



Calculations Policy

March 2020

Chair of Governors	Heather Aspbury
Head Teacher	Sam Mitchell
Policy written by	Paul Johnson
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Date of next review	
Committee Responsible	Curriculum

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1. Rationale

At Egerton, we believe that all children should master calculation skills that equip them to solve mathematical problems. We believe that a coherent approach embeds their understanding and the use of manipulations will ensure that their knowledge is secure. Visual representations are taught to understand the process of calculations. Strong calculation skills underpin many areas of mathematics and a sequential approach to calculation is imperative for our children's learning. Children will be taught to become fluent and will be able to select appropriate methods to solve calculations.

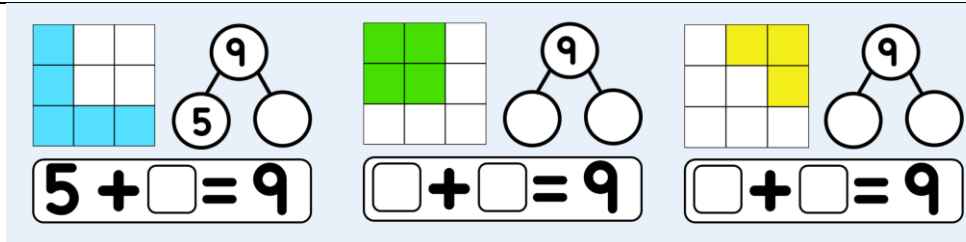
2. Intent

Through the successful implementation of this policy, we intend the following outcomes:

- All children should have strong calculation skills
- All children should be secure in their methods through the use of a CPA approach (Concrete, Pictorial, Abstract)
- Progression in calculation methods is built upon previous knowledge learnt (coherence).
- Children can apply their skills across the curriculum.

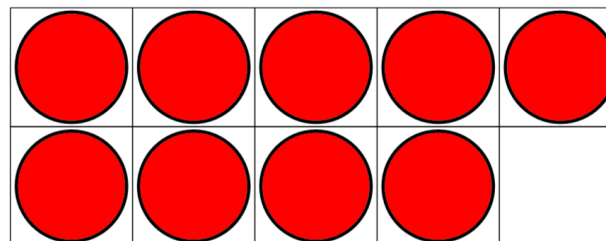
3. Addition

Concept	Methods
Early Counting	Children use a range of everyday objects/manipulations to count and recognise numbers. These should be presented in a number of different ways. All of the images below show the number 9. Part Whole Models Part whole models are used to deepen understanding of partitioning numbers in a variety of ways. This will enable children to become fluent.

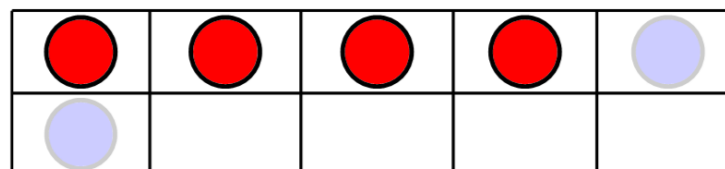


Tens Frames

Tens frames are introduced as a structure for children to count and add. Children should be encouraged to complete a row and know this is five and that the whole frame is worth 10.



$$4 + 2 =$$

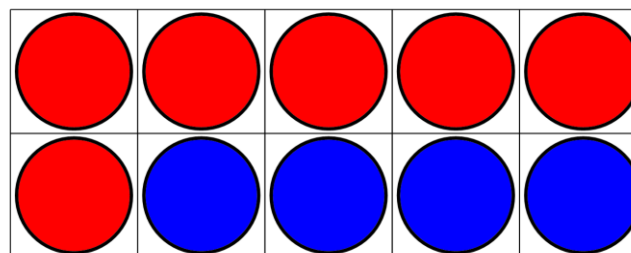


One more

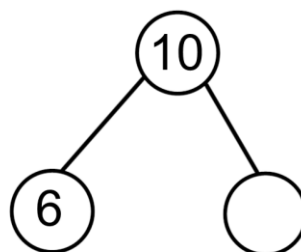
Number tracts are used with manipulations to deepen understanding.

