Magdalen Gates Primary

Calculation Policy.

For further details on the approaches and methods used, please see the 'Calculation Policy- Guidance' document.

Fundamental Principles

The following fundamental principles underpin all the strategies taught.

Fundamental concept 1 - Place value.

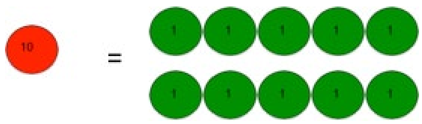
The methods in this policy are based on a **place value** system of number. This means that when referring to different digits in a number, we refer to them as the place value of the digit as well as the digit name. For example, in the number 7321 we would refer to the digits as being 'seven thousand, three hundred, twenty and one' and refer to the individual digits as 'seven, three, two, one', using questioning to ensure children's understanding.

For the avoidance of doubt, under our curriculum, the term 'ones' is expected to be used in place of 'units'.

Fundamental concepts 2+3-   Base 10 and exchange.

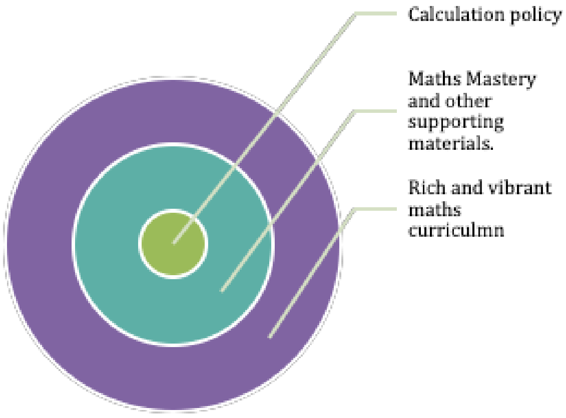
Children need to understand that our number system is a 'base 10' system which relies on exchanges to work. Place value representations, such as Base 10 (Dienes) and place value counters are essential in supporting the developing of these concepts. Place value mats/grids can also help when children are manipulating these representations.

This means that children need to understand that you can exchange **10** 'ones' for **1** 'ten' or **10** 'tens' for **1** hundred etc…



They need to understand that when giving their final answer, these exchanges **must** have occurred (e.g. you can't record the number 'one hundred and eleven' as 1011 as the eleven 1's would have to be exchanged for one '10')

Children also need to understand that exchange *can temporarily* happen in either direction if this assists with a calculation. E.g. 456 can be *temporarily* thought of as ' four '100's', four '10's' and sixteen '1's' to support a subtraction calculation (i.e. 456-347=?)



No algorithms or 'tricks' should be taught, children should be taught how to calculate with **conceptual understanding.**

Conceptual understanding will be taught using the CPA (concrete, pictorial, abstract) structure to ensure children understand how the concept is demonstrated within the algorithm.

Fundamental concept 4- The Concrete→Pictorial→Abstract (CPA) approach.
It is important that children are exposed to a range of concrete, pictorial and abstract representations throughout their maths learning. Children should be encouraged to represent the maths they are learning in different ways, and should experience Concrete, Pictorial and Abstract approaches in most lessons.

Fundamental concept 5- Efficiency.
Children need to be encouraged to work efficiently. Efficient working means a method of working that is **accurate** and **quick.** Speed or accuracy alone **does not create an efficient method.**

The efficient methods children use will develop with their conceptual understanding. For example, for a particular child, an informal written method may, at some points in their mathematics education, or for some calculation types, be more efficient than the formal written method, for example, if the formal written method is leading to mistakes (which would point to a lack of conceptual understanding which needs to be developed though the informal written methods).

Fundamental concept 6- Accurate vocabulary.

Children should be able to talk about their work using accurate and concise mathematical vocabulary, and this needs to be modelled by adults.

Note the words below, which are often used incorrectly along with their correct definitions

Sum- applies to the answer to an addition question only. You are not carrying out multiplication 'sums', rather multiplication 'questions' or 'problems'.

Negative – should be used to describe numbers below 0- not minus.

Fundamental concept 7- Meaning of the equals sign.

It is important that children understand that the equals symbol (=) means 'balance' rather than 'the answer'.

When presenting problems, always make sure they are presented balanced- i.e. with a ? or other symbol after the = symbol. For example- 6+2=?, 67+4=[] c=321+345

Presenting problems in a range of formats (e.g. 6 + ?=10, 10+6=?, ?+4=10) also helps re-enforce this definition..

Mental calculation.

