Winterton Primary School and Nursery Calculations Policy

We provide our pupils with a mathematics education which allows them to thrive as **resilient, confident and independent learners** who are enthusiastic and engaged; through quality-first teaching, we aim to cultivate an environment which provides pupils with the tools to gain a positive mindset when faced with challenge, an environment where a love of learning extends to the often complex, creative, intriguing and rewarding subject of mathematics.

Through our teaching and the use of our calculations policy, our aim is for our pupils to become confident learners who use a range of methods for solving problems and can apply mathematical skill to functional, real-life problems and use verbal reasoning to discuss and debate.

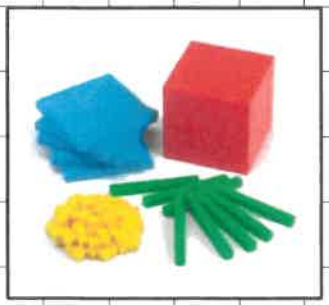
We believe that those children who learn to explain why something makes sense and can apply reasoning through their mathematical explanations will not only develop a clearer and deeper knowledge, resulting in longer term understanding, but they will also develop a positive attitude towards the subject of mathematics and see the value of their studies.

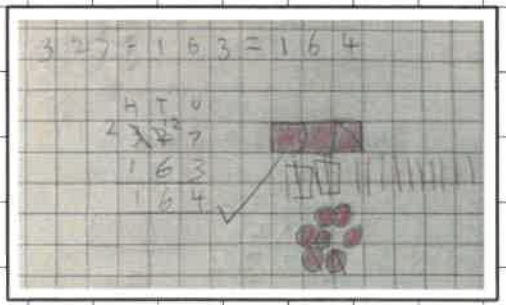
Mathematics is a creative and highly inter-connected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. It is essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment. ***A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.***
(National Curriculum, 2014)

Winterton Primary School and Nursery Calculations Policy

The Concrete-Pictoral-Abstract Approach

For children to secure a deep knowledge of mathematical concepts, it is fundamental that they progress through the three necessary steps: **concrete**, **pictoral** and **abstract** learning. In our lessons we actively promote a C-P-A approach to teaching and learning and we ensure that children progress through these stages at their own pace. Additionally, we understand that research shows each time a new concept is introduced to pupils it is necessary to return to **concrete** explorations.



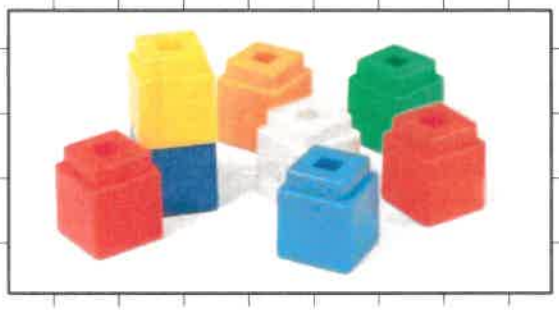


Winterton Primary School and Nursery Calculations Policy

Addition

Pupils experience addition through practical resources, collecting and sorting without even realising it. Counting activities and hands-on arranging and rearranging of groups will begin to give children visual representations of addition and at this point children will hear and be encouraged to begin using correct mathematical terminology and vocabulary associated with addition. At this point, children will begin to record their results informally using mark making, diagrams and beginning to use digits.

Alice has 5 cubes and Benjamin has 3 cubes. How many do they have altogether?

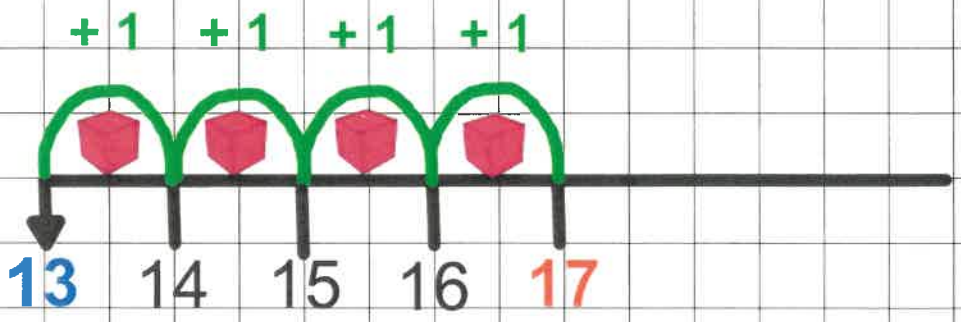


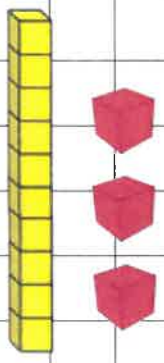
Vocabulary

sum, total, parts and wholes, plus, add, altogether, more, 'is equal to', 'is the same as', double, partition, column, carry,

13 + 4 = 17

Addition on a number line





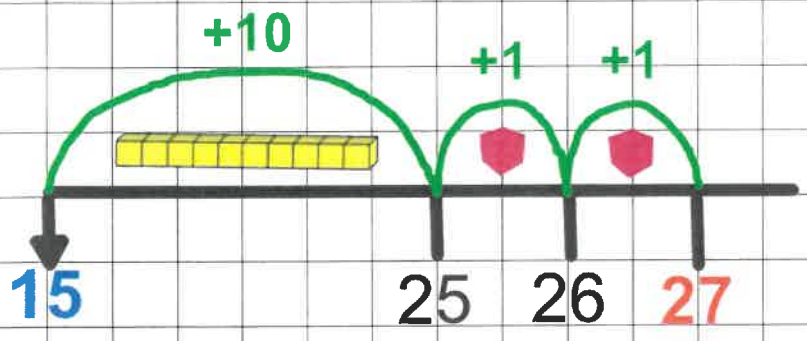
Build the number (*addend*) using Dienes and support addition by using concrete Dienes on the numberline.

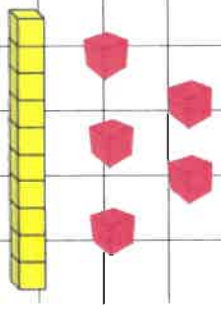
Addition on a number line

15 + 12 = 27

First, partition the smaller number (*addend*) you will be adding.

10 2





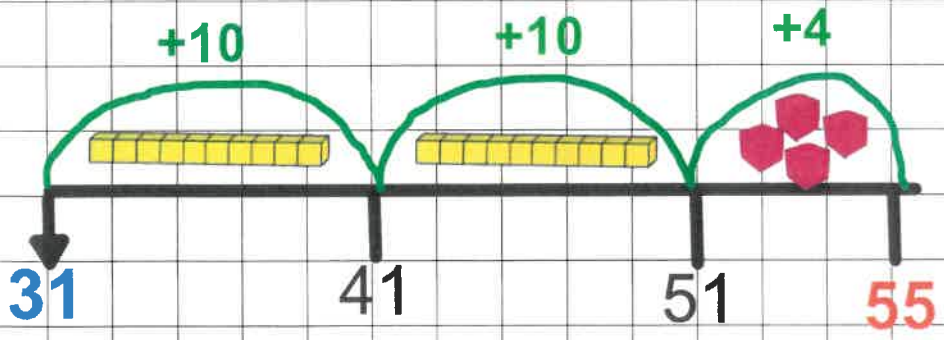
Build the number (*addend*) using Dienes and support addition by using concrete Dienes on the numberline.

