Fernwood Primary and Nursery School

Calculation Policy

Updated September 2020

At Fernwood Primary and Nursery School we accept and understand that all children develop differently and therefore cannot be expected to make progress at exactly the same rate.

To this end, we present our **Calculation Policy** which outlines our approach and the methods that we employ in the teaching of both written and mental calculating.

Children are encouraged to *approximate* their answers before calculating and they are also encouraged to *check* their answers after calculation using an appropriate strategy (e.g. the inverse method, etc.)

Estimate!
Calculate!
Check!

Children are also encouraged to consider whether a mental calculation would be appropriate before using written methods. From there, all of our children will be using some of the methods outlined here for each of the four operations. We ask parents and carers to understand that not all children will be at exactly the same stage even though they may be of the same age.

With this in mind, this document is intended to inform and help parents and carers as they work at home with their children, giving at the same time an insight into how we expect children to work and record their calculations.

By the end of their time at Fernwood Primary and Nursery School, our children will have developed a range of methods, both mental and written, the selection of such will depend upon the numbers involved and a child's confidence.

Great importance is also placed upon children's increasing ability with regard to mental maths, including such things as number bonds to 10, 100, 1000; doubles; square numbers, percentages and fractions; decimals and factor pairs.

Children are also encouraged to use jottings to show their calculations and thoughts.

Underpinning all that follows is an expectation that children will learn their times tables as the importance of this cannot be stressed enough. Children will begin by learning the 2x, 5x and 10x, and should then develop a quick recall of the all the other times tables up to and including 12 x 12.

Children will encounter many different ways of learning their times tables (songs, chants, games, quick tests, etc) and anything extra you can do at home to help with this will be beneficial.

In addition, we would hope that children would also know the corresponding division facts.
i.e. how many 7s make 35?

The ‘Inverse Operation’

Throughout their time with us, our children are always taught to check their answers to whatever type of calculations they are performing.

One of the key ways to do this is to use the ‘Inverse Operation’ which, quite simply put, means to ‘do the opposite’.

For example, if a child is given this calculation ...

487
-263
224

... the expectation would be that the child could then add the answer (224) to the number that was taken away (263) just to ensure that we get back to the number that we began with (487).

This is a very simple method of checking and works with all the four operations, as can be seen here ...

- *2-number addition can be checked by subtracting one of the two numbers from the answer and ensuring that you are left with the other number.*
- *Subtraction can be checked using the method described in the example above;*
- *If children perform a division calculation they can multiply the answer by the divisor to check that they return to the original number being divided.*
- *Multiplication can be checked by dividing the answer by one of the two multipliers.*

CALCULATION POLICY

1 … Addition

2 … Subtraction

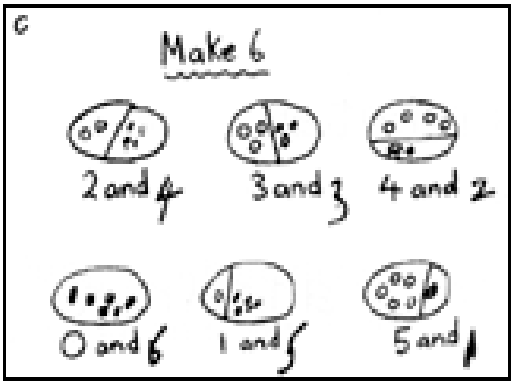
3 … Multiplication

4 … Division

ADDITION

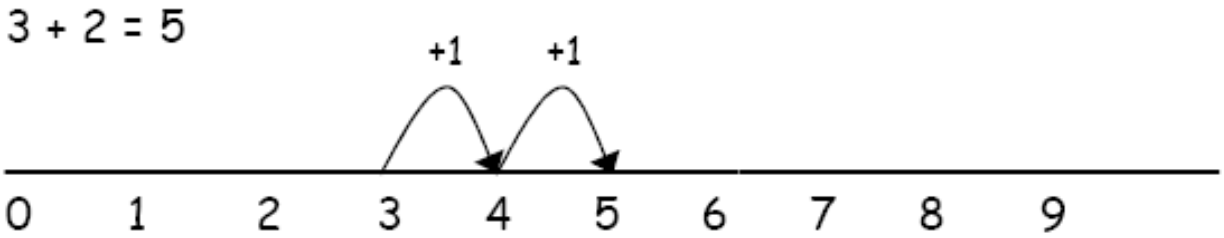
- Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures, etc.

- Children will draw pictures of additions and perform one-to-one matching activities using counters and other apparatus.

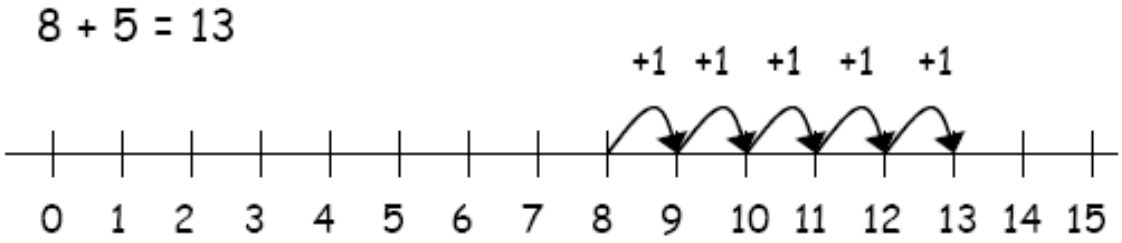


- Children count on their fingers using small numbers (i.e. number bonds to ten) and use "10 Frames" as a way of visualising this.

