Calculation Policy 2017

'With Christ at our centre, we love, listen and learn'

Whilst working through the stages in calculation it is important to provide opportunities to rehearse and develop mental calculations strategies.

Key mental calculation strategies include:

From Year R:

- Partition and recombine
- Doubles and near doubles
- Use number pairs to 10 and 100
- Counting on

From Year 1

- Adding near multiples of ten and adjusting
- Using patterns of similar calculations
- Using known number facts
- Bridging though ten, hundred, tenth
- Use relationships between operations

From Year 3

- x4 by doubling and doubling again
- x5 by x10 and halving
- x20 by x10 and doubling

Stages in counting

All children go through these stages in counting. Generally, they should be secure with them by the end of Year R.

1. Stable order (knowing numbers come in an order)
2. One to one correspondence (touching and counting)
3. Cardinal (knowing last number is the total)
4. Abstraction (being able to count without seeing/touching items)
5. Order irrelevance (doesn't matter how you count the total will be the same)

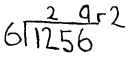
Place value

- Positional: the quantities represented by the individual digits are determined by the positions that they hold in the whole numeral. The value given to a digit is according to the position in a number
- Base 10: the value of the position increases in powers of 10
- Multiplicative: the value of an individual digit is found by multiplying the face value of the digit by the value assigned to its position
- Additive: the quantity represented by the whole numeral is the sum of the values represented by the individual digits

For example:

1000	100	10	1
6	8	3	7

Positional: 6 is in the 1000's position, 8 in the hundreds, 3 in the tens and 7 in the ones
Multipicative: because 6 is in the 1000's position it is multipled by 1000 to give its value, 8 is multiplied by 100, 3 by 10 and 7 by one to give their values.
Additive: add all the numbers together to give the total 6000 + 800 + 30 + 7 = 6837
Base 10: if 37 is multipled by 10, 3 tens becomes 3 hundreds, 7 ones become 7 tens and a place holder is placed in the ones position: 370



The children need to be able to partition numbers in different ways to help understanding and also mental calculation:

- Partition all pairs of numbers for all numbers to 20, e.g. 1 + 4 = 5, 2 + 3 = 5, 3 + 2 = 5
- Partition 2-, 3- etc. digit numbers in different ways, e.g. 57: 50 + 7, 40 + 17, 30 + 27, 20 + 17, 10 + 7

Equals sign

The equals sign is not an indication of an answer. It is a sign of equivalence – the same as.

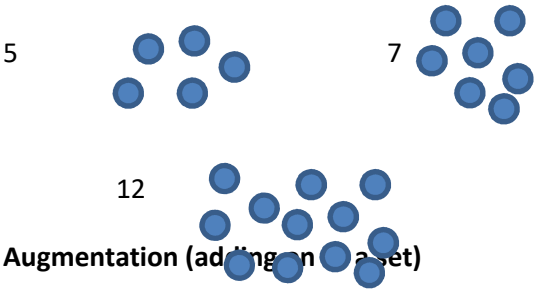
Year 1: 2 + 3 = 1 + ☖

Year 5: 23 + y = 35. Take 23 away from both sides, y = 12

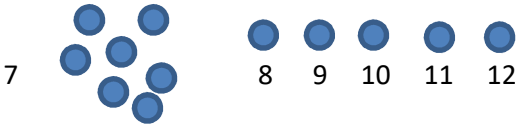
Year 6: 2y + 36 = 40. Take 36 away from both sides, 2y = 4. Divide both sides by 2, y = 2

Stages in addition

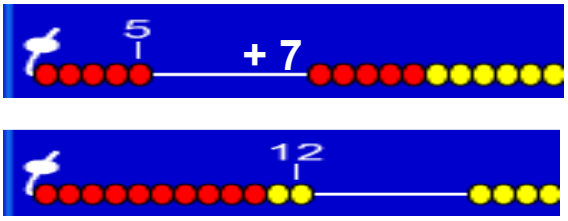
Aggregation (counting all)