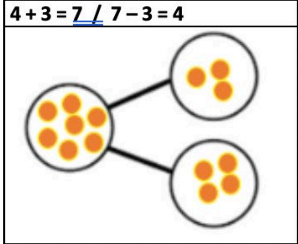
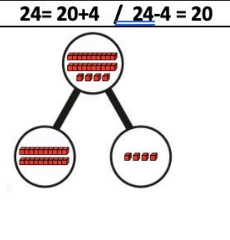
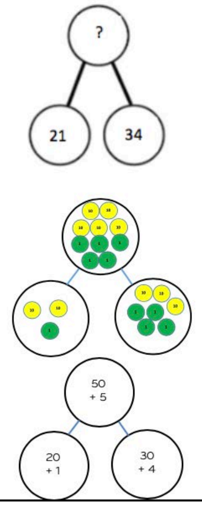
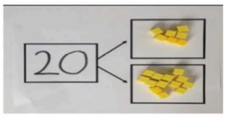
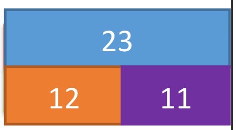
Mental calculation skills are key, and children should be able to fluently calculate mentally in all four operations. Fluent mental calculations support efficient written methods and leads to higher achievement.

Examples of the stages of progression in mental calculation skills for each operation are contained in the guidance document.

Key Models and Images

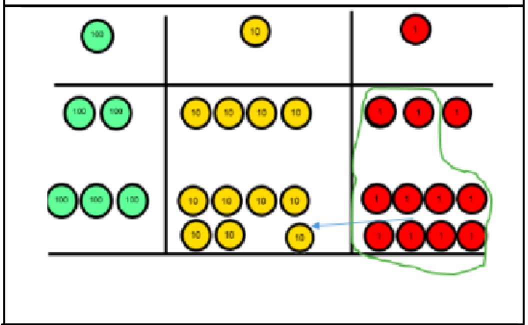
Addition and Subtraction

Part-Whole

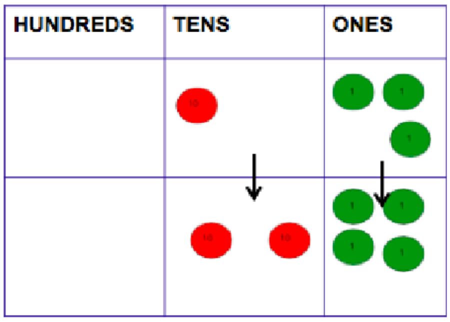
4 + 3 = 7 / 7 – 3 = 4	24= 20+4 / 24-4 = 20	21 + 34= ?
		
20 = 13 + 7/ 20=13 + 7 / 20-13 = 7 / 20-13=7	12+11=23/ 11+12=23 23-11=12 / 23-12=11	
		

Place Value Counters

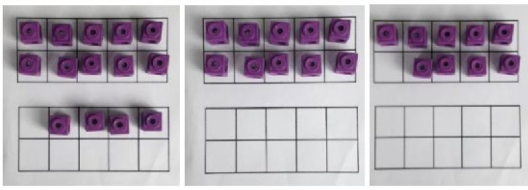
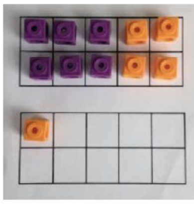
243 + 368= ?



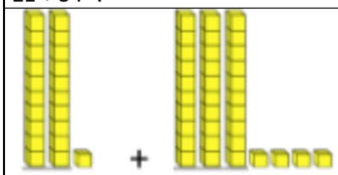
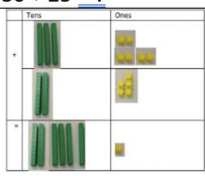
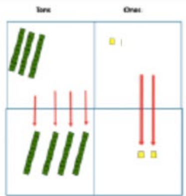
37-24=?



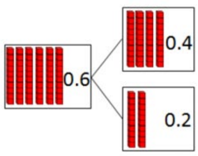
Tens Frames

14-5=9	6+5=11
 14-4=10 10-1=9	

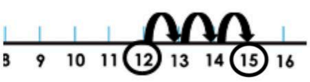
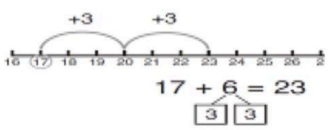
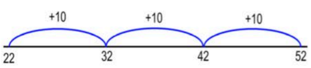
Base 10

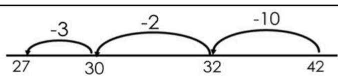
21 + 34=?	36 + 25 = ?	73-42=?
		