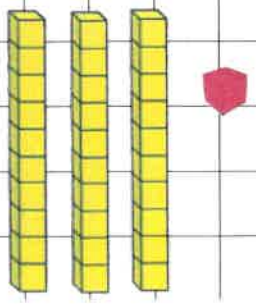
Addition on a number line

31 + 24 = 55

First, partition the smaller number (*addend*) you will be adding.

20 4





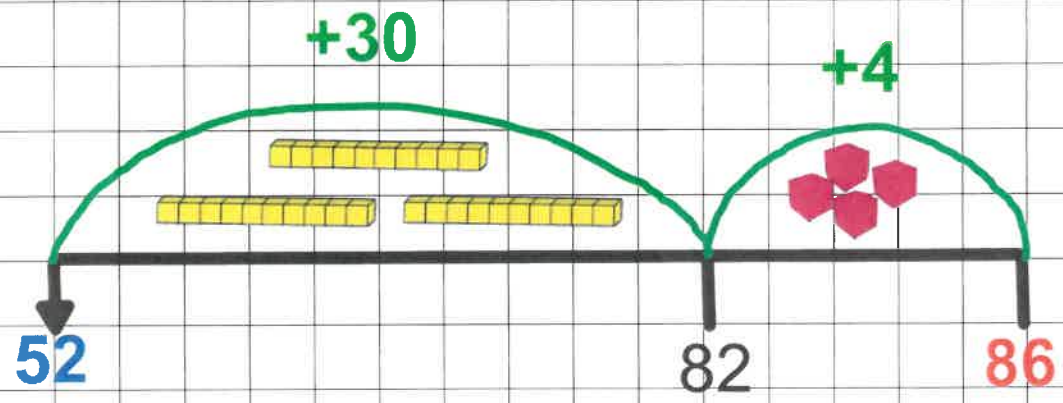
Build the number (*addend*) using Dienes and support addition by using concrete Dienes on the numberline.

Addition on a number line

$52 + 34 = 86$

30 4

Begin to reduce the number of jumps by jumping in multiples of 10.

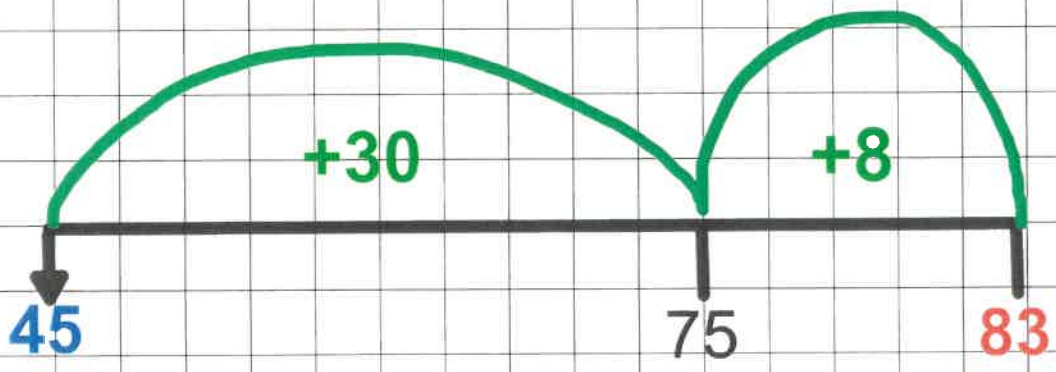


Addition on a number line

$45 + 38 = 83$

30 8

Begin to reduce the number of jumps by jumping in multiples of 10.



When children are confident, equipment can be swapped for pictoral representations and then, ultimately, these can also be removed.

Addition on a number line

$362 + 247 = 609$

200 40 7

When adding 3 digit numbers, continue to partition the smaller number (*addend*).

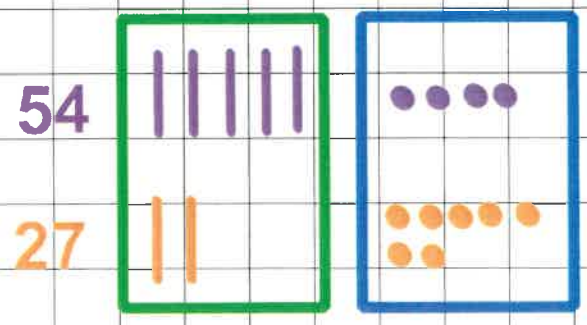
Addition using the expanded column method

$54 + 27 = 81$

T	U	
5	4	
2	7	+
1	1	(4 + 7)
7	0	(50 + 20)
8	1	(70 + 11)

Begin by adding from the units first from this point on.

This can be supported using concrete resources or drawn pictorially.

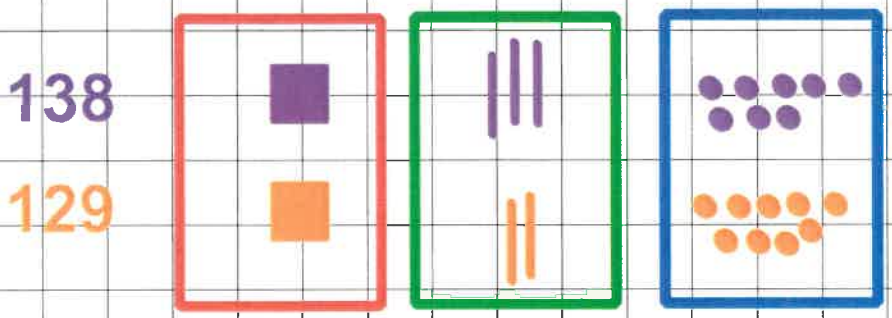


138 + 129 = 267

Addition using the **expanded column method**

H	T	U	
1	3	8	
1	2	9	+
	1	7	(8 + 9)
	5	0	(30 + 20)
2	0	0	(100 + 100)
2	6	7	(200 + 50 + 17)

This can be supported using concrete resources or drawn pictorially.



273 + 152 = 425

Compacted column method

H	T	U	
2	7	3	
1	5	2	+
4	2	5	
~~1~~			

Using this compacted method, children must use knowledge that "120" is one hundred and 2 tens.

258 + 494 = 752

Place the carried tens and hundreds under the second line and cross out once they have been used.