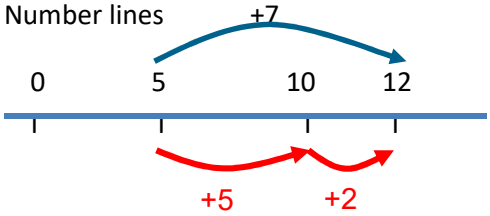
Augmentation (adding on a set)



Bead strings



Number lines



Partitioning

48 + 33

40 8 30 3 = 70+11= 81

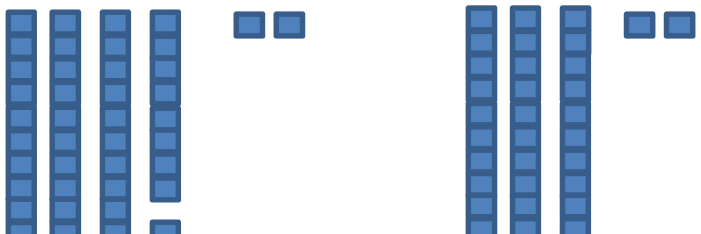
48
+ 33
70
11
81

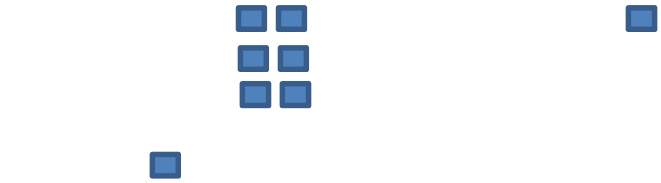
Sequencing

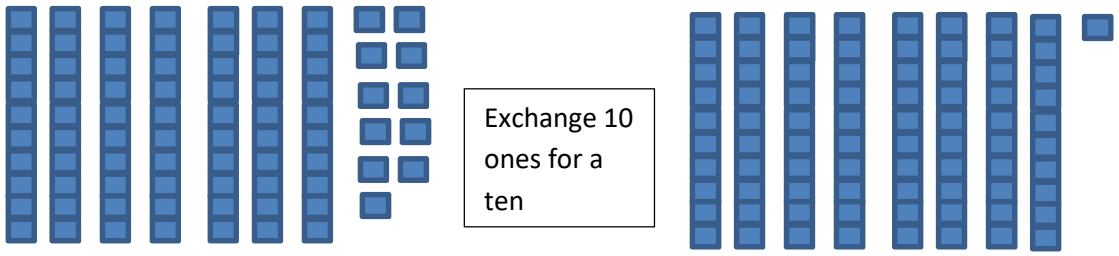
48 + 30 + 3 = 78 +3 = 81

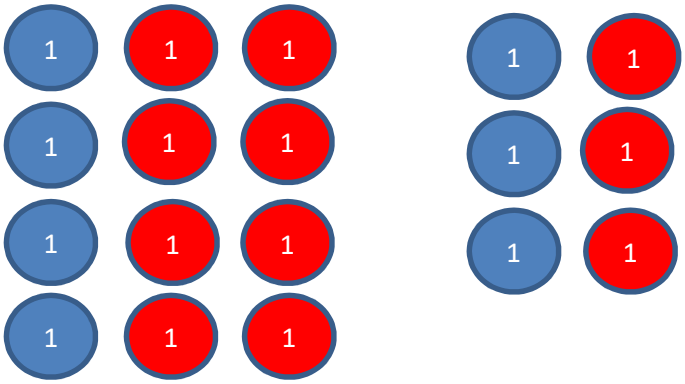
Compact method

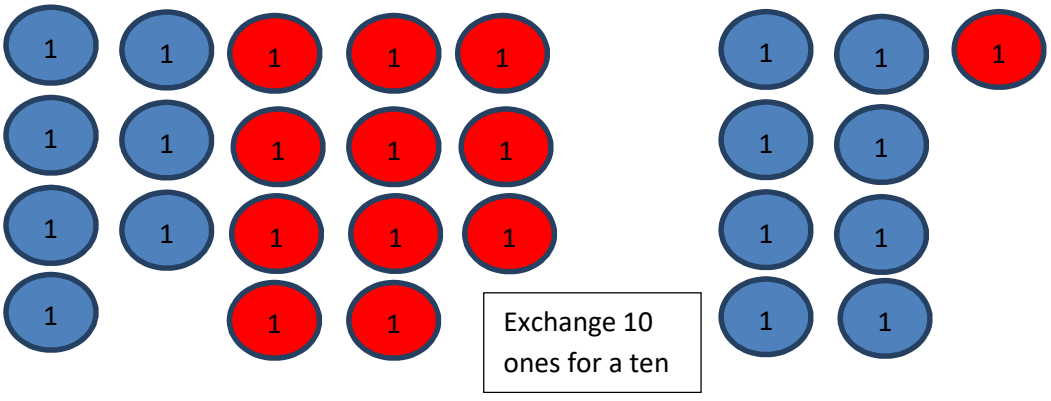
Use of manipulatives to lead to short method: 48 + 33