0.6=0.4+0.2 / 0.2+0.4=0.6 / 0.6-0.2=0.4 / 0.6-0.4 = 0.2



Numberline

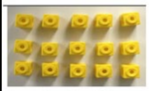
12 + 3 = 15	17 + 6 = 23 (bridging 10)	22 + 30 = 52 (counting in multiples)
		

42 – 15 = 27 (bridging 10)	7326 + 4650 = 11,976 (canonical partitioning)
	

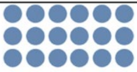
Multiplication

Array

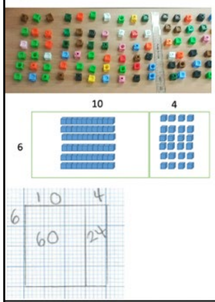
e.g. 3 x 5 = 15



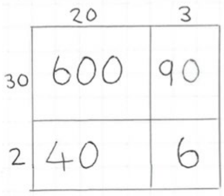
e.g. 3 x 6 = 18



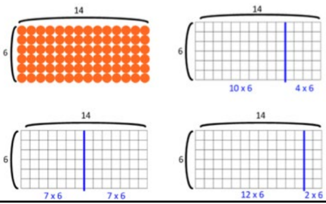
E.g. 6 x 14 = 84



E.g. 23 x 32 = 736

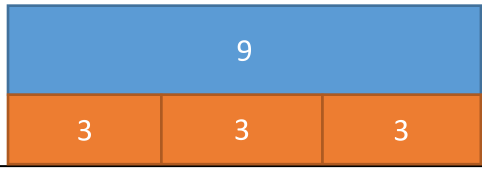


E.g 14 x 6 = 84



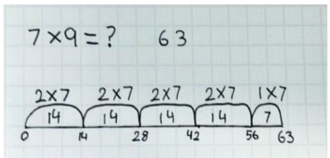
Bar Model

e.g. 3 x 3 = 9



Number Line

e.g. 7 x 9 = 63



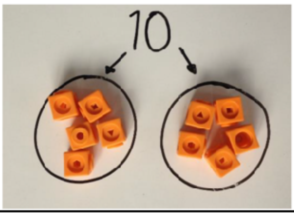
Beadstring

e.g. 8 x 5= 40

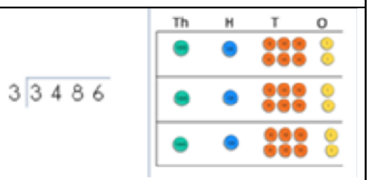
Division

Sharing

10 ÷ 2 = 5

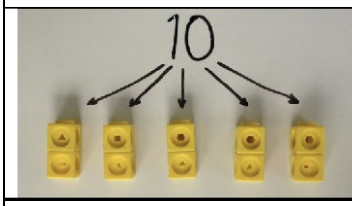


3486 ÷ 3 = 1162



Grouping

10 ÷ 2 = 5



60 ÷ 30 = 2

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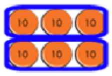
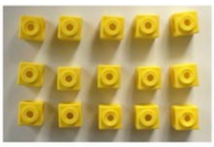
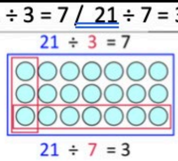


Arrays

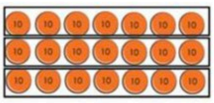
15 ÷ 3 = 3 / 15÷ 5 = 3



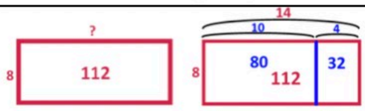
21 ÷ 3 = 7 / 21 ÷ 7 = 3



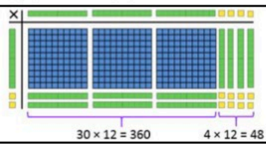
210÷ 3 = 70



112 ÷ 8 = 14



408 ÷ 12 = 34

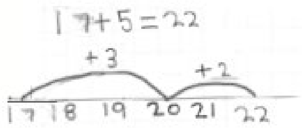


Calculation methods at a glance.

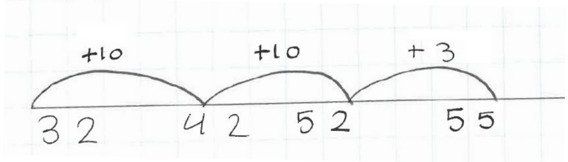
Please refer to guidance document for more information. The below summarises the key stages- full interim steps and progression guidance is contained in the guidance documentation.