1	2	3	4	5	6	7	8		
									

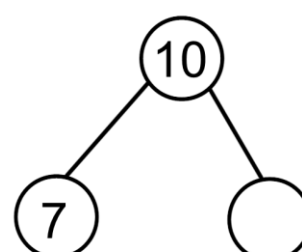
To know number
bonds within and
of 10



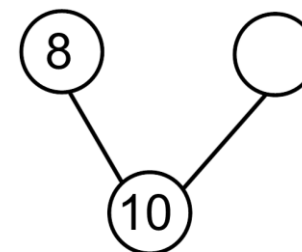
$$6 + 4 = 10$$



$$6 + \square = 10$$



$$10 = 7 + \square$$

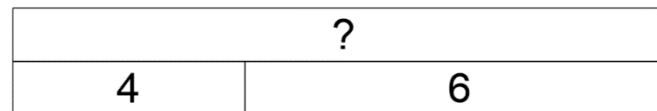
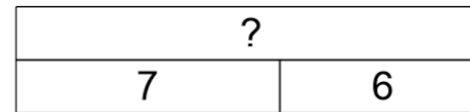
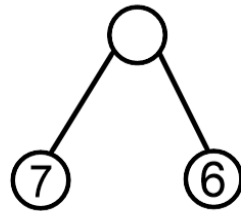


$$8 + \square = 10$$

Children are to know all combinations of 10.

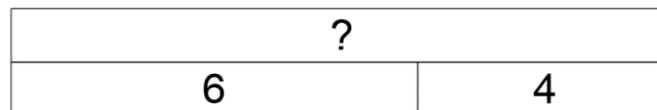
Commutative law

Children to become familiar that addition can be completed in any order. Introduction of bar models develops this.
Link part whole model to bar model first.



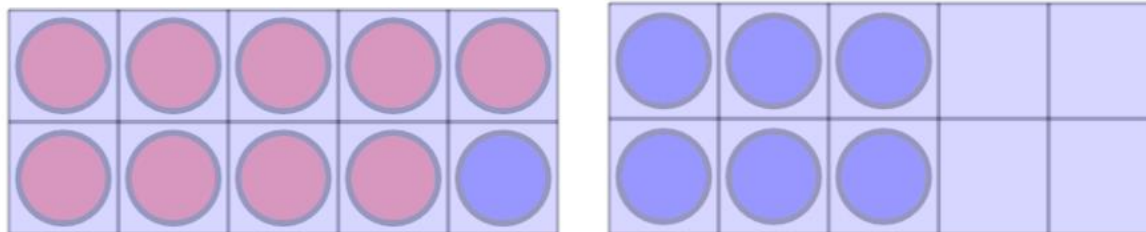
$$4 + 6 =$$

$$6 + 4 =$$

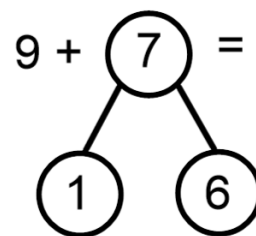


Bridging ten

Using tens frames



Children use 2 tens frames. The above representation helps to embed the below structure.