- They use number lines and practical resources to support calculation and teachers *demonstrate* the use of the number line where children **'count on'**. It is easier to count on from the larger number.



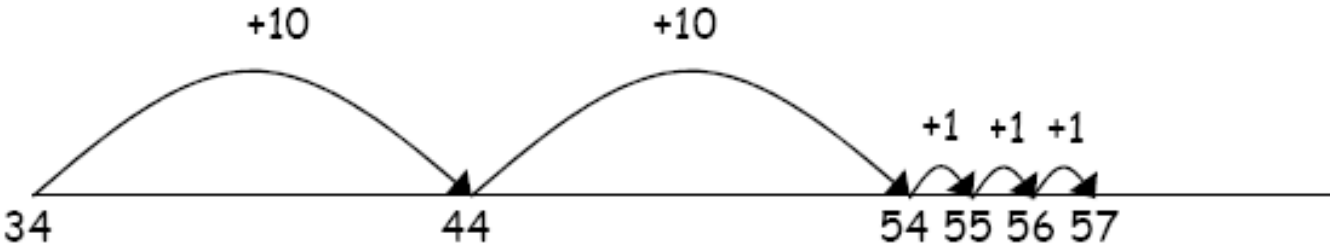
- Children then begin to use numbered lines to support their own calculations using a numbered line to count on in ones.



- Children will begin to use 'empty number lines' themselves starting with the larger number and counting on.

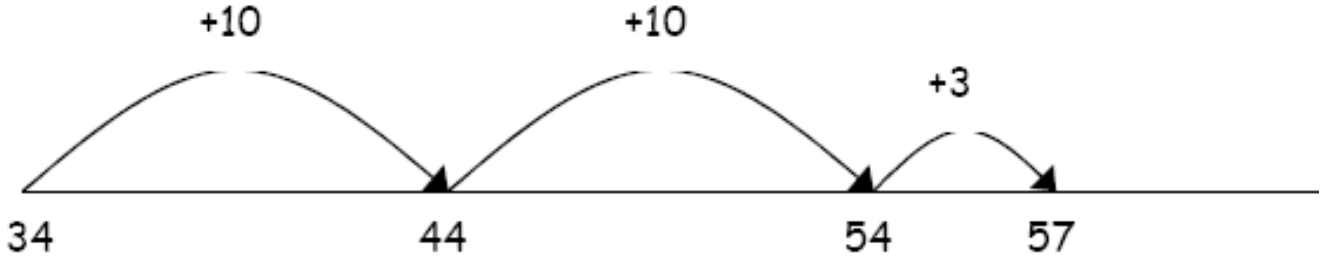
- First counting on <u>in tens</u> (rather than up to the next ten) and ones.

34 + 23 = 57



- Then helping children to become more efficient by adding the units in one jump (by using the known fact 4 + 3 = 7).

34 + 23 = 57

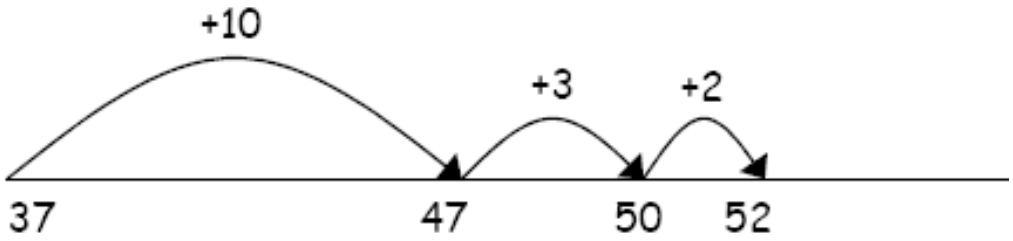


- Followed by adding the tens in one jump and the units in one jump.

34 + 23 = 57

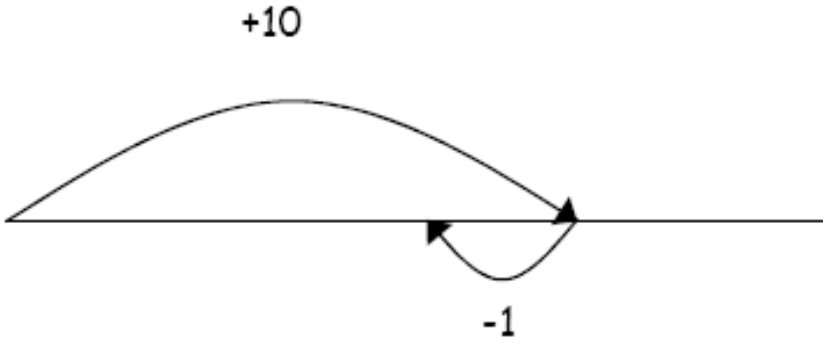
- *'Bridging'* through ten can help children become more efficient.