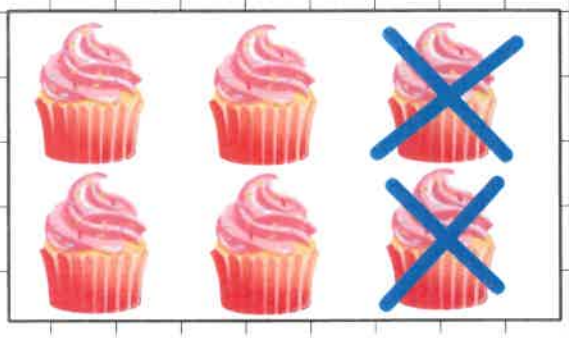
H	T	U	
2	5	8	
4	9	4	+
7	5	2	
~~1~~	~~1~~		

Winterton Primary School and Nursery Calculations Policy

Subtraction

Pupils will also begin to use subtraction through practical resources and exploring their environments without even realising it. Counting activities and hands-on arranging and rearranging of groups will begin to give children visual representations of subtraction and at this point children will hear and be encouraged to begin using correct mathematical terminology and vocabulary associated with this operation. At this point, children will begin to record their results informally using mark making, diagrams and beginning to use digits.

Alice has 6 cupcakes. She gives two to Benjamin. How many does she have left?



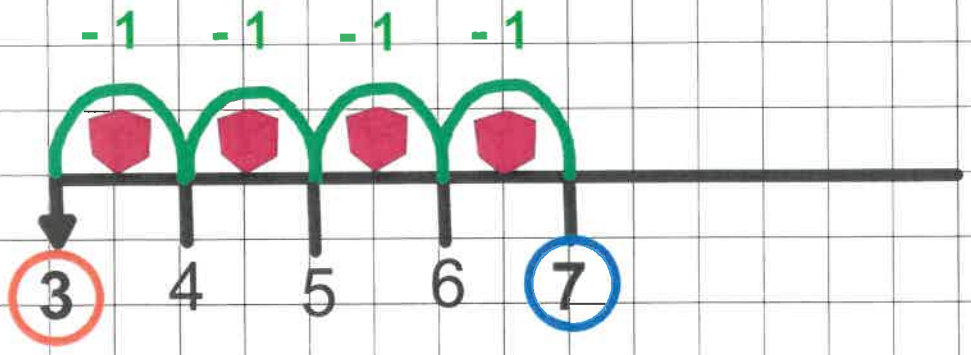
Vocabulary

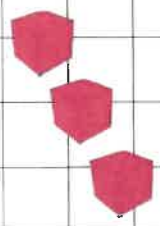
take away, less than, the difference, subtract, minus, fewer, decrease, find the difference, leaves, distance between, exchange

Subtraction of ones on a number line

7 - 4 = 3

Begin to support subtraction of concrete objects using a number track or labelled number line.

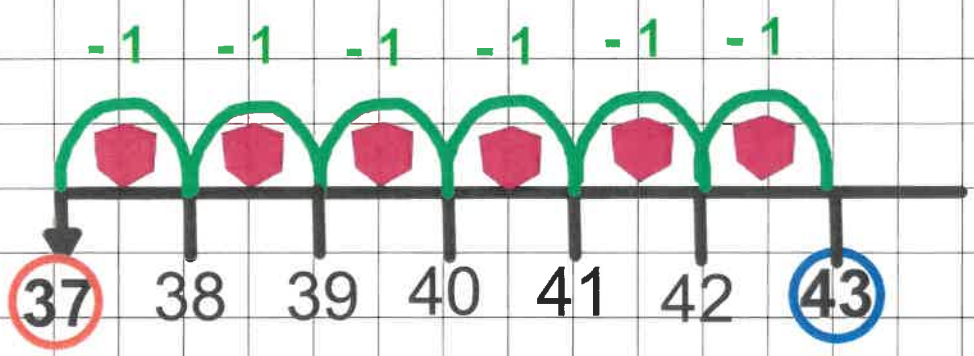




Jump backwards on the number line, supporting the subtracting by placing concrete objects under jumps.

Subtraction of ones on a number line

43 - 6 = 37



Jump backwards on the number line, supporting the subtracting by placing concrete objects under jumps.

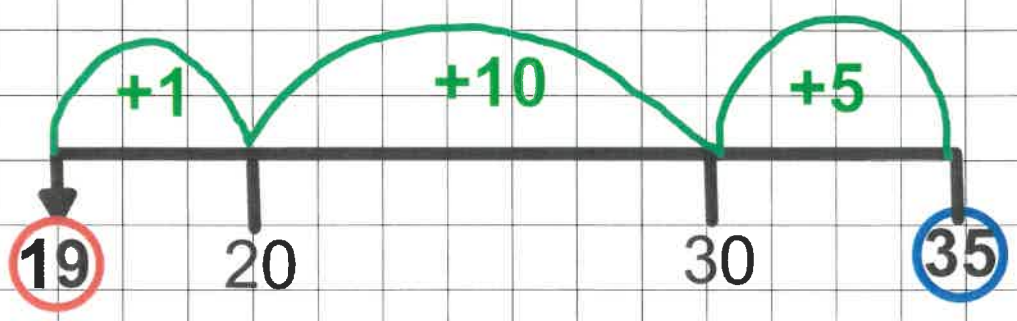
Subtraction by finding the difference on a number line

35 - 19 = 16

Jump from the number we are subtracting (subtrahend) to the next multiple of 10

Jump to the next multiple of 10

Jump to the largest number (minuend)



The total number we have jumped is the answer (difference)

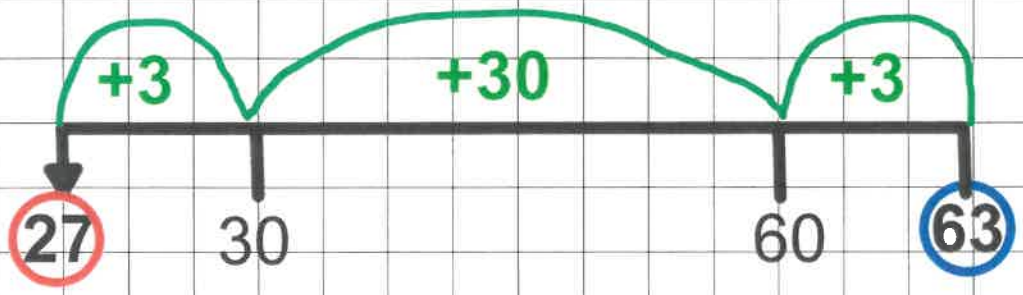
Subtraction by finding the difference on a number line

63 - 27 = 36

Jump from the subtrahend to the next multiple of 10

Jump in multiples of ten to the multiple of ten closest to the largest number (minuend)

Jump to rest of the way to the minuend



Subtraction by finding the difference on a number line

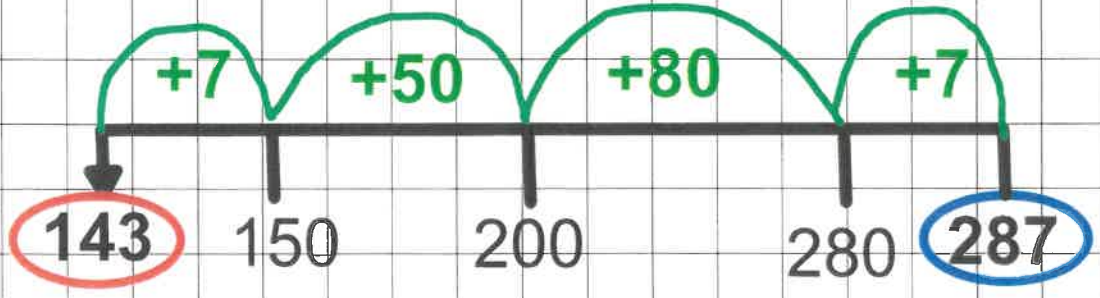
287 - 143 = 144

Jump from the subtrahend to the next multiple of 10

Jump in multiples of ten to the next multiple of 100

Jump to the multiple of ten closest to the largest number (minuend)

