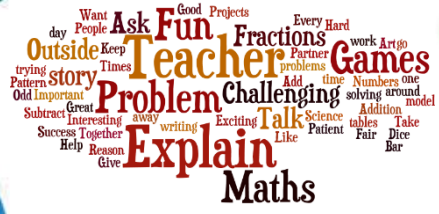


The Russell School

Maths Calculation Policy

The Russell School
Petersham

Updated: February 2016

About Our Calculation Policy

This documents is written for all adults working with our pupils; including teachers, teaching assistants, students, supply teachers and parents. It should be part of an induction package for all staff with inset as appropriate.

Our Calculation Policy has been devised to meet the requirements of the National Curriculum 2014, but most importantly the learning needs of our children at the Russell. The policy has been designed to give pupils a consistent and smooth progression of learning calculations across the school. Teachers should refer to this policy in all planning for calculations including cross curricular links.

The calculation policy is organised according to the requirements that need to be embedded in each year group of the primary curriculum as set out in the National Curriculum 2014; one set of mathematical concepts and big ideas for all. One of our fundamental mathematical Key principles; that this policy has been derived from, is the assumption that children use the language of maths correctly, so that children can develop mathematical concepts and also allows teachers to address misconceptions early and ensure that children have a firm understanding of key mathematical concepts before moving on.

It is vital that children are taught according to the 'stage' that they are working at, the transition between stages should not be hurried as not all children will be ready to move on to the next stage at the same time. Throughout this policy stages have been developed which introduces new concepts, outlines appropriate manipulatives and visual models, and what mathematical language is involved for a particular concept. Latter stages are for those children who are showing to have 'mastered' a concept, allowing them to apply their learning in a real life context further deepening their understanding. The new curriculum focuses on skills and mastery and is not about moving children on to the next method as soon as they can do the one before.

Written methods of calculations are based on mental strategies that have been taught using appropriate manipulatives and are only expected once a child has a clear understanding of the processes involved. This policy uses pictorial models that are consistent across year groups which means that skills can be taught, practised and reviewed constantly. These skills lead to more formal written methods of calculation.

Strategies for calculation need to be supported by familiar models and methods to reinforce understanding, such as the whole part model which children are exposed to throughout this policy. The written methods in this document are important but they by no means replace the superb mental methods we have developed. It is important for children to handle manipulatives to develop and reinforce understanding at all stages from Foundation to Year Six. A sound understanding of the number system and the value of a given number (place value) is essential for children to carry out calculations efficiently and accurately. Efficiency in calculation requires having a variety of mental strategies, which are carefully taught at a particular stage in a child's learning. Another key principle is the importance of 10, referred to as 'magic 10' (NCETM, 2015), which allows children to partition numbers to bridge 10, for example 9+6=9+1+5=15, which is helpful to make 10 as this makes this calculation easier.

Children need to be taught and encouraged to communicate their reasoning and thinking at all stages. Confidence in their ability in mathematics and calculations should be encouraged and supported with all children, fostering a 'can do' attitude. The long term aim is for our children to be able to select an efficient method of their own choice asking systematically:

Can I do this in my head?

Can I do this using drawings or jottings?

Do I need to use a pencil and paper procedure?

What resources could I use to help me?

A Malin

January 2016

Year Three

Children in Year Three will read and write numbers up to 1000 in numerals and words, count in multiples of 1s, 10s and 100s and order numbers to 1000. Pupils use multiples of 2,3,4,5,8,10, 50 and 100 to solve problems and will use the whole part model to partition numbers up to 1000 (Eg 932-900+30+2) using their knowledge of fact families. Children will continue to practise their mental recall of multiplication tables when they are calculating mathematical statements in order to improve fluency. Through doubling, they connect the 2, 4 and 8 multiplication tables.

Children will develop efficient mental methods, for example, using commutativity and associativity (for example, 4 × 12 × 5 = 4 × 5 × 12 = 20 × 12 = 240) and multiplication and division facts (for example, using 3 × 2 = 6, 6 ÷ 3 = 2 and 2 = 6 ÷ 3) to derive related facts (for example, 30 × 2 = 60, 60 ÷ 3 = 20 and 20 = 60 ÷ 3).

By the end of Year Three, children will develop reliable written methods for multiplication and division, starting with calculations of two-digit numbers by one-digit numbers and progressing to the formal written methods of short multiplication and division. Children will be able to solve simple problems in contexts, deciding which of the four operations to use and why. These include measuring and scaling contexts, (for example, four times as high, eight times as long etc.) and correspondence problems in which m objects are connected to n objects (for example, 3 hats and 4 coats, how many different outfits?; 12 sweets shared equally between 4 children; 4 cakes shared equally between 8 children).