37 + 15 = 52



- Adding ten and then *compensating* when adding 9, 11, 19, 21 etc

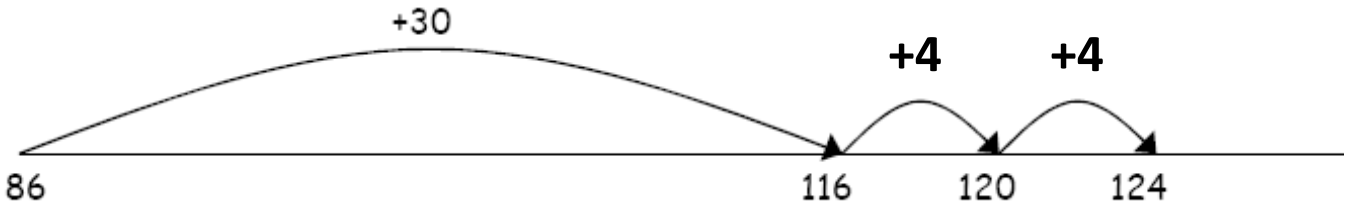
36 + 9 = 45



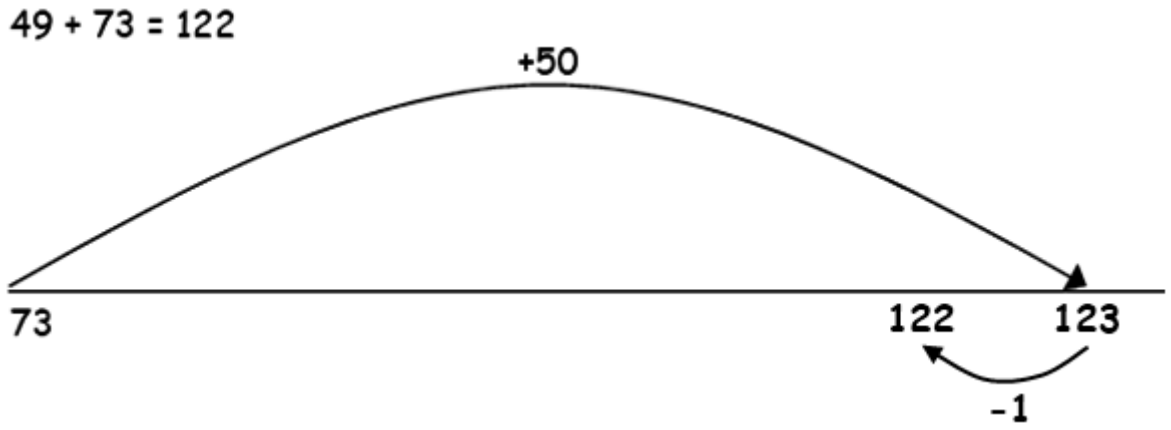
- Children will continue to use empty number lines with increasingly large numbers, including compensation where appropriate.

- Count on from the largest number irrespective of the order of the calculation.

38 + 86 = 124



- Compensation



- Children also use 100-squares to 'count on'. It's easy to add on 10s as they simply drop a row and then 'count on'; many will also use a ruler to 'count on'.

- Children soon move on to column addition without 'carrying' at first.

43	**12**
+24	**+46**
67	**58**

- Some children might now be taught *'expanded addition'* where they 'partition' or 'split' the numbers into their component tens and units and then add them, like this …

53 → **50 + 3**
+42 → **40 + 2**
90 + 5 → 95

- This may be further developed as follows

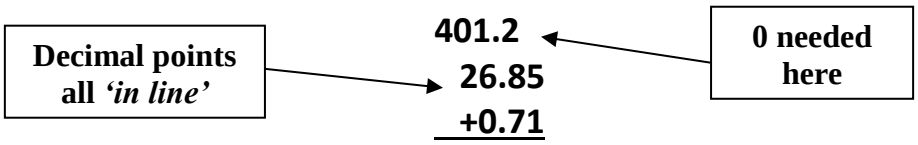
373
+168
11 → 3 + 8
130 → 70 + 60
400 → 300 + 100
541 → total

- From this, children will begin to carry below the line.

$$\begin{array}{r} 783 \\ +\ 42 \\ \hline 825 \\ \hline 1 \end{array} \qquad \begin{array}{r} 367 \\ +\ 85 \\ \hline 452 \\ \hline 11 \end{array}$$

- From here children are able to add 3 and 4 digit numbers, decimals and money, knowing that it is important to keep the decimal point in line. The use of squared-paper in our maths books will help children to write digits in the correct column, with an understanding of place vale (thousands, hundreds, tens, units, tenths, hundredths, etc.) They are also told that the decimal point itself has ***no value*** and therefore is written on a vertical line rather than in a column.

- Children are then able to add numbers with varying amounts of digits *after* the decimal point, realising that the decimal points should be lined up correctly and that a '0' might be needed as a 'place-holder' e.g. 401.2 + 26.85 + 0.71



- Children will add mentally, using partitioning as a method.