Jump to rest of the way to the minuend

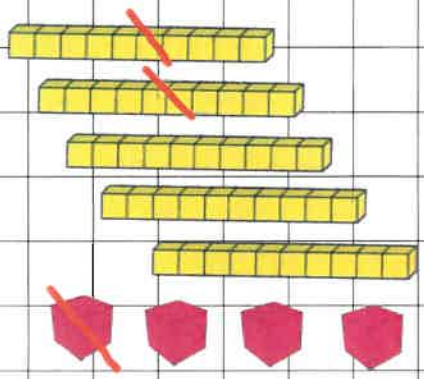


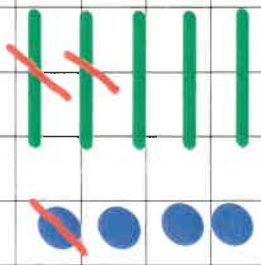
54 - 21 = 33

Subtraction using the column method for **vertical decomposition**

T	U
5	4
2	1 -
3	3

This subtraction of units first, then tens can be supported using concrete resources or drawn pictorially.



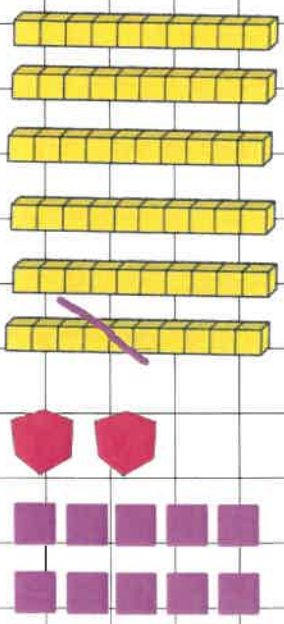


62 - 37 = 35

Subtraction using the column method for **vertical decomposition**

T	U
5	12
~~6~~	~~2~~
2	7 -
3	5

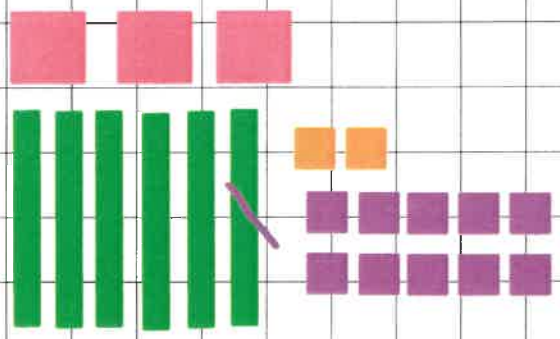
We can **exchange** one ten for ten units. Do this using concrete resources before moving on to pictures. This is then represented on the column when the values of tens and units are changed.



Subtraction using the column method for **vertical decomposition**

362 - 139 = 223

H	T	U
	5	12
3	~~6~~	~~2~~
1	3	9 -
2	2	3

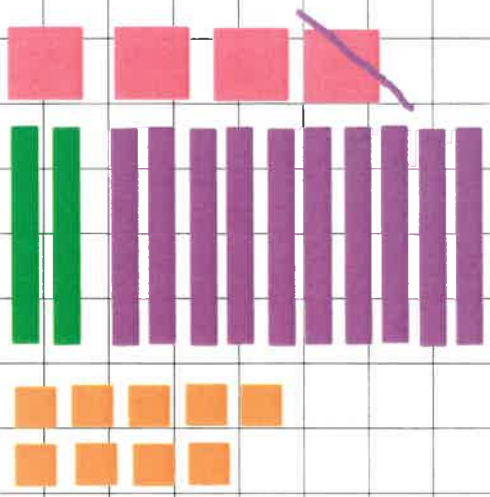


Continue to support the column method with **concrete resources** or **pictures**.

Subtraction using the column method for **vertical decomposition**

429 - 273 = 156

H	T	U
	3	12
~~4~~	~~2~~	~~9~~
2	7	3 -
1	5	6



Continue to support the column method with **concrete resources** or **pictures**.

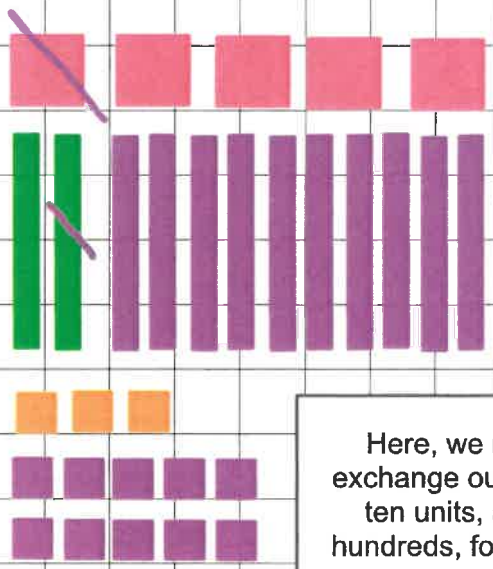
Here, we do not need to exchange our tens for any units; however, we need to exchange one hundred for ten tens.

Subtraction using the column method for **vertical decomposition**

523 - 278 = 245

H T U

4 ~~1~~ 13
~~5~~ ~~2~~ ~~3~~
2 7 8 -
2 4 5



Here, we need to exchange our tens, for ten units, and our hundreds, for ten tens.

Continue to support the column method with **concrete resources** or **pictures**.

Subtraction using the column method for **vertical decomposition**

653 - 295 = 358

H T U

14
5 ~~4~~ 13
~~6~~ ~~5~~ ~~3~~
2 9 5 -
3 5 8

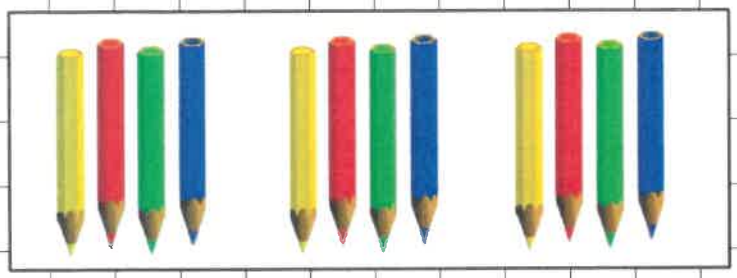
When children are secure with decomposition supported by pictorial representations, they can begin using column method without drawings.