Key Vocabulary: partition, value, digit, hundreds, tens, ones, whole, part, exchange, borrow, condensed method, expanded method, fact family, inverse, operation, multiple, addition, subtraction, difference, division, array, place value, remainder, numerator, denominator, fraction, bar model

Key Instant Recall Facts

Autumn 1: I know number bonds for all numbers to 20.

Autumn 2: I know the multiplication and division facts for the 3 times table.

Spring 1: I can recall facts about durations of time.

Spring 2: I know the multiplication and division facts for the 4 times table.

Summer 1: I can tell the time.

Summer 2: I know the multiplication and division facts for the 8 times table.

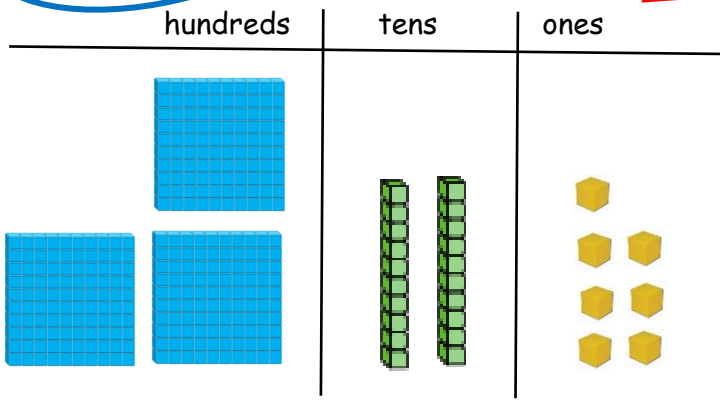
Number-Number and Place Value

Recognise the place value of each digit in a three-digit number (hundred, tens, ones)
Identify, represent and estimate numbers using different representations.
Count from 0 in multiples of 4, 8, 50 and 100; find 10 or 100 more or less than a given number
Compare and order numbers up to 100.

Stage 1

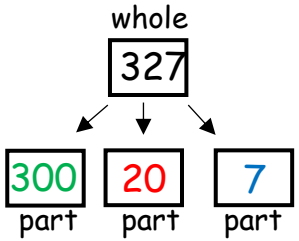
What is the **value** of each **digit** in the number 327?

The 3 has a **value** of 300 because there are 3 **lots of a hundred** in the **hundreds column**.

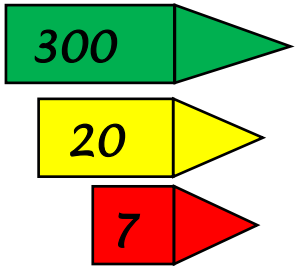


Use base 10 alongside Numicon to develop mathematical understanding and language.

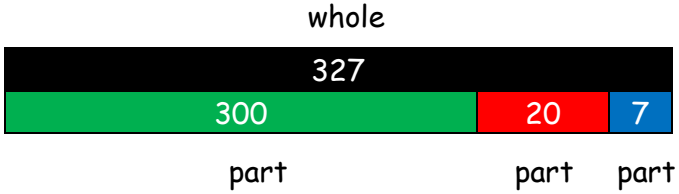
Record using whole part part model:



Stage 2



There are 3 **lots of hundred**, 2 lots **of ten** and 7 **lots of one**. Altogether there are 327.



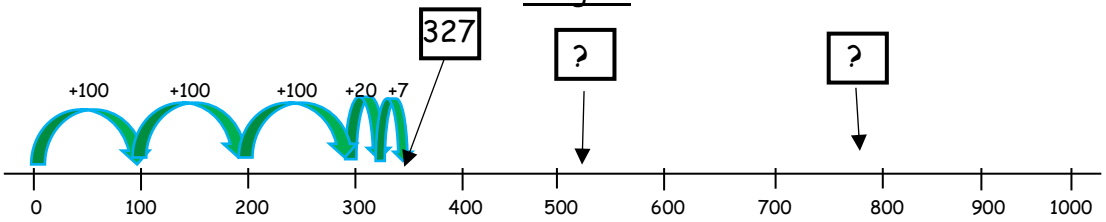
Use place value arrow cards alongside a bar model to develop mathematical understanding and reasoning.

Record using an equation:

$327 = 300 + 20 + 7$

What could the missing numbers be, why?

Stage 3



Use a blank number to develop mathematical understanding and language.