53 + 45 → (50 + 40) + (3 + 5) → 90 + 8 = 98

- Children will add mentally, using rounding as a method.

59 + 48 → 60 + 50 = 110 – 1 – 2 = 107

- As they move through the school, children are also expected to know – and apply – number bonds to 10, 20, 50, 100 and 1000.

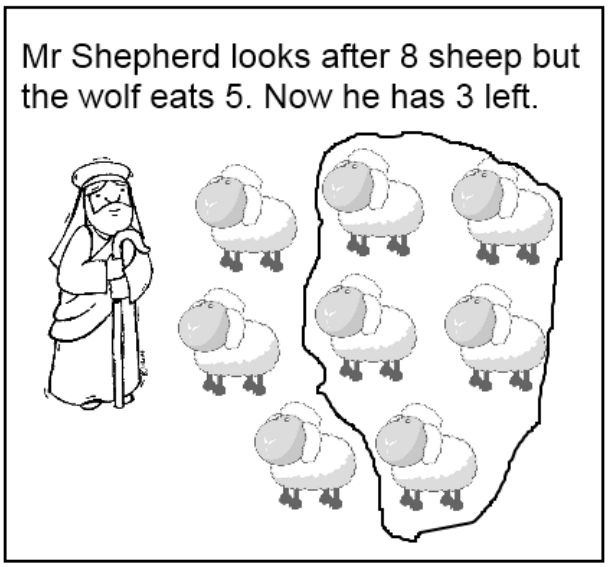
- Children will learn the vocabulary of addition, including such terms as …

ADD, TOTAL, SUM, MORE/GREATER THAN, PLUS, INCREASE
They should also know that the word 'sum' should only be used in reference to addition; it is good practice to say 'calculations' rather than 'sums'.

SUBTRACTION

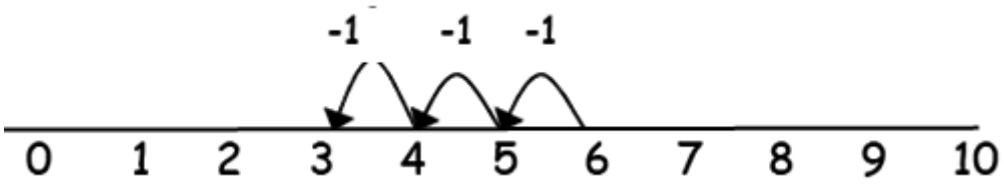
- Children might begin with physically removing a set number of counters or objects such as beads or dried peas, etc.

- Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They develop ways of recording calculations using pictures etc.

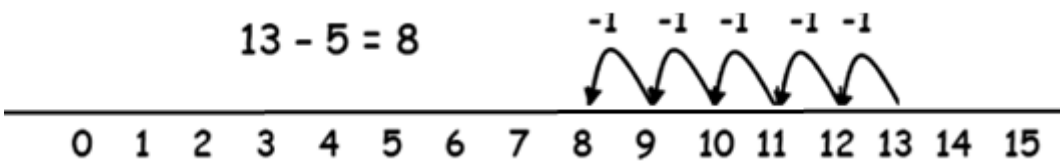


- Number lines are again used as the next step in supporting their calculation. Teachers will demonstrate how to do this.

6 – 3 = 3

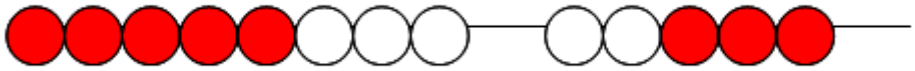


- Children then begin to use numbered lines to support their own calculations - using a numbered line to count back in ones.



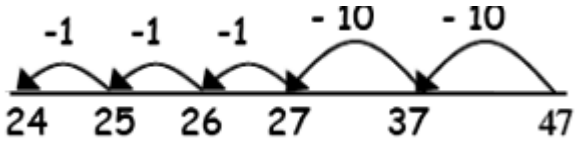
- Bead strings or bead bars can be used to illustrate subtraction including bridging through ten by counting back 3 then counting back 2.

13 – 5 = 8



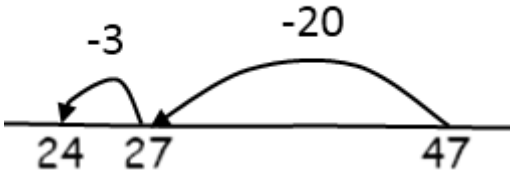
- Children will begin to use empty number lines to support calculations.
- **Counting back**
- First counting back in tens and ones.

47 – 23 = 24



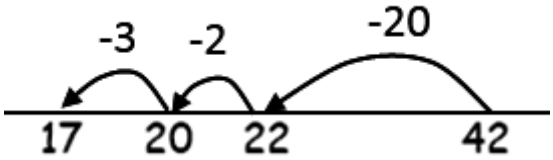
- Subtracting the tens in one jump and the units in one jump.

47 – 23 = 24



- *'Bridging through ten'* can help children become more efficient.