Winterton Primary School and Nursery Calculations Policy

Multiplication

Pupils will begin to see multiplication through doubling; first through the use of concrete objects and secondly using images before finally moving on to mentally doubling numbers. Visual representations of groups, or 'lots of' will enable children to begin to consider the concept of repeated addition as a form of multiplication. At this point, children can begin to informally write down simple number sentences to display their multiplication calculations, having worked the answer out using concrete resources or drawing pictures. The important at this stage is to note that these groupings must be equal.

If Ruby, Sam and Olivia have four pencils each, how many are there altogether? This is 3 lots of 4.



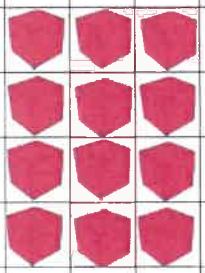
Vocabulary

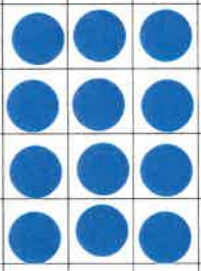
double, times, lots of, multiple, product, groups of, equal groups, commutative, array, grid, inverse, sets of, square

Multiplication using arrays

4 x 3 = 12

"Four lots of three"

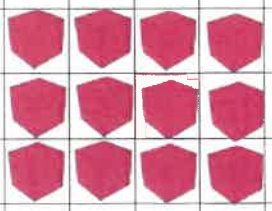


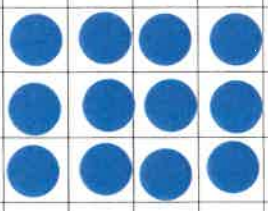


We use arrays to demonstrate multiplication using concrete objects and pictorial representations. Using the terminology "lots of", this is also a clear way for the children to explore the commutative nature of multiplication.

3 x 4 = 12

"Three lots of four"

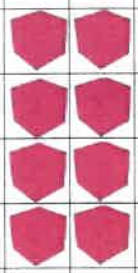


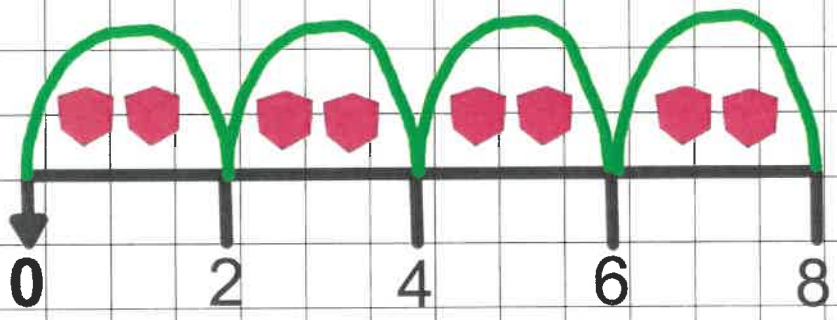


Multiplication using a **numberline**

$4 \times 2 = 8$

"Four lots of two"



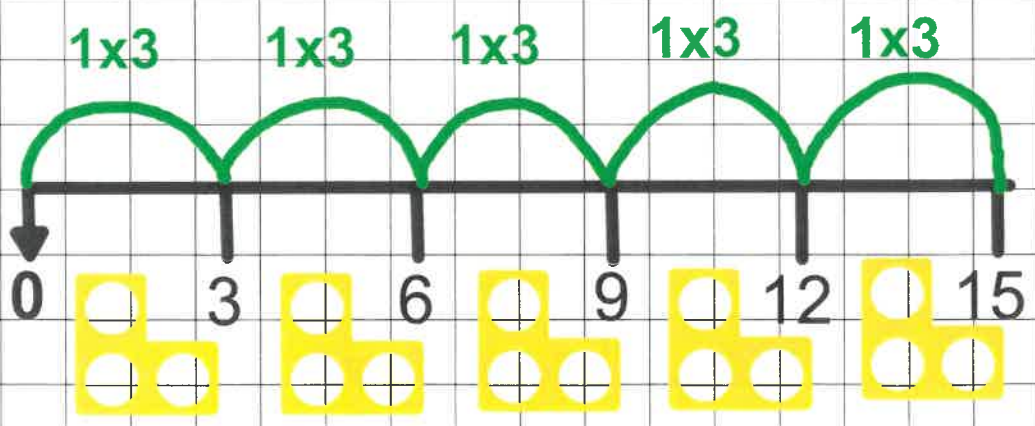


Continuing to the use the terminology "lots of", multiplication can be calculated on a blank numberline using repeated addition. Children can use concrete resources to move from the array to this linear approach.

Multiplication using a **numberline**

$5 \times 3 = 15$

"Five lots of three"

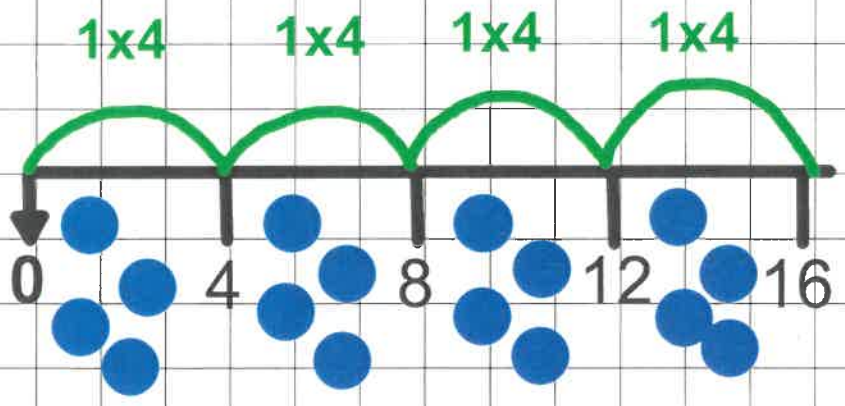


Continuing to the use the terminology "lots of", multiplication can be calculated on a blank numberline using repeated addition. Children can use concrete resources to move from the array to this linear approach.

Multiplication using a **numberline**

4 x 4 = 16

"Four lots of four"

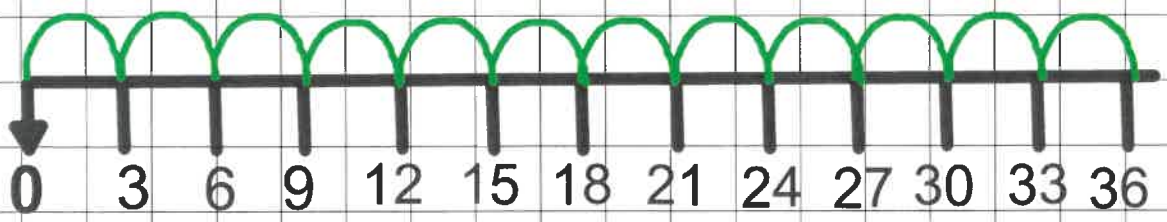


Continuing to the use the terminology "lots of", multiplication can be calculated on a blank numberline using repeated addition. Children can begin to move on to using simple drawings to show their multiplication.