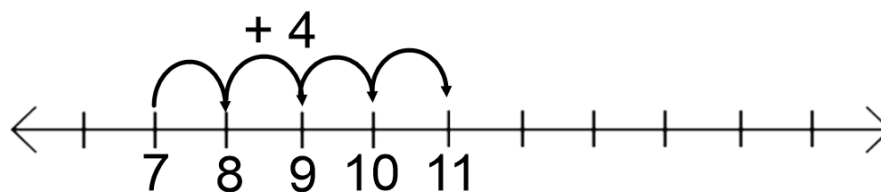


$$9 + 1 = 10$$

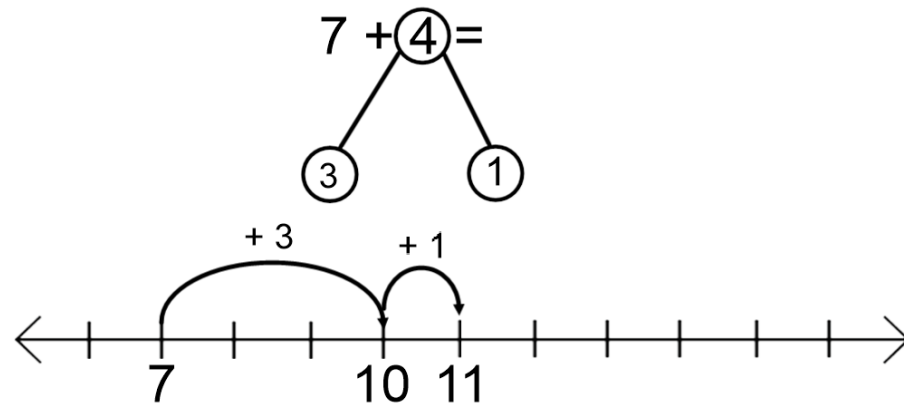
$$10 + 6 = 16$$

Using a Number Line

$$7 + 4 =$$



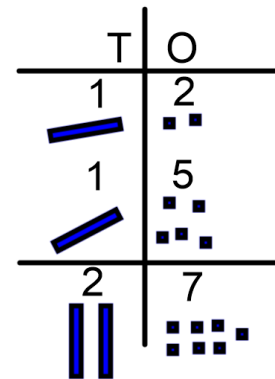
Progress to children adding to the nearest 10.



To use a formal written method

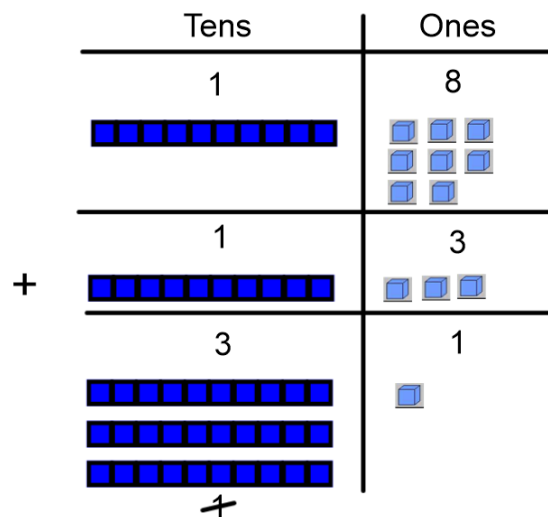
Follow CPA approach using base ten
Introduction of structure should involve no exchange (shown below) until children are secure.

$$12 + 15 =$$



Exchanging

Children need to develop an understanding that 10 ones can be exchanged for 1 ten.



10 of the ones
have been
exchanged for
1 ten.

Abstract method

$$\begin{array}{r} 67 \\ + 81 \\ \hline 148 \\ \hline \cancel{1} \end{array}$$

Adding decimals

$$245 + 17.2 =$$

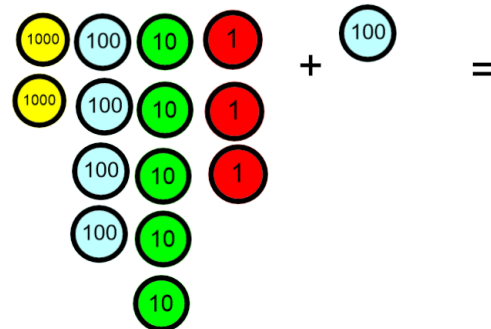
2 4 5 . 0 → a place holder is needed

$$\begin{array}{r} + \quad 17.2 \\ \hline 245.0 \\ \hline 262.2 \\ \hline \end{array}$$