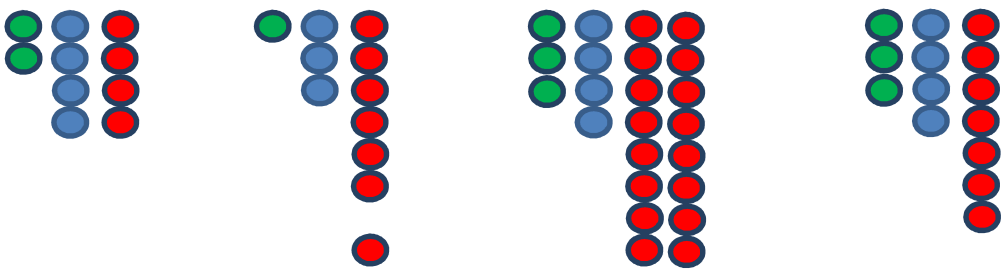


$$\begin{array}{r} 48 \\ +\ 33 \\ \hline 81 \\ \hline 1 \end{array}$$

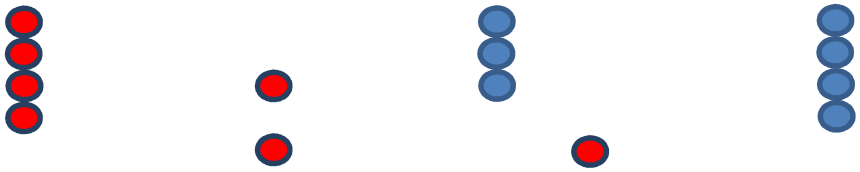
What's the same? What's different?

Compact method (with manipulatives first)

$$\begin{array}{r} 248 \\ +\ 139 \\ \hline 487 \end{array}$$

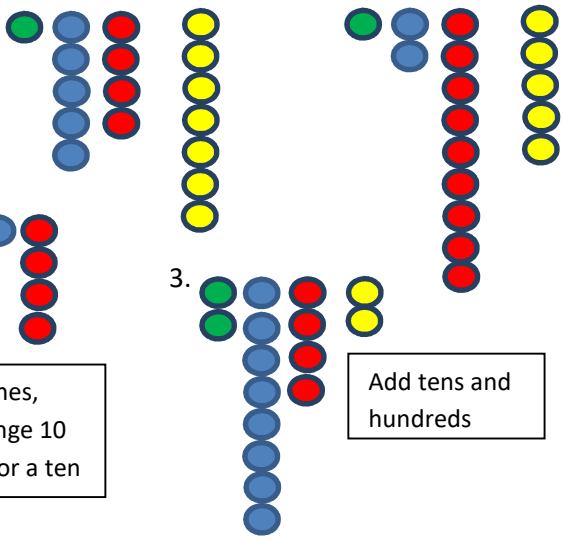


1

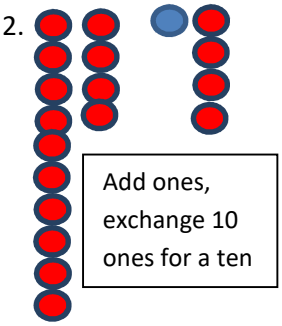


Compact method: decimals (with manipulatives first)

154.7
+ 129.5
284.2
1 1



2.