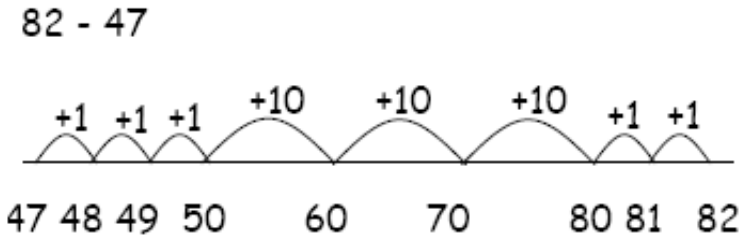
42 - 25 =17



- **Counting on**

- 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.

- Count **up** from 47 to 82 in jumps of 1 and jumps of 10.



So we now add 3 + 30 + 2 = 35

Help children to become more efficient with counting on by:
- Subtracting the units in one jump;
- Subtracting the tens in one jump and the units in one jump;
- *'Bridging'* through ten (see method a little earlier);
- Counting back on a ruler.

- Next children will begin to use informal pencil and paper methods (jottings) to support, record and explain partial mental methods building on existing mental strategies.

Column subtraction involving partitioning and decomposition

Initially, the children will be taught using examples that do not need the children to include decomposition.

This process could be demonstrated using Tens and Units cards to show the partitioning and base 10 materials to show the decomposition of the number.

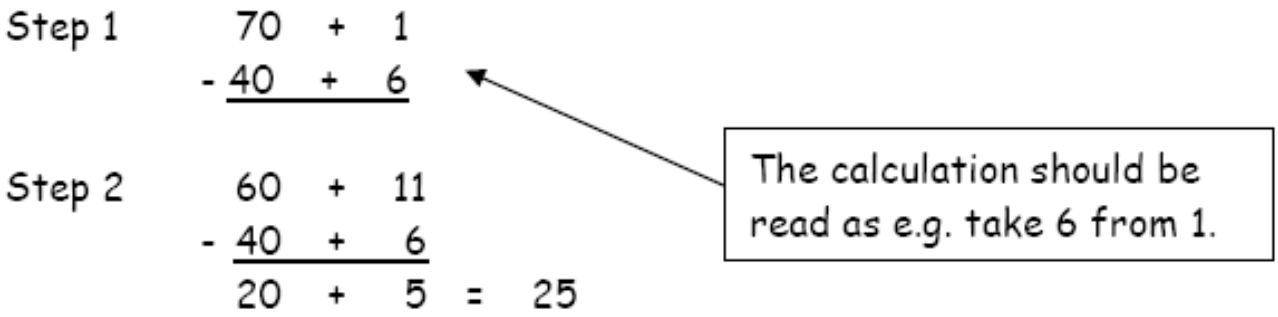
- This method can be demonstrated by the teacher as means of introduction and children could copy the method and use it, thus

$$\begin{array}{rcl} 89 & = & 80 + 9 \\ -\ 57 & & 50 + 7 \\ \hline & & 30 + 2 = 32 \end{array}$$

- The next step would be for children to record ‘normally’ like this

$$\begin{array}{r} 89 \\ -\ 57 \\ \hline 32 \end{array}$$

- To introduce decomposition, the teacher might use the following method as a demonstration



- And the next step would be to record thus …

$$\begin{array}{r} {\scriptstyle 60} \\ \cancel{70} + {}^{1}1 \\ -\ 40 + 6 \\ \hline 20 + 5 = 25 \end{array}$$

- Many parents will know this method as ‘borrowing’ a Ten, although teachers may now use the terminology ‘changing’ a Ten into ten extra Units, as borrowing implies something will be returned!

- The next stage is to introduce bigger numbers, i.e. HTU or ThHTU; the process is the same.

- This leads to the now familiar method of decomposition subtraction …

$$\begin{array}{r} {\scriptstyle 614\ 1} \\ \cancel{7}\cancel{5}4 \\ -\ 286 \\ \hline 468 \end{array}$$

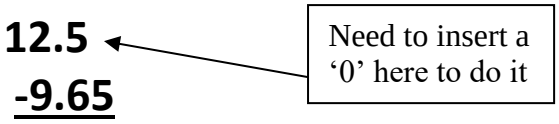
- Children could now reasonably expected to deal with mental calculations where they might partition thus

57 – 22 → (57 – 20 = 37) – 2 = <u>35</u>

and

52 – 26 → 52 – 20 = 32 – 6 = <u>26</u>

- Children would then be expected to deal with decimals in the same way, ensuring that all the decimal points are lined-up ; money questions; subtractions where there are fewer digits in the Tenths and Hundredths columns, thus making the children use extra '0's to perform the calculation.