To develop mental strategies for addition

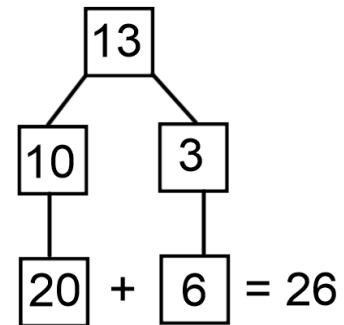
Adding 1/10/100/1000 to a number

$$2453 + 100 =$$

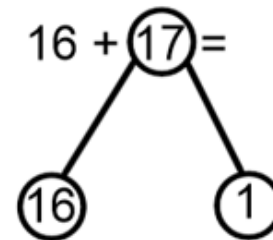


Adding doubles

Partition the number and then recombine



Adding near doubles



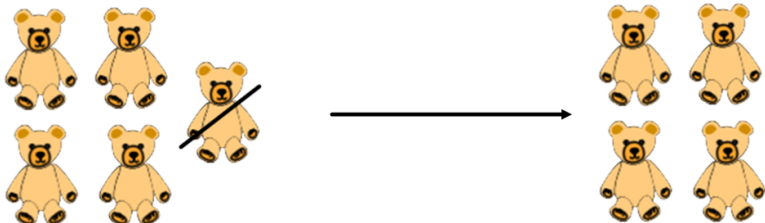
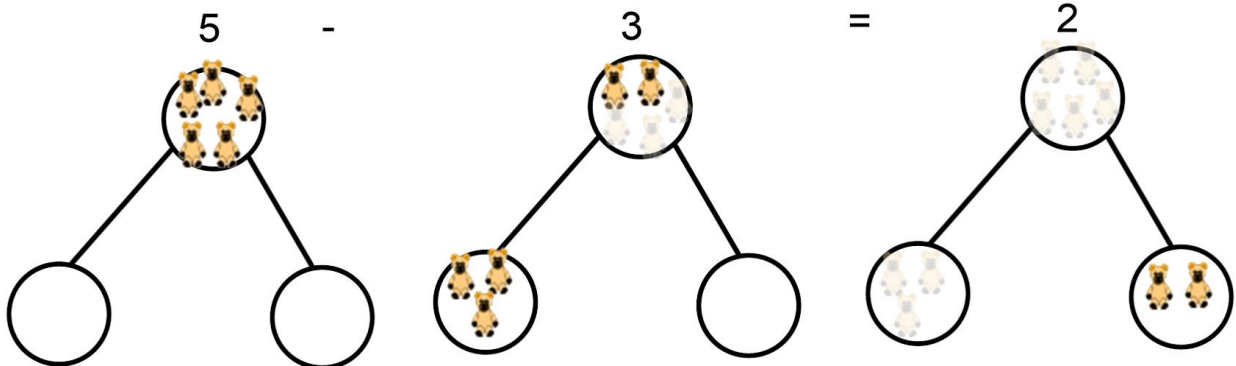
Partition one of the numbers to make a double
Double and then adjust

Adding decimals

$$3 \text{ tenths} + 2 \text{ tenths} = \square \text{ tenths}$$

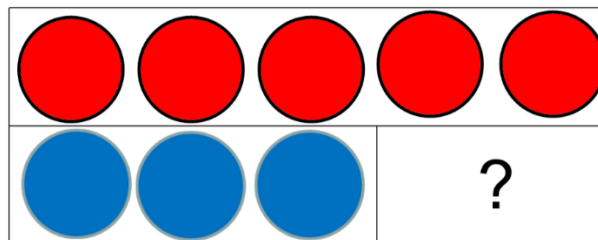
$$0.3 + 0.2 = \square$$

4. Subtraction

Concept	Method
To understand take away	$5 - 1 =$  Introduction of Part-whole model 

To understand difference

$$5 - 3 = 2$$



Bridging ten

Using a Tens frame

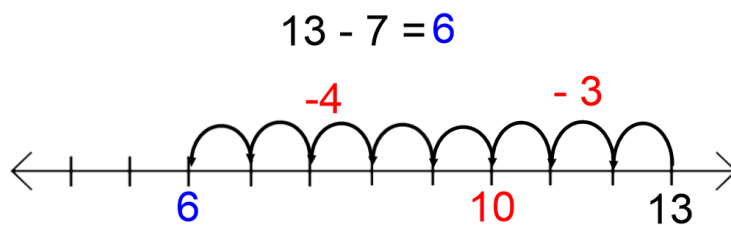
The method of takeaway is used with 2 tens frames to develop understanding. Children partition number being taken away to return to a number of ten.



$$13 - 7 = 6$$

3 4

Using a Number line

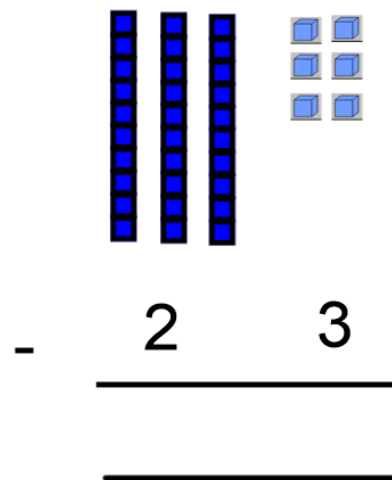


To use a formal written method

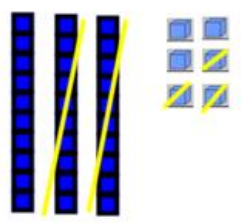
The structure of column subtraction is to be introduced.