Multiplication using a **numberline**

12 x 3 = 36

"Twelve lots of three"



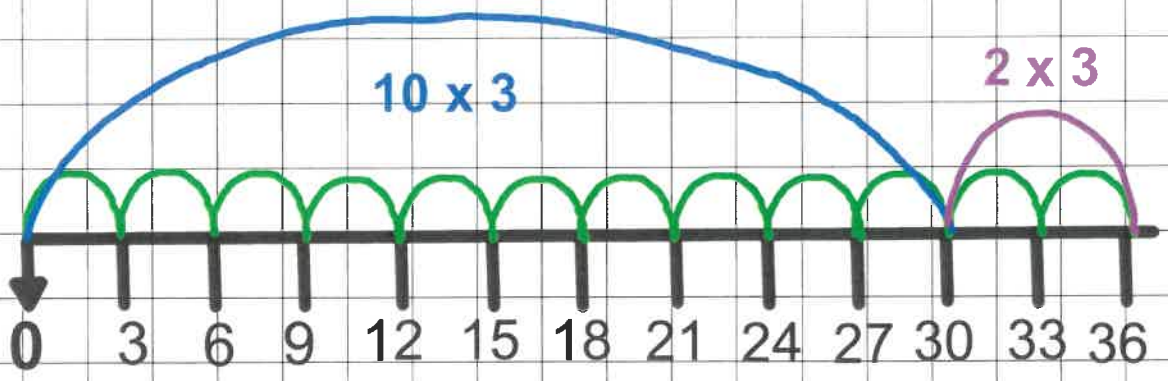
Repeated addition can also be used for multiplying a 2-digit number by a 1-digit number. This is an important, valuable progression point to model to the children before moving on to the next stage.

Multiplication using a **numberline**

12 x 3 = 36

"Twelve lots of three"

10 2



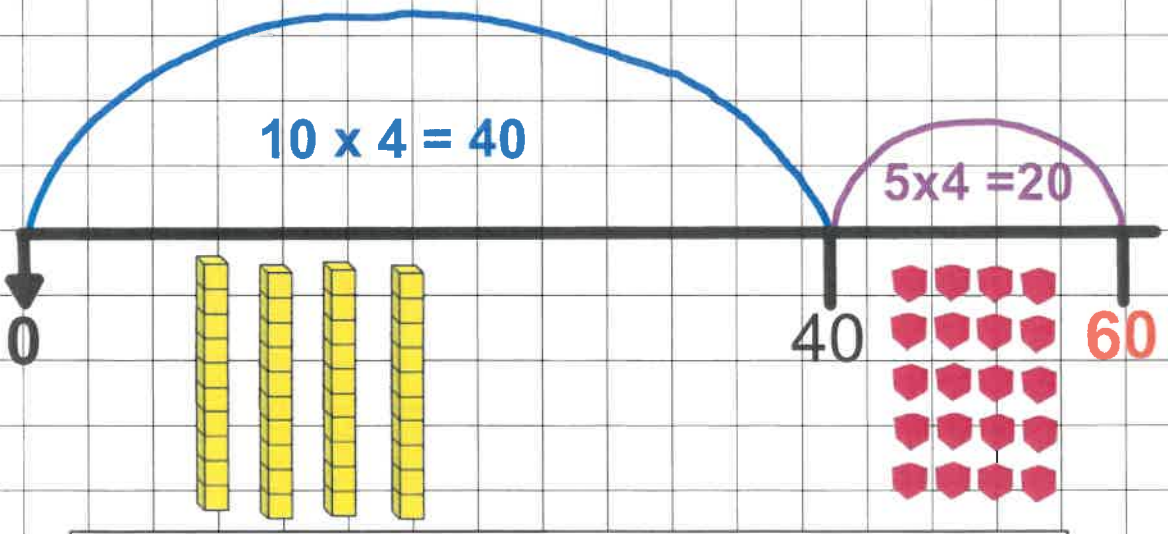
We can begin to partition two-digit numbers into their tens and units. From there, we can jump "ten lots of" first, to combat having to make many smaller jumps. These two methods can be modelled on the same numberline until children are confident with the progression.

Multiplication using a **numberline**

15 x 4 = 60

"Fifteen lots of four"

10 5



Larger two-digit numbers can begin to be multiplied using this partitioning method. Children can use concrete resources and pictures to support their multiplication as they learn to recall their times table facts.

Multiplication using the grid method

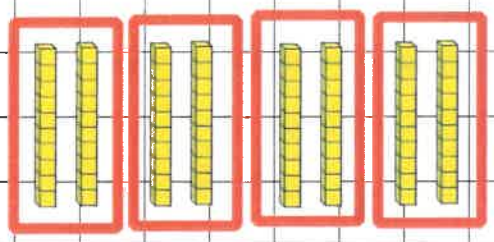
23 x 4 = 92

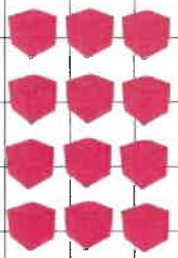
20 3

T	U
8	0
1	2
9	2

+

x	20	3
4	80	12





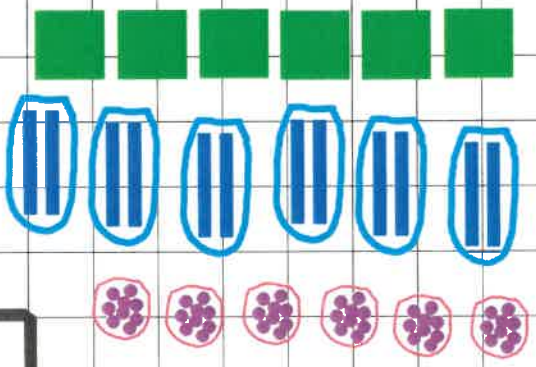
Children are encouraged to use number facts which they know and apply these to solving problems involving multiples of ten. For example, they know that 4 lots of 2 is 8 therefore they can apply this to 4 lots of 20 which must be 80.

Children can continue to use concrete resources and drawings to support their multiplication using this new method.

Multiplication using the grid method

159 x 6 = 774

100 50 9



x	100	20	9
6	600	120	54

H	T	U
6	0	0
1	2	0
	5	4
7	7	4

+

Children can continue to support their multiplication through the use of concrete objects or drawing pictures whilst being encouraged to apply what they know of their times tables to mutiples of ten and one hundred.

Multiplication using the **grid method**

17 x 6 = 102 *"Seventeen lots of six"*

10 7

x	10	7
6	60	42

H T U

60 +

42

102

Using knowledge of the grid methid, children can begin to use the grid method for the multiplication of two-digit numbers. Children can use the column method to add their values up; they are also encouraged to add these values in their heads where possible.

Multiplication using the **grid method**

4763 x 6 = 28578

4000 700 60 3

x	4000	700	60	3
6	24000	4200	360	18

Children are encouraged to continue applying what they know from their times tables to multiples of tens, hundreds and thousands.

Children to add as many values from their grid mentally before using the column method to find their final answer.

