + 5 + 5

Stage 1	Method	Models and Images	Examples
C] Multiplication as an array	Multiplication is commutative through the use of arrays (They group objects into rows and columns. It helps children to understand that the order of the numerals in a multiplication question are interchangeable (e.g. 4 x 3 = 3 x 4) and it gives them a picture to relate to a number.) You could turn the picture anticlockwise 90 degrees to show them it can be commutative. (They would also begin to record their work using x and =)	Objects, paper and pencils Multi array itp Multiplication facts itp Multiplication square	 
D] Multiplication as partitioning	Partitioning units and tens, hundreds.	Empty Number Line Dienes apparatus	22 x 4 = 20 x 4 = 80 2 x 4 = 8 **88** (Mental methods for multiplying TU × U can be based on the distributive law of multiplication over addition. This allows the tens and ones to be multiplied separately to form partial products. These are then added to find the total product. Either the tens or the ones can be multiplied first but it is more common to start with the tens.)
Other methods children may use for multiplication: Applying the knowledge of doubles and halves to known facts, using multiplication facts – 2, 5, 10 count, use closely related facts.			

Division

The aim is that children **use mental methods when appropriate**, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence. Children are entitled to be taught and to acquire secure mental methods of calculation and one efficient written method of calculation for division which they know they can rely on when mental methods are not appropriate. These notes show the stages in division through EYFS and Key Stage 1.

Note: *It is important that children's mental methods of calculation are practised and secured alongside their learning and use of an efficient written method for division.*

(Extract taken from Primary Strategy Guidance paper on calculation)

To divide successfully children need to be able to:

understand and use the vocabulary of division

partition two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways;

recall multiplication and division facts

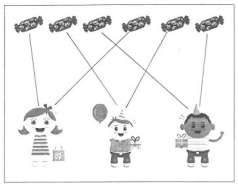
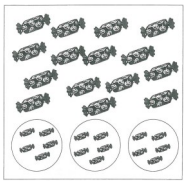
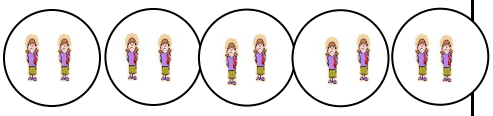
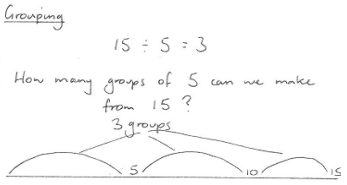
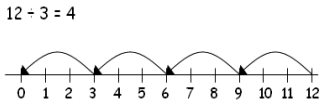
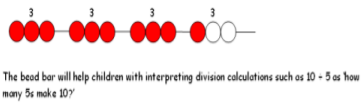
understand and use multiplication and division as inverse operations.

understand division as repeated addition;

add numbers using an appropriate method.

This will mean that our children will be able to recognise division in a variety of situations. The teacher will aid this through ensuring:

- They start with a meaningful context or problem.
- Ensure that they represent that through concrete practical resources including mathematical equipment, objects and counters.
- Represent with mathematical symbols as a number sentence/calculation ensuring that the number sentence matches the pictorial representation.
- Modelling inverse.

Stage	Method	Models and Images	Examples
A]	Understand Division as sharing: Share objects into equal groups and count how many in each group. (Begin to include calculations with remainders)	Objects, jottings – pictures, ITP's	If I have 6 sweets to share between 3 children, how many does each child get?  There are 3 children and 15 sweets. How many sweets would they each have?
B]	Understand division as grouping (Begin to include calculations with remainders) (They would also begin to record their work using ÷ and =)	Objects, pictures, ITP's	There are 3 children and 15 sweets. How many sweets would they each have?  10 children are grouped into teams of 2. How many teams will there be? **10 ÷ 2 = 5** 
C]	Repeated addition using a number line or bead string	Number lines, bead strings, ITP's	  

Other methods children may use for Division: Knowing that halving is dividing by 2, applying the knowledge of doubles and halves to known facts, using multiplication facts – 2, 5, 10 count, use closely related facts.