Follow a CPA approach using base ten.

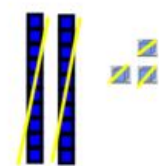
Without Exchange



6 ones takeaway 3 ones equals 3 ones
3 tens takeaway 2 tens equals 1 ten



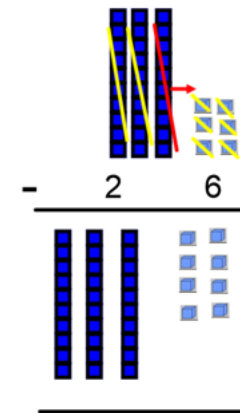
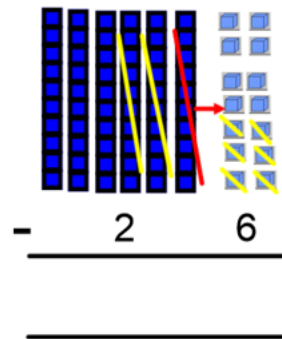
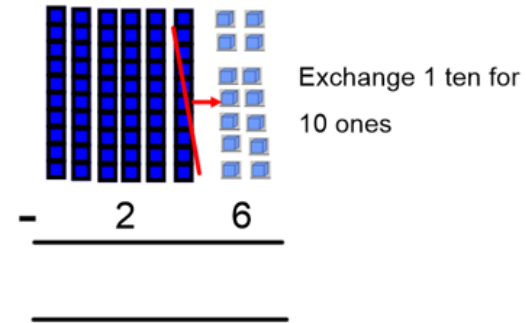
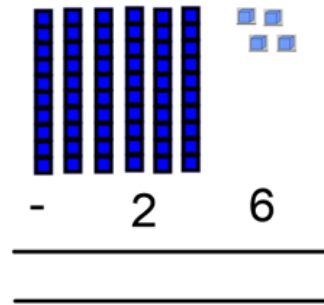
$$\begin{array}{r} - \quad 2 \quad 3 \\ \hline \\ \hline \end{array}$$



$$\begin{array}{r} - \quad 2 \quad 3 \\ \hline \\ \hline \end{array}$$

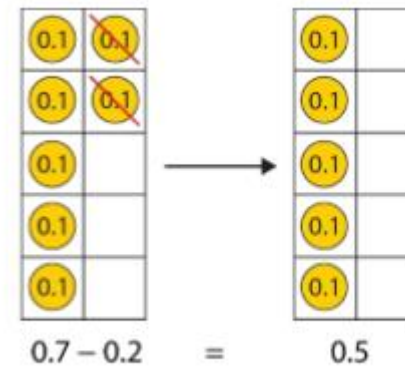
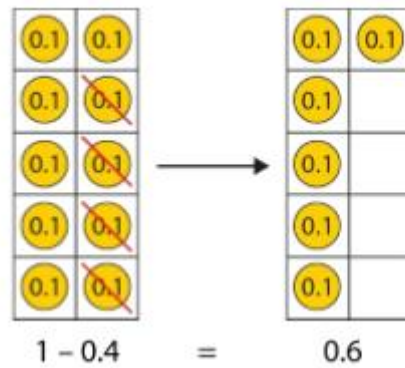
$$\begin{array}{r} 2435 \\ - 1214 \\ \hline 1221 \\ \hline \end{array}$$