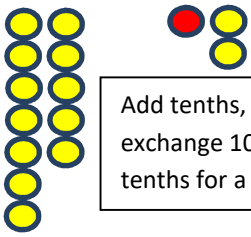


Add ones, exchange 10 ones for a ten

3.

Add tens and hundreds

1.

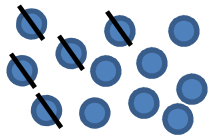


Add tenths, exchange 10 tenths for a one

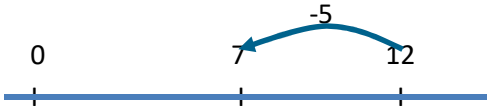
Stages in subtraction

Removing items from a set (reduction or take-away)

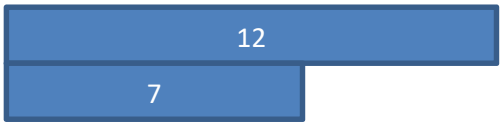
12 – 5 = 7

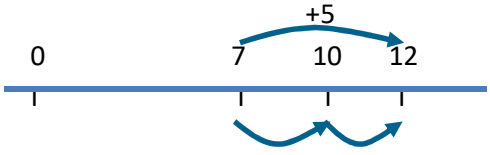


Counting back along a number line



Finding the difference on a number line





+3 +2

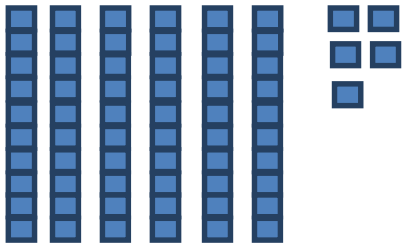
Sequencing

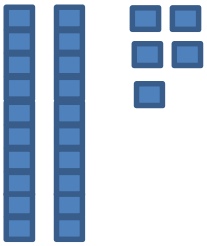
56 – 24

56 – 20 – 4 = 36 – 4 = 32

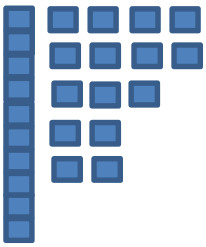
Use of manipulatives to lead to compact method:

65 – 49 Take away 40

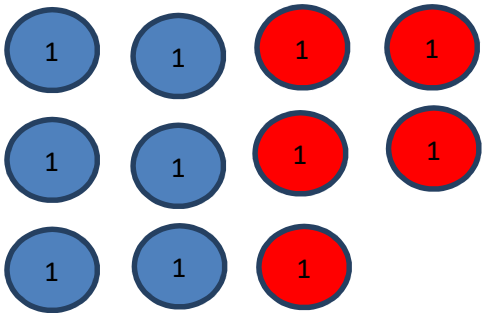


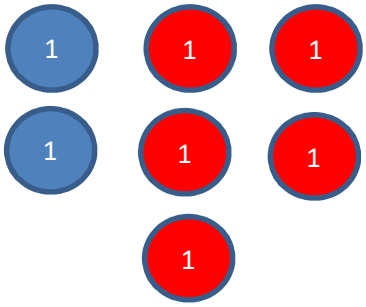


Exchange one 10 for 10 ones in order to take away 9

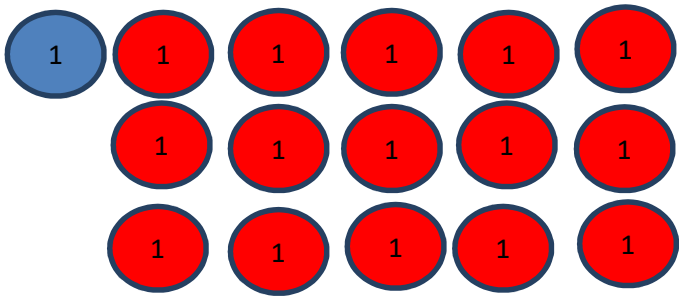


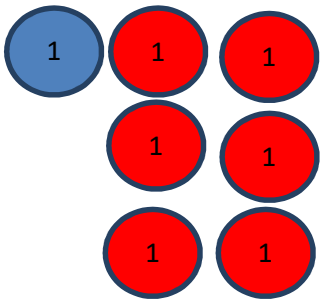
65 – 49 Take away 40





Exchange one ten for 10 ones Take away 9





Partitioning and re-partitioning to lead to short method

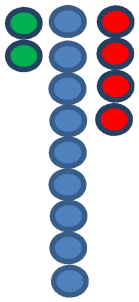
294 – 178

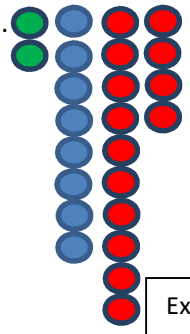
200 90 4	200 80 14
- 100 70 8	- 100 70 8
	100 10 6

100 + 10 + 6 = 116

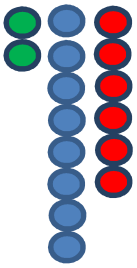
Compact method (with manipulatives first)

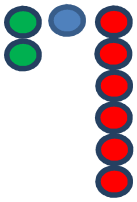
$$\begin{array}{r} 2\,{}^{8}\!\not{9}\,{}^{1}4 \\ -\ 1\ 7\ 8 \\ \hline 1\ 1\ 6 \end{array}$$

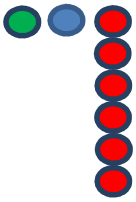
1. 

2. 

Exchange one ten for ones and subtract 8

3. 

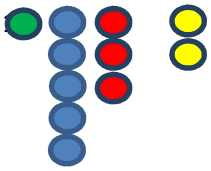
4. 

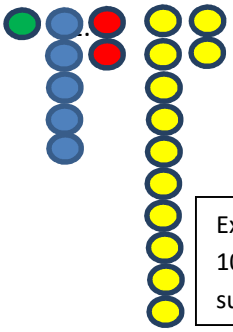
5. 

Subtract tens and then hundreds

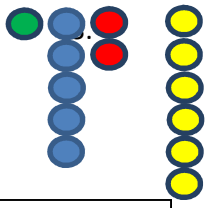
Compact method: decimals (with manipulatives first)

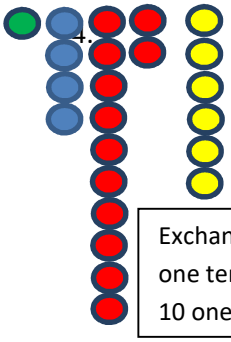
$$\begin{array}{r} 1\,{}^{14}\!\not{5}\,{}^{12}\!\not{3}.{}^{1}2 \\ -\ 9\ 7.6 \\ \hline 5\ 5.6 \end{array}$$

1. 

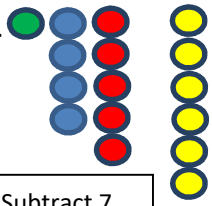
2. 

Exchange one for 10 tenths and subtract 6 tenths

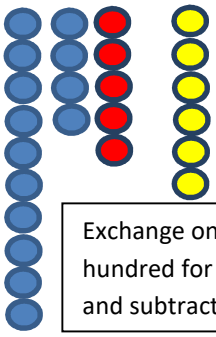
3. 

4. 

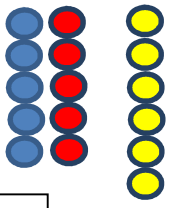
Exchange one ten for 10 ones

5. 

Subtract 7

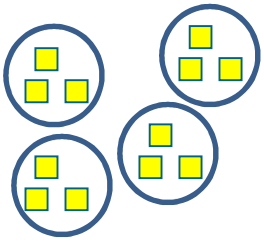
6. 

Exchange one hundred for 10 tens and subtract 9 tens

7. 