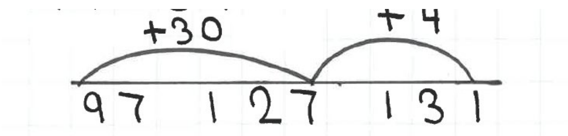
Addition

Stage A- Addition by counting on (number line)

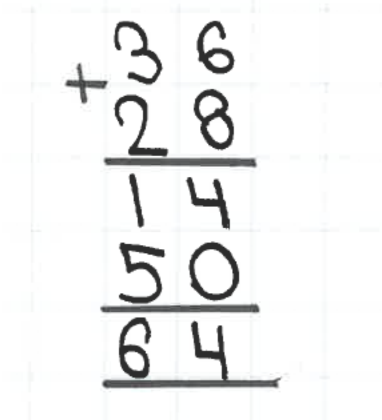


Progressing to counting on through canonical partitioning

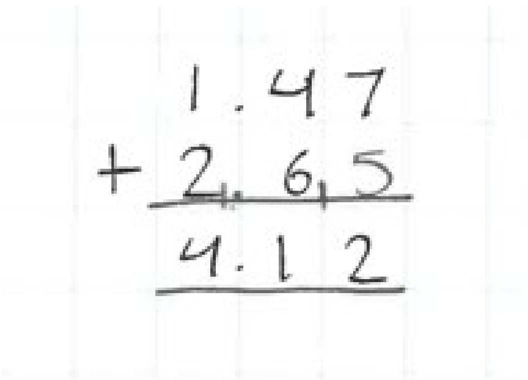




Stage B- Vertical method.
Starting with - expanded vertical

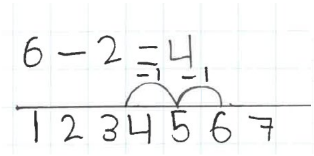


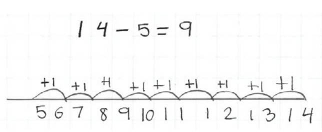
Progressing to the compact vertical method
Remember place value, not digit value- *e.g 1 'ten' not 1.*



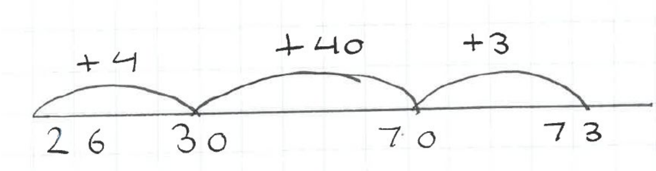
Subtraction

Stage A- Subtraction as finding the difference and taking away on the number line.



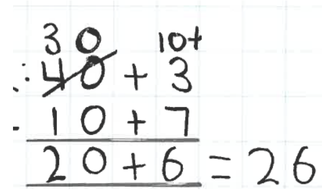


73-26=?

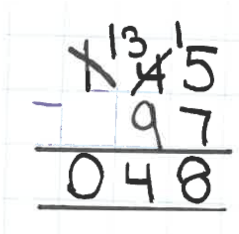


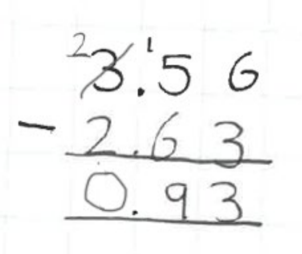
Stage B- Progression to standard vertical method.

Expanded vertical method- partitioning <u>with exchange.</u>
Introduce with place value counters.



Compact vertical method





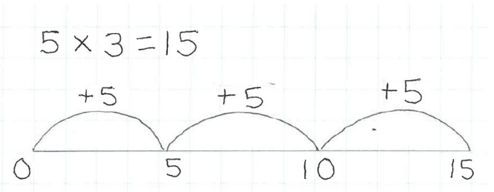
Key Concepts- Correct language when talking about exchange and place value.

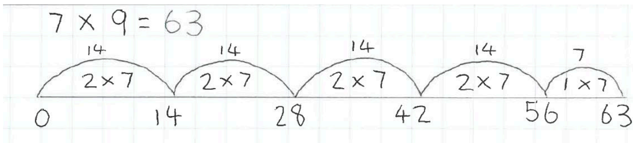
When modeling the formal written method for subtraction, it is important that you do not refer to 'borrowing'. You are **exchanging** (e.g. one '10' for ten '1's')

It is also important that you model the correct place value terminology- e.g. in the example 543-212=?
You would not say:-
"3-2=1, 4-1=3, 5-2=3"
but rather:-
"3-2=1, 40-10=3, 500-200=300"