With Exchange

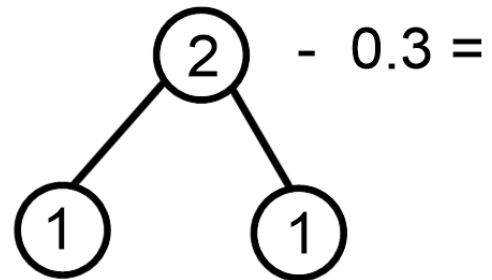
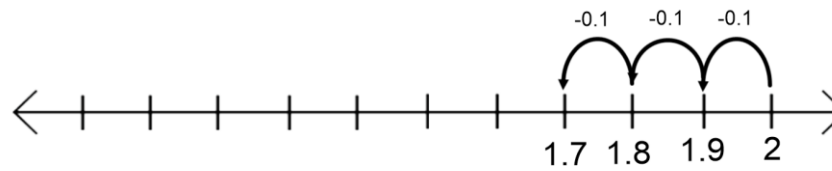


$$\begin{array}{r}
 3 \overset{1}{\cancel{2}} \overset{1}{6} \\
 - 117 \\
 \hline
 219
 \end{array}$$

Subtracting decimals



$$2 - 0.3 =$$



$$1 - 0.3 = 0.7$$

$$0.7 + 1 = 1.7$$

To develop mental
strategies for
subtraction

Subtracting Multiples of 10, 100 and 1000

$$80 - 20 =$$

$$8 \text{ tens} - 2 \text{ tens} = 6 \text{ tens}$$

Subtracting near Multiples of 10/100 and 1000

$$230 - 99 =$$

$$230 - 100 = 130$$

$$130 + 1 = 131$$

$$1283 - 201 =$$

$$1283 - 200 = 1083$$

$$1083 - 1 = 1082$$

5. Multiplication

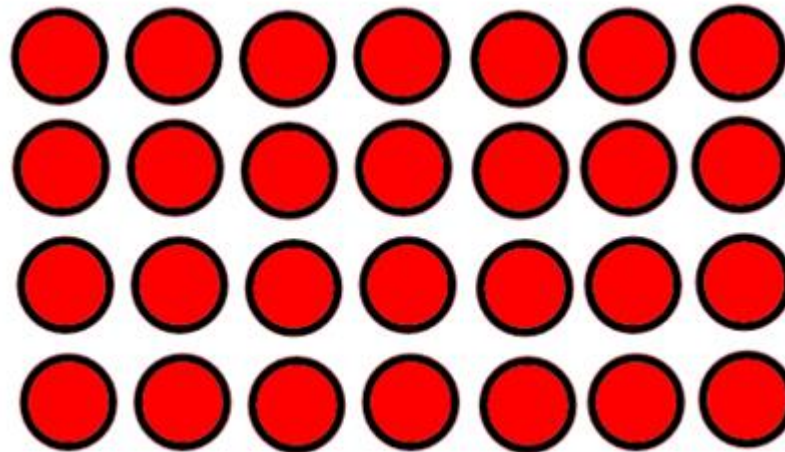
Concept	Method
To understand multiplication as repeated addition	<i>3 groups of 2 equals 6</i> $2 + 2 + 2 = 6$  This progresses to children writing multiplication equation. 3 groups of 2 equals 6 $3 \times 2 = 6$ A bar model is used to represent multiplicative structure.

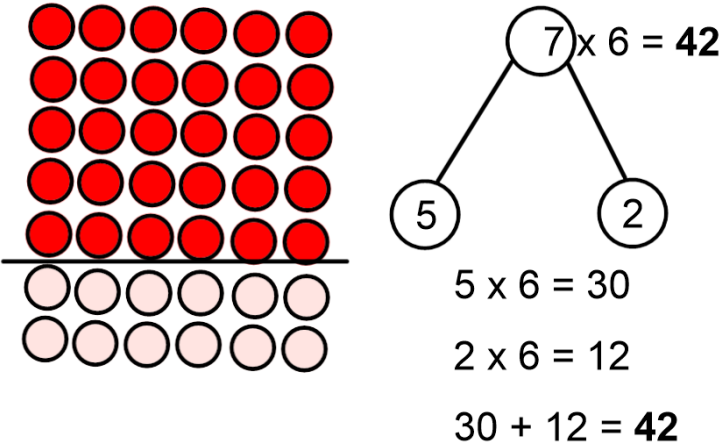
?		
		

?		
4	4	4

To use an array to understand commutativity.

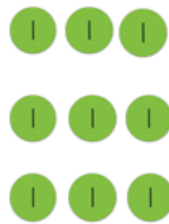
The array below shows 4 rows with each row containing 7, therefore 4×7 . It also shows 7 columns with each column containing 4, therefore 7×4 . This illustrates commutative and that multiplication can be completed in any order.