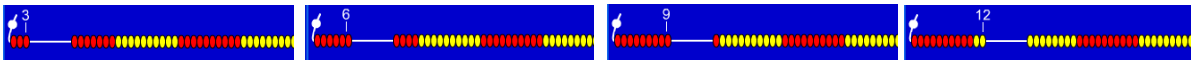
Stages in multiplication

Groups of the same thing

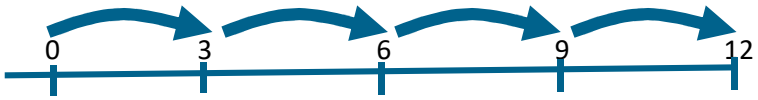


4 groups of 3 = 3 four times = 3 x 4

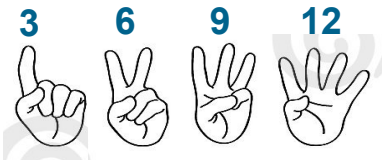
Bead strings



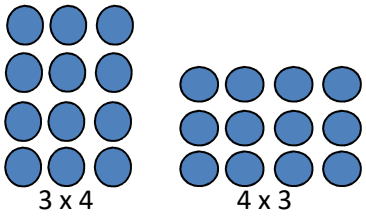
Number lines



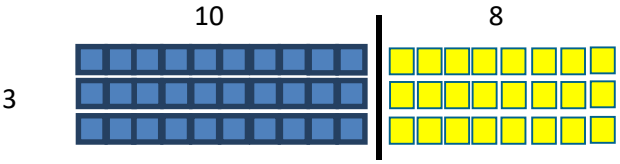
Fingers



Arrays

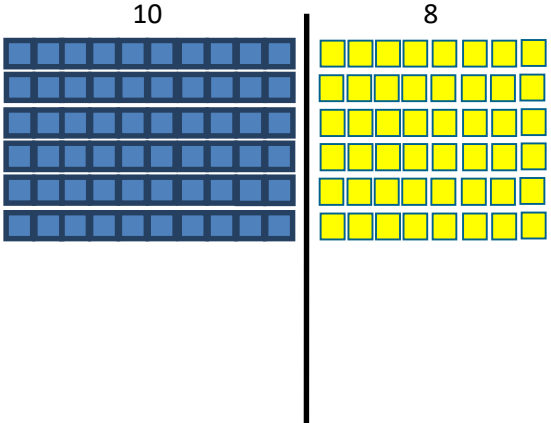


Arrays to support the grid method

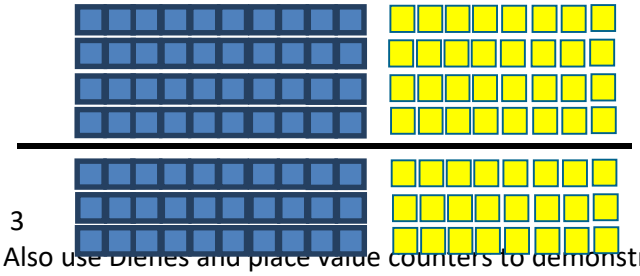


	10	8
3	30	24

Total: 54



10



3

Also use Dienes and place value counters to demonstrate this

	10	8	
10	100	80	180
3	30	24	54
		Total:	234

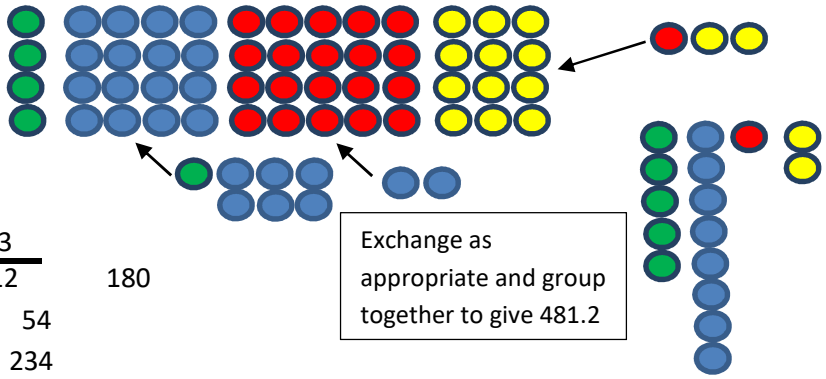
Leading to compact method:

```
  18
x 13
  54
 180
 234
```

or…

18	18	180
x 10	x 3	+ 54
180	54	203

Compact method: decimals



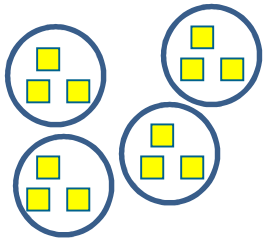
Exchange as appropriate and group together to give 481.2