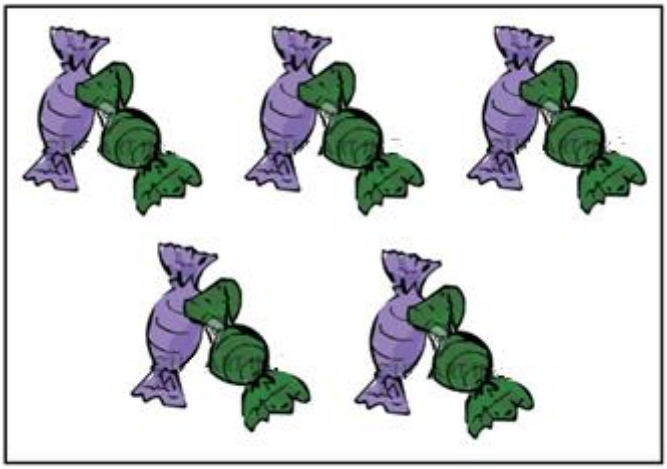
- Children will learn the vocabulary of subtraction, including such terms as …

TAKE AWAY, SUBTRACT, MINUS, LESS THAN, DIFFERENCE, FEWER, DECREASE.

MULTIPLICATION

- Children will experience equal groups of objects. Some will count in 2s and 10s and begin to count in 5s. They will work on practical problem-solving activities involving equal sets or groups. Children are then taught practically to count repeated groups of the same size.

e.g. if five children have 2 sweets, how many altogether? (using apparatus)

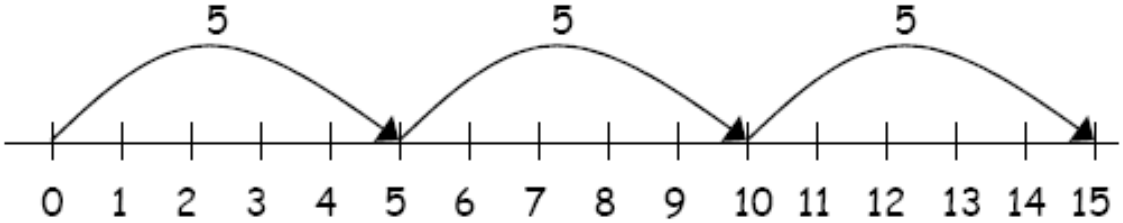


- Children will develop their understanding of multiplication beginning with the concept of 'lots of' or 'groups of' a certain number (**<u>repeated addition</u>**), i.e. 3 x 4 is three lots of four, thus

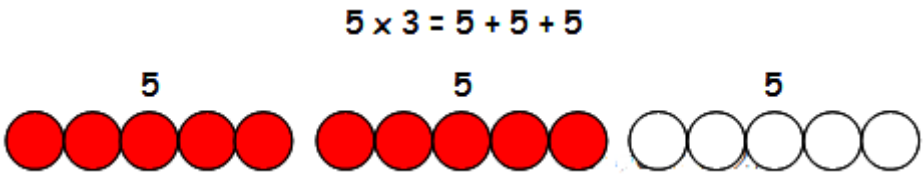
4 + 4 + 4 = 12

- Repeated addition can be shown easily on a number line:

$5 \times 3 = 5 + 5 + 5$

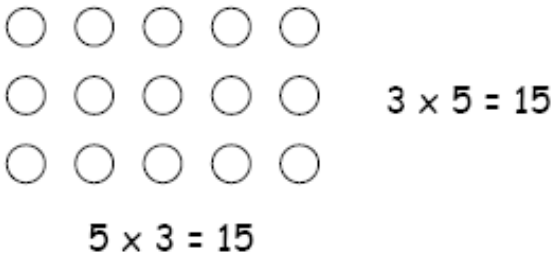


- Repeated addition can also be shown on a bead bar



Arrays

- Children should be able to model a multiplication calculation using an array. This knowledge will support with the development of the grid method.



- From here, children might reasonably progress to grid method multiplication where the Tens and Units are 'partitioned' (split) up, i.e.

23 x 8 would be done like this …

x	20	3
8	160	24

$$\begin{array}{r} 160 \\ +\ 24 \\ \hline 184 \end{array}$$

- Long multiplication using the grid method is done by 'partitioning' both numbers, multiplying and adding the products, thus

38 x 72 would be done like this …

x	70	2
30	2100	60
8	560	16

2100
+ 560
+ 60
+ 16
2736

- In the above example, children would be taught to check that the biggest answer is **ALWAYS** in the top left corner, whilst the smallest is **ALWAYS** in the bottom right corner.

- **HTU x HTU** multiplication would follow the same course, except that there would obviously be more *products* to find and then add.

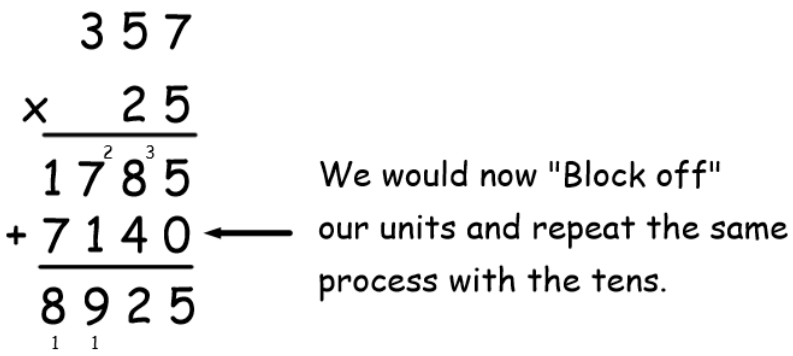
- This would finally be written multiplication as most people know it, i.e.

$$\begin{array}{r} {}^{3}{}^{6}438 \\ \times 8 \\ \hline 3504 \end{array}$$

- This could also be represented as

438
x8
64 → (8x8)
240 → (8x30)
3200 → (8x400)
3504 → Total
1

- We would then expect the final stage of multiplication to make use of this standard written method (short method), including multiplying by more than one digit. If we take this HTU x TU as an example:



- Children will learn the vocabulary of multiplication, including such terms as …

MULTIPLY, TIMES, PRODUCT, LOTS/GROUPS/SETS OF, MULTIPLES, FACTORS.