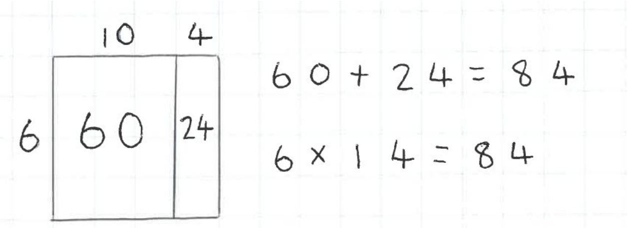
Multiplication

Stage A- Multiplication as repeated addition
(used alongside arrays)



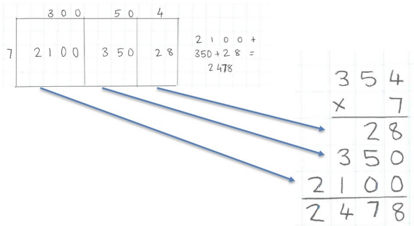


Stage B - Multiplication as an array.

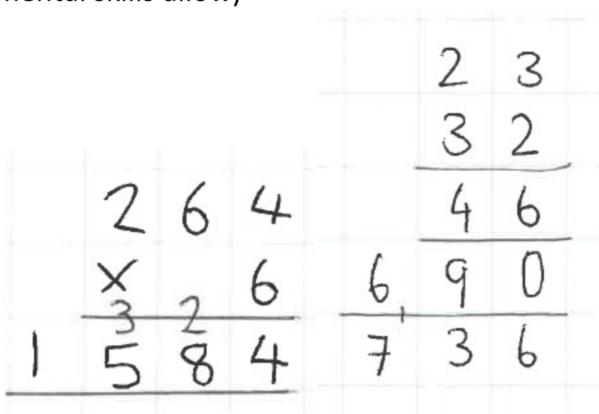


Stage C- Progression to formal written methods

Make conceptual links to the arrays- compare arrays with formal method- what's the same, what's different?



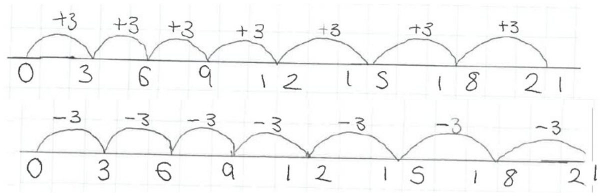
Leading to the compact formal method (when mental skills allow)



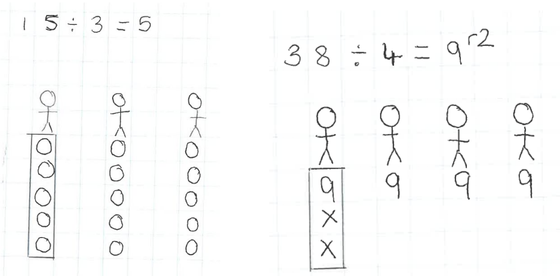
Division

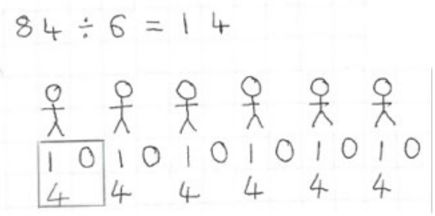
Stage A- Division as grouping and sharing.

21 ÷ 3 = ?



Stage B- Informal sharing written method-

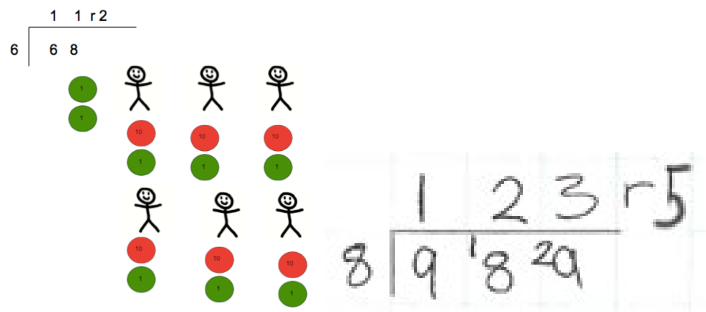




Stage C- Short Division (arrays)

Note- introduce with place value counters- see guidance.
Dividend shared between divisor (e.g. 138 shared between 6 (sharing the hundreds, tens and ones) not 6 shared between 138)

68 ÷ 6 =? 989 ÷8 =?



Stage D- Long division (arrays)-

Using short division method and known facts.