	100	40	5	.3	
4	400	160	20	12	180
3	30		24		54
			Total:		234

```
145.3
x   4
581.2
111
```

Stages in division

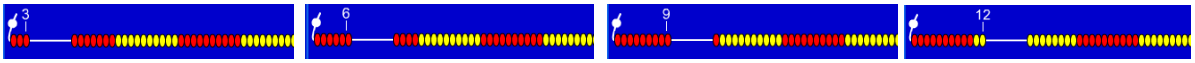
Groups of the same thing



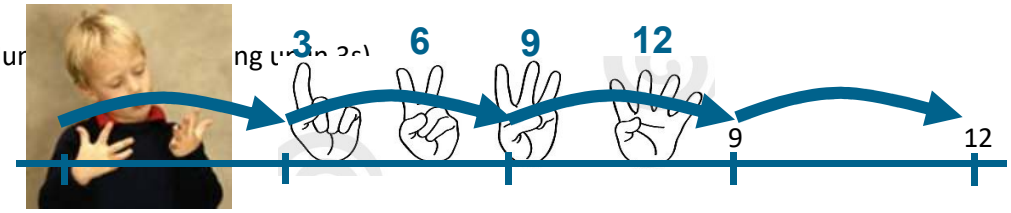
12 ÷ 3

How many groups of 3 in 12

Bead strings

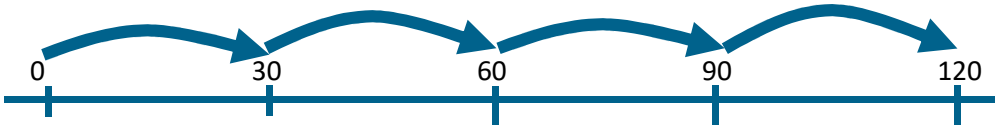


Fingers



Counting in larger multiples:

122 ÷ 3



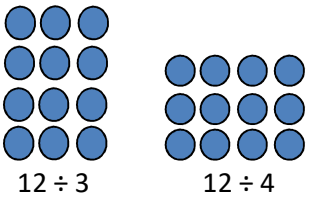
Vertical grouping:

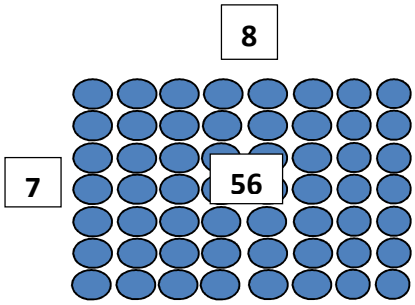
122 ÷ 3
- 120 (3 x 40)
2

Partitioning:

120 + 2
40 remainder 2 out of a group of 3 or 2/3

Arrays





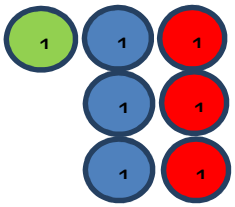
Leading to:

$$7\overline{)56}\quad 8$$

Compact method (with manipulatives first)

133 ÷ 6

Important to let the children use manipulatives such as place value counters to explore exchange:



You cannot take 6 groups of 100 away from the one 100

Exchange the 100 for 10 tens so you have 13 tens

$$6\overline{)\not{1}\,^{1}3\;3}$$

You can now take two groups of 6 tens

$$\begin{array}{r} \quad 2 \\ 6\overline{)\not{1}\,^{1}3\;3} \end{array}$$

One groups of ten will be left. This is exchanged for 10 ones. You now have 13 ones.

$$\begin{array}{r} \quad 2 \\ 6\overline{)\not{1}\,^{1}\not{3}\,^{1}3} \end{array}$$

You can take another two groups of 6 ones from the 13 leaving a remainder of 1

$$\begin{array}{r} \quad 2\;2\;^{1}/_{6} \\ 6\overline{)\not{1}\,^{1}\not{3}\,^{1}3} \end{array}$$