	This knowledge is applied to multiplying 3 numbers. $3 \times 9 \times 3 = 3 \times 3 \times 9$ (this way the calculation is a mental calculation)
To understand distributive law	Children are to be taught and develop an understanding of distributive law. This provides children with the knowledge that a number can be partitioned. This can make a hard calculation easier to solve by known facts.  $7 \times 6 = 42$ $5 \times 6 = 30$ $2 \times 6 = 12$ $30 + 12 = 42$

To use grid multiplication as a formal written method

Distributive law is applied when using grid multiplication as the number is partitioned. Place value counters are used to develop understanding.

x	10	3
3	 30	 9

This progresses to an abstract method.

$$13 \times 3 =$$

x	10	3
3	(10×3) 30	(3×3) 9

$$30 + 9 = 39$$

To use long multiplication as a formal written method	Long multiplication provides a link between grid multiplication and short multiplication and should be modelled together. $ \begin{array}{r} 14 \\ \times 3 \\ \hline 12 \quad (3 \times 4) \\ 30 \quad (3 \times 10) \\ \hline 42 \end{array} $
To use short division as a formal written method	$ \begin{array}{r} 14 \\ \times 3 \\ \hline 42 \\ \hline \neq \end{array} $ Progress to 3 x 1 digit, 4 x 1 digit before 2 x 2 digit.

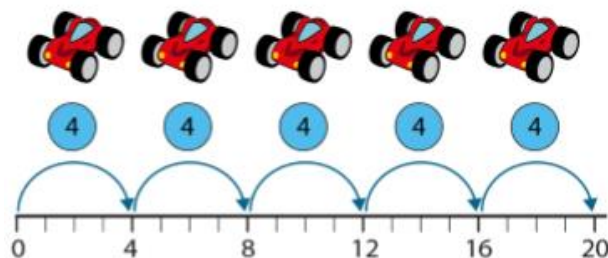
To know all multiplication facts up to 12 x 12

The following multiplication facts are taught in the following years.

Year Two	x10, x 2, x5
Year Three	x 3, x 4, x 8
Year Four	x 6, x 7, x 11, x 12

Children should be taught using a CPA approach (example x4)

'How many wheels are there? Count in groups of four.'



$0 \times 4 = 0$

$1 \times 4 = 4$

$2 \times 4 = 8$

$3 \times 4 = 12$

$4 \times 4 = 16$

$5 \times 4 = 20$

$6 \times 4 = 24$

$4 \times 0 = 0$

$4 \times 1 = 4$

$4 \times 2 = 8$

$4 \times 3 = 12$

$4 \times 4 = 16$

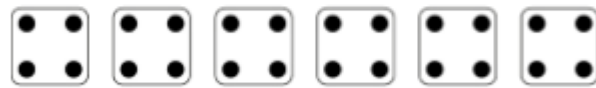
$4 \times 5 = 20$

$4 \times 6 = 24$



$5 \times 4 = \square$

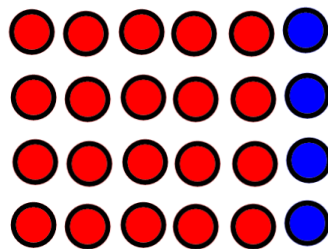
$4 \times 5 = \square$



$\square \times 4 = \square$

$4 \times \square = \square$

$4 \times 6 =$



leads to

$$4 \times \textcircled{6} =$$

$\textcircled{5}$ $\textcircled{1}$

$4 \times 5 = 20$

$4 \times 1 = 4$

$20 + 4 = 24$

$4 \times 5 = 20$

$4 \times 1 = 4$

$20 + 4 = 24$

To multiply by
10/100/100

$$17 \times 10 =$$

All of the digits move 1 place to the left

TTH	Th	H	T	O
			1	7
		1	7	

A place holder is then added if needed

$$17 \times 10 =$$

All of the digits move 1 place to the left

TTH	Th	H	T	O
			1	7
		1	7	0

To use known table facts to solve related facts.

$$4 \times 3 = 12$$

$$40 \times 3 = 120$$

$$4 \times 3 = 12$$

because 40 is ten times bigger than 4 we multiply the product by 10.