Multiplication using the **expanded short method**

342 x 7 = 2394

342
7 x
---
14 (2 x 7)
280 (40 x 7)
2100 (300 x 7)

2394

This first method is similar to a vertical grid method; however, misconceptions can arise as the digits are no longer presented in partitioned form. For example, children may calculate 4x7 rather than 40x7 in this question. To combat this, we can show the working in brackets until children become secure.

As we move into formal strategies, we move away from presenting these numbers in partitioned form and hence work in a much more abstract way.

Multiplication using the **short multiplication method**

342 x 7 = 2394

342
7 x

2394

~~2~~ ~~1~~

The progression to short multiplication removes the brackets from the vertical layout: instead, children use carrying in this compacted form.

1463 x 6 = 8778

1463
6 x

8778

~~2~~ ~~3~~ ~~1~~

Here, the understanding of place value is vital to ensure the children are correctly demarcating the carried tens, hundreds or thousands in the correct place value columns.

Multiplication using the **long multiplication method**

146 x 84 = 12264

```
   1 4 6
     8 4 x
 ---------
   5 8 4
   1 2
 1 1 6 8 0
   3 4
 ---------
 1 2 2 6 4
   1 1
```

For the final progression of formal methods for multiplication, children will apply their knowledge of short multiplication to more complex problems.

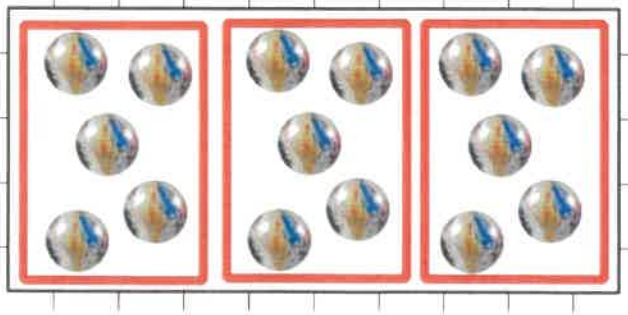
Again, here it is vital that the children are showing their carried tens, hundreds and thousands in the correct place value columns as they work through the multiplication.

Winterton Primary School and Nursery Calculations Policy

Division

Pupils will experience the concept of division and sharing from an early age; however, the equal sharing aspect can be harder for younger children to grasp. Through repeated experience with concrete resources, and making links with their knowledge of multiplication, children will begin to form a clearer understanding of the importance of equal groupings. The process of division through sharing will be explored by children through their play and the use of concrete objects.

Simon, Eliza and Ashley share 15 marbles equally. How many do they each get?



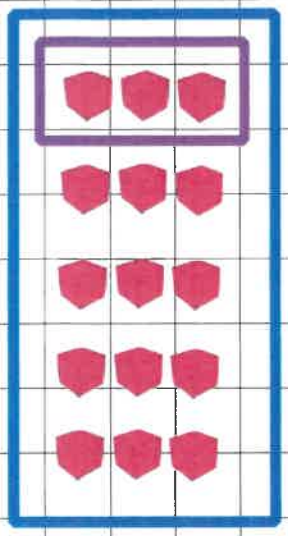
Vocabulary

share, group, equal, half, quarter, share equally, array, divide, lots of, inverse, division, grouping,

Division using **arrays**

$15 \div 3 = 5$

"How many lots of 3 are in 15?"



1 "lot of 3"

5 "lots of 3"

We can use arrays to demonstrate division of concrete objects. Using the terminology "lots of" and asking the question "how many lots of...?" is also a clear way to demonstrate the relationshis between division and its inverse of multiplication.

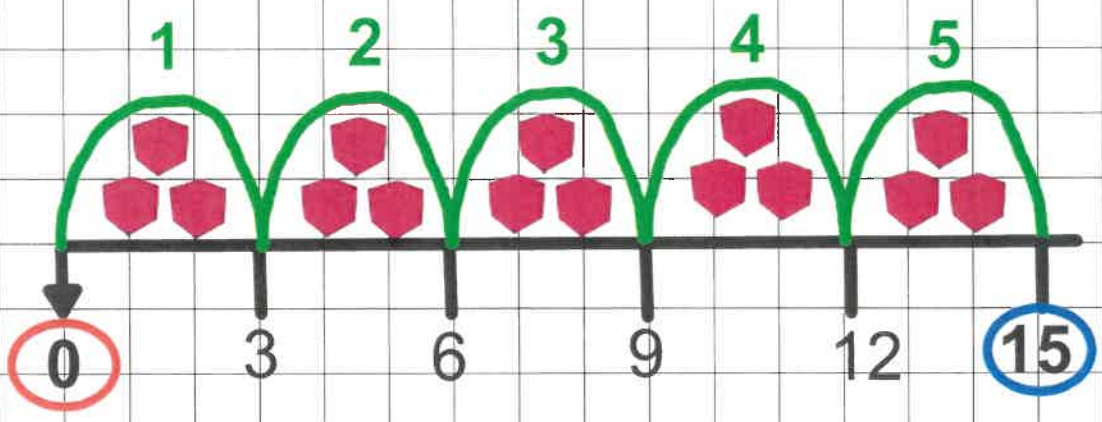
Children can collect the number of concrete resources needed for their *dividend* (the number being divded) and then create the array. The *divisor* tells us the size of the groups - or "lots of" - we need to make.

Division using the **number line**

$15 \div 3 = 5$

"How many lots of 3 are in 15?"

We can effectively calculate division on an empty numberline using repeated addition by asking the question "how many lots of?".



Like multiplication, our numberline starts at 0 as we have no "lots of 3".

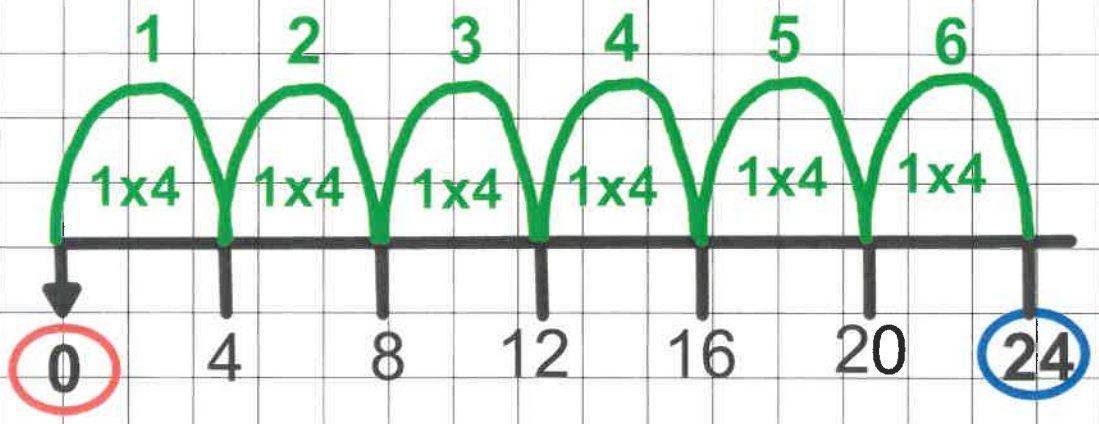
Our divisor, 15, must go at the end of the numberline as that is our whole amount we are counting to.