DIVISION

- Children will understand equal groups and share out items in play and problem-solving. They will count in 2s and 10s, later in 5s.

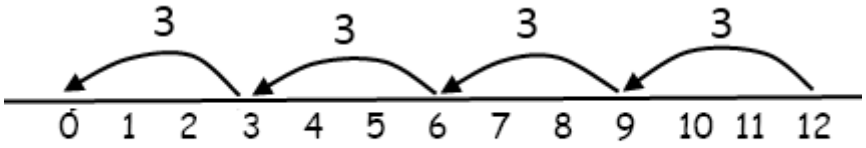
For example 15 sweets shared between 5 people

So each person gets three sweets

15 ÷ 5 = 3

- Repeated subtraction using a number line e.g. 12 ÷ 3

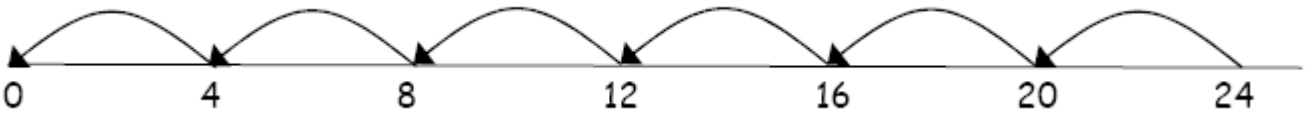
Start at 12 and count back in threes …



So there are 4 'lots of' 3 in 12

- Children will begin to use an empty number line to support their calculation.

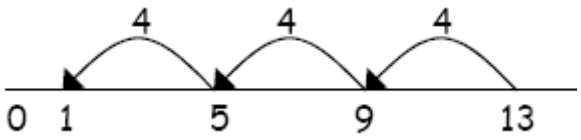
24 ÷ 4



24 ÷ 4 = 6 (six 'lots of' 4 in 24)

- Children should also move onto calculations involving remainders.

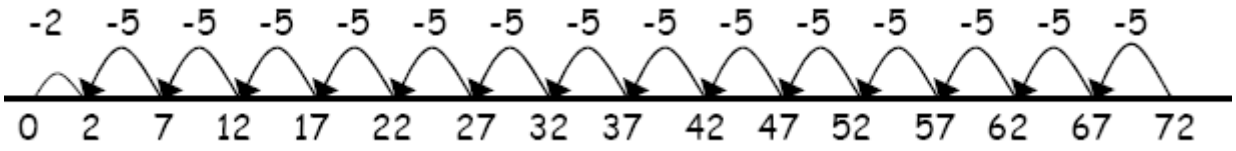
13 ÷ 4



So 13 ÷ 4 = 3 'lots of 4' r1

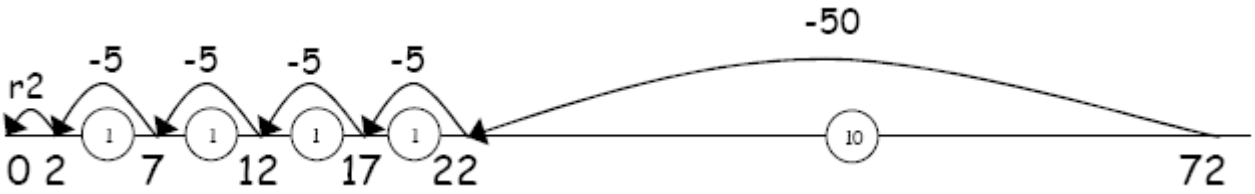
- Children will develop their use of repeated subtraction to be able to subtract multiples of the divisor. Initially, these should be multiples of 10s, 5s, 2s and 1s – numbers with which the children are more familiar.

72 ÷ 5



So 72 ÷ 5 = 14 'lots of 5' r2

- They may now move on to



10 lots of 5 (to make 50), 4 more lots of 5 and 2 remainder

- Then onto the vertical or 'BUS-STOP' method with which most parents are familiar

$$\begin{array}{r} 24 \\ 2\overline{)48} \end{array} \qquad \begin{array}{r} 258 \\ 2\overline{)5^{1}1^{1}6} \end{array}$$

- Initially children will work with division involving no remainders, but will then progress to encounter remainders which should be shown as integers, i.e. 14 remainder 2 or 14 r 2

- Later on this can be developed to rounding an answer up or down.

  e.g. *I have 62p. Sweets are 8p each. How many can I buy?*
  Answer: 7 (the remaining 6p is not enough to buy another sweet)

  e.g. *Apples are packed into boxes of 8. There are 62 apples. How many boxes are needed?*
  Answer: 8 (the remaining 6 apples still need to be placed into a box)

- This can be further developed by converting remainders into fractions of the divisor or decimals.

$$5\overline{)\,6^{1}2^{2}9}\quad 125\,\tfrac{4}{5}$$

Here, 629 will divide by 5 giving the answer 125 r4, but the 4 becomes 4/5 since the divisor is 5

And here,

$$5\overline{)\,6^{1}2^{2}9.^{4}0}\quad 125.8$$

the answer is given as a decimal by placing the decimal point and a '0' to continue dividing until there is no remainder.