Compact method: decimals (with manipulatives first)

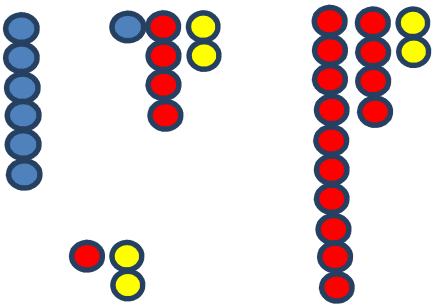
73.2 ÷ 6

Important to let the children use manipulatives such as place value counters to explore exchange:

You can take one group of six 10s away from the seven 10s. There will be one hundred left

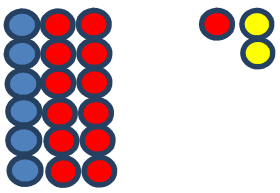
Exchange the 10 for 10 ones so you have 13 ones

$$\begin{array}{r} \quad 1 \\ 6\overline{)\not{7}\,^{1}3.\;2} \end{array}$$



You can now take two groups of 6 tens

$$\begin{array}{r} \quad 1\;\;2 \\ 6\overline{)\quad\quad} \end{array}$$

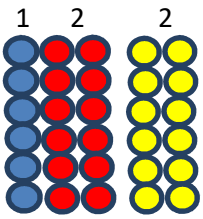


6 $\overline{)7^{1}3.2}$

One will be left. This is exchanged for 10 tenths. You now have 12 tenths.

$$6\overline{)7^{1}3.^{1}2}\quad 1\ 2.2$$

You can take two groups of 6 tenths



$$6\overline{)7^{1}3.^{1}2}\quad 1\,2.2$$

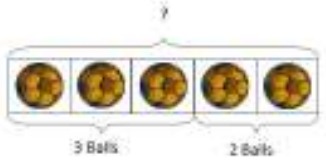
The bar model

This visual representation helps children make sense of problems. It needs to begin in EYFS (practically and visually) then developed throughout the school.

EYFS:

There are 3 footballs in the red basket and 2 footballs in the blue basket.

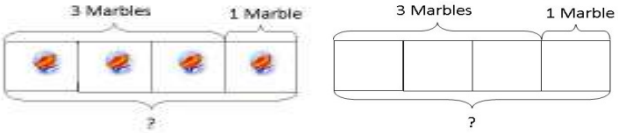
How many footballs are there altogether?



Peter has 3 marbles.

Harry gives Peter 1 more marble.

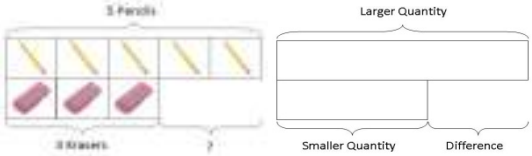
How many marbles does Peter have now?



Visual to Abstract

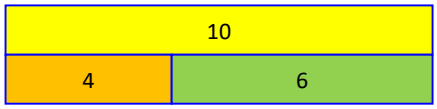
Peter has 5 pencils and 3 erasers.

How many more pencils than erasers does he have?

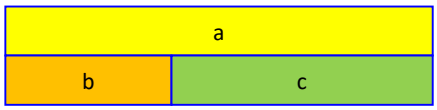


Visual to Abstract

Year 1 upwards:



This leads to an abstract model which helps with links between addition and subtraction



a = b + c	a = c + b
b = a – c	c = a - b

This can then help the children solve, for example, missing number problems:

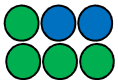
45 + ? = 93, ? – 62 = 13, 146 - ? = 79, ? + 82 = 147

Peter has 4 books.
Harry has three times as many books as Peter. How many more books has Harry?

Peter's books 
Harry's books 

Sam had 5 times as many marbles as Tom. If Sam gives 26 marbles to Tom, the two friends will have exactly the same amount. How many marbles do they have altogether?

Tom's marbles 
Sam's marbles 


26 so each circle is worth 13

On the Google Drive (under Numeracy) there are Smartboard files which have examples of these for each year.

To be reviewed: 2018