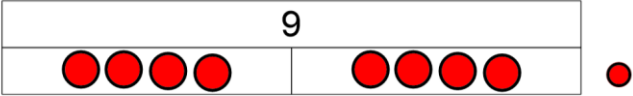
Patterns are developed and relationships are explored.

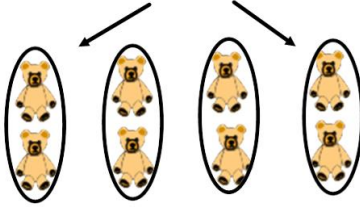
$$4 \times 3 = 12$$

$$40 \times 3 = 120$$

$$400 \times 3 = 1200$$

6. Division

Concept	Method
To understand division as sharing (In sharing you are finding how many are in each group)	8 shared equally between 2 groups A part whole model progresses to a bar model <u>Including remainders</u> The example below, demonstrates 9 divided by 2. Each of the 2 groups will get 4 with 1 left over which is placed outside of the bar model. The statement $1 < 2$ explains why there is a remainder. 9 divided by 2  $9/2 = 4 \text{ r}1$ $1 < 2$
To understand division as grouping (In grouping you are finding how many groups)	There are 8 teddies and in each group there are 2 teddies.

	8 divided by 2  Children need to understand the difference between grouping and sharing.
To use known division facts to know related facts.	Children to use time table facts to spot patterns $12 \div 3 = 4$ $120 \div 3 = 40$ $1200 \div 3 = 400$ <i>As the dividend increases by x10, the quotient increases by x10.</i> $12 \div 3 = 4$ $1.2 \div 3 = 0.4$ $0.12 \div 3 = 0.04$ <i>As the dividend decreases by x10, the quotient decreases by x10.</i>

$$12 \div 3 = 4$$

$$12 \div 30 = 0.4$$

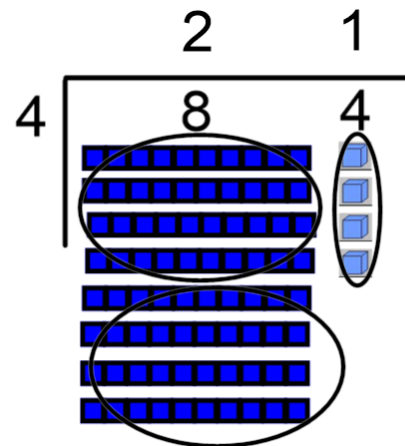
$$12 \div 300 = 0.04$$

As the divisor increases by x10, the quotient decreases by x10.

To use short division as a written method to divide by a single digit number

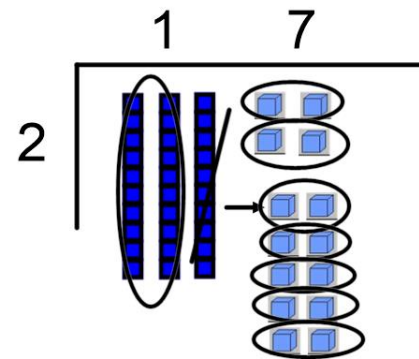
The method for short division is grouping.

No exchange



When secure move onto exchange

34 divided by 2



Abstract no exchange

$$\begin{array}{r} 21 \\ 4 \overline{) 84} \end{array}$$

*There are 2 groups of 4 tens in 8 tens.
There is 1 group of 4 ones in 4 ones.*

Abstract with exchange

$$\begin{array}{r} 117 \\ 3 \overline{) 3521} \end{array}$$

Including exchange into decimals (introduced in Year 5; by Year 6 if dividing by a a single digit number children should go into decimals)

To use chunking as a written method to divided by a 2 digit number

Write first 5 multiples

- 28 (x 1)
- 56 (x 2)
- 84 (x 3)
- 112 (x 4)
- 140 (x 5)

$$\begin{array}{r} 127 \\ 28 \overline{) 3556} \\ \underline{- 2800 \text{ (x 100)}} \\ 756 \\ \underline{- 560 \text{ (x 20)}} \\ 196 \\ \underline{- 140 \text{ (x 5)}} \\ 56 \\ \underline{- 56 \text{ (x 2)}} \\ 0 \end{array}$$