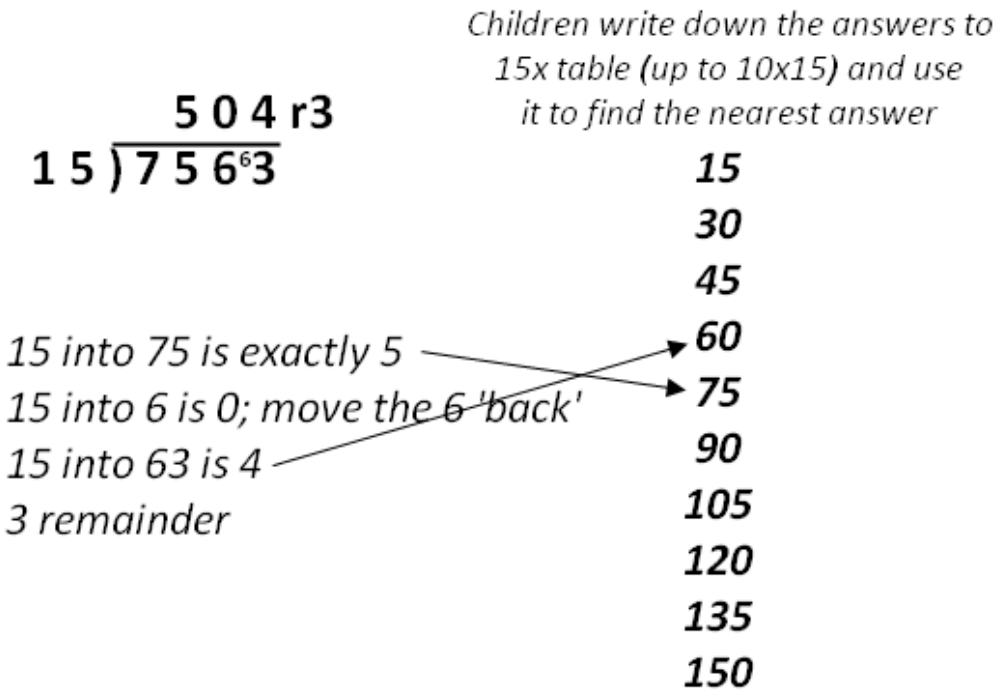
- Some children may use the expanded method of division which is the same as above, but shows more detail

```
  125r4
5)629
 -5
  12
 -10
   29
  -25
    4
```

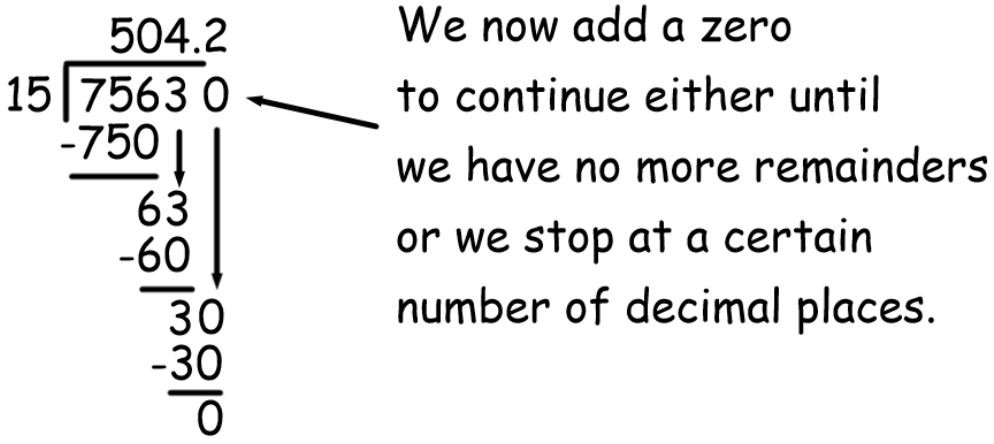
Here we can see the calculations in greater detail and actually see where mistakes (if any) are made.

- More able children will learn to round decimals to the nearest decimal place (or two)

- Long division presents its own problems. We are not in favour of 'chunking', but would suggest the following method …



- Providing that children add the multiples of the divisor carefully, this works well.
- Equally, this could be completed using Drop Down Division:



- Children will learn the vocabulary of division, including such terms as …

SHARE, DIVIDE, QUOTIENT, FACTORS, GROUPS/LOTS OF.