Division using the **number line**

24 ÷ 4 = 6

"How many lots of 4 are in 24?"

We can effectively calculate division on an empty numberline using repeated addition by asking the question "how many lots of?".

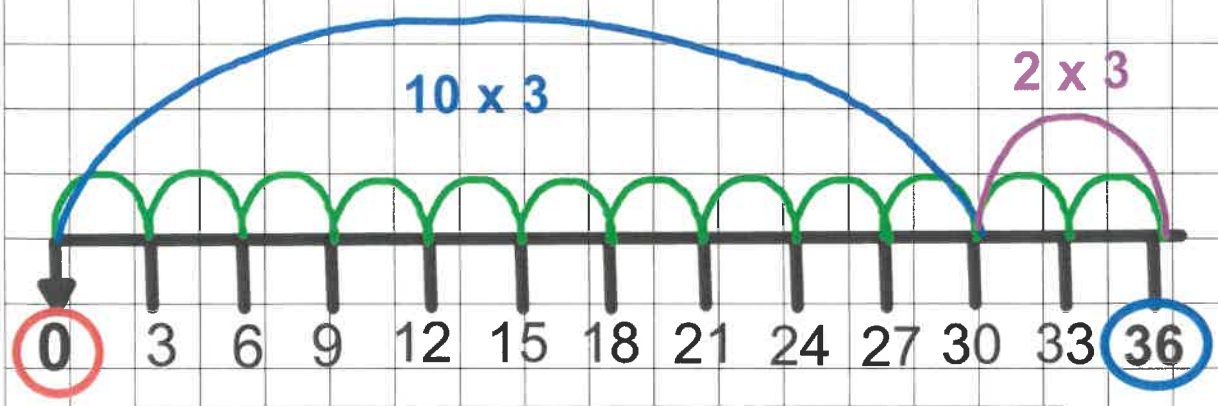


Division using the **number line**

36 ÷ 3 = 6

"How many lots of 3 are in 36?"

As the numbers get larger and more jumps are required, like with multiplication, children can be encouraged to take larger jumps using their times tables knowledge.



Rather than jumping individual jumps of 3, 12 times, we can use what we know - that 10 lots of 3 is 30 - to do a larger jump and then jump again until we reach our dividend of 36 (the number being divided).

Division using the **chunking method**

$36 \div 3 = 12$

"How many lots of 3 are in 36?"

$3 \overline{)36}$

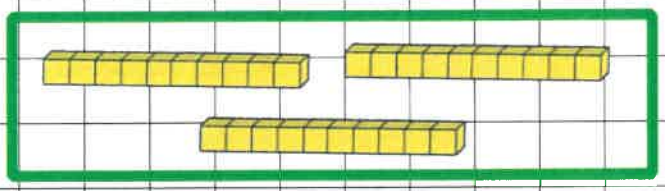
30 ($\underline{10} \times 3$)

6

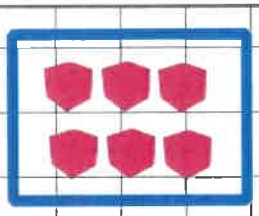
6 ($\underline{2} \times 3$)

0

Using what we know, we can take a **chunk of 30** - 10 lots of 3 - away from our divisor of 36.



Using what we know, we can take a chunk of 6 - 2 lots of 3 - away from the remaining 6.



The chunking method words vertically taking away from the divisor until zero - or a remainder is reached using easy multiplication facts that are known.

Division using the **chunking method**

$64 \div 4 = 16$

"How many lots of 4 are in 64?"

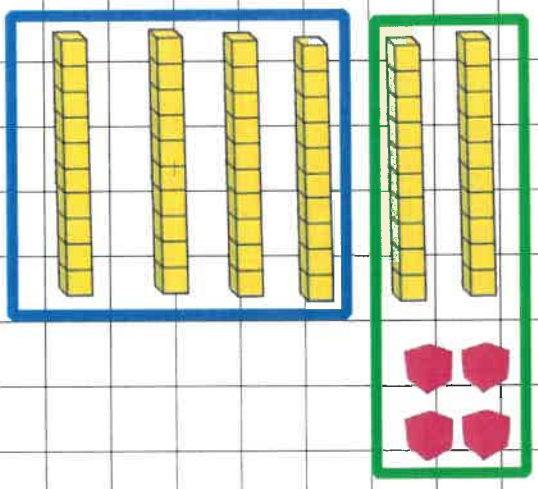
$4 \overline{)64}$

40 ($\underline{10} \times 4$)

24

24 ($\underline{6} \times 4$)

0



Using what we know, we can take a **chunk of 40** - 10 lots of 4 - away from our divisor of 64.

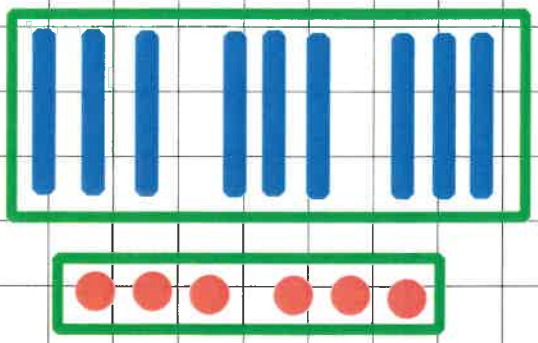
Using what we know, we can take a **chunk of 24** - 6 lots of 4 - away from the remaining 24.

Division using the **chunking method**

$96 \div 3 = 32$

"How many lots of 3 are in 96?"

$$
\begin{array}{r|l}
4 & 96 \\
 & 90 \quad (\underline{30} \times 3) \\
\hline
 & 6 \\
 & 6 \quad (\underline{2} \times 3) \\
\hline
 & 0
\end{array}
$$



As children become more confident with applying their times tables to multiples of 10 and 100, they will be able to take larger chunks when solving division problems.

Children can apply their knowledge of 3x3=9 to 30x3 equally 90 and taking a much larger chunk. Similarly, rather than chunking in threes, they can take one larger chunk of 6.

Division using the **short division method**

$52 \div 4 = 13$

$$
\begin{array}{r}
13 \\
4\overline{)\,5^{1}2}
\end{array}
$$

How many lots of 4 are in 5? 1 lot of four and one remainder; therefore we have 12 left. *How many lots of 4 are in 12*? 3. Therefore our answer is 13.

This method can be extremely quick; however, due to its nature, the true value of each part of the dividend is not considered. This method is only suitable for children who have a secure understanding of number, division as an inverse of multiplication and the previous stages of chunking.

$258 \div 6 = 43$

$$
\begin{array}{r}
43 \\
6\overline{)\,25^{1}8}
\end{array}
$$

How many lots of 6 are in 2? We can't do this so we think: *how many lots of 6 are in 25? 4 lots of 6 and 1 remainder*; therefore we have 18 left. *How many lots of 6 are in 18*? 3. Therefore our answer is 43.