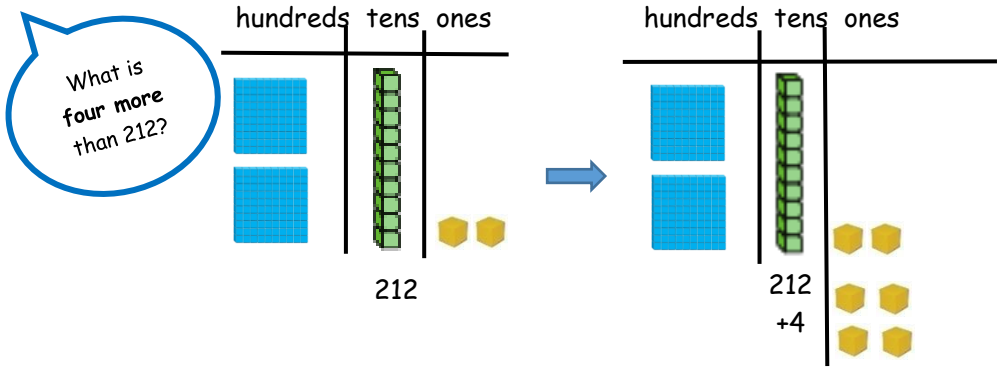
Number- Addition and Subtraction

Add and subtract numbers mentally, including a three digit number and tens and a three digit number and hundreds.
Add and subtract numbers with up to three digits, using formal methods of column addition and subtraction.
Estimate the answer to a calculation and use inverse calculations to check answers.
Solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction.

Addition (The process of finding the total of two or more sets)

Phase 1- Adding a two or three digit number to a one, two or three digit number **when not bridging**

Stage 1



The answer is 216. There are 2 **lots of hundred**, 1 **lot of ten** and 6 **lots of ones**.

Note: It is important that children begin to lay base 10 in a column format when adding 2 two digit numbers.

Use base 10 alongside a place value grid to support mathematical process.

$212+4=216$

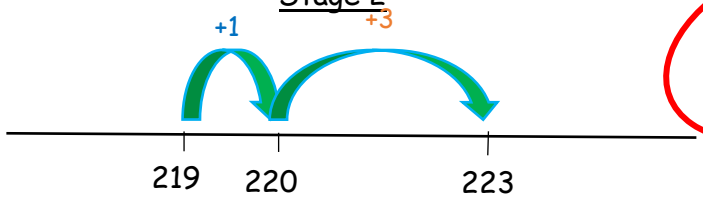
Note: Children should add the ones first.

$2+4=6$
$10+0=10$
$200+0=200$
$200+10+6 = 216$

Record as a partition column method.

Stage 2

Note: It is important that children count on to the nearest ten and then count on the remainder to support mental arithmetic.



The **difference** between 223 and 219 is 4.

Use a number line to support mathematical process.

Record using a number equation:

$219+4=219+1+3$

$220+3=223$

Stage 3

What is the missing part?

219+ □ =223?

Use a bar model to support mathematical reasoning.

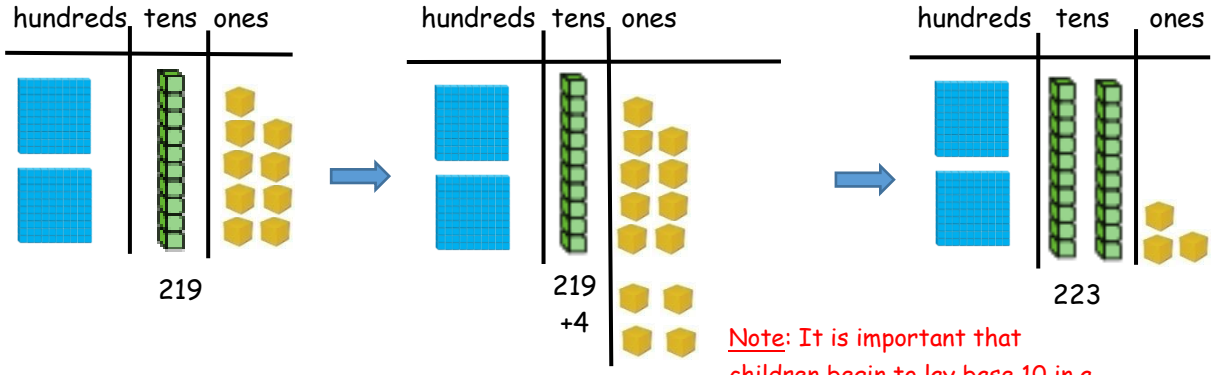
Record as a fact family:

$4+219=223$ $219+4=223$
$223-4=219$ $223-219=4$

Phase 2- Adding a two or three digit number to a one, two or three digit number **when bridging**

What is **four more** than 219?

Stage 1



I had to **exchange** 10 **ones** to make a **lot of ten**.

Note: It is important that children begin to lay base 10 in a column format when adding 2 two digit numbers.

Note: Children should further partition the ones to make it easier for mental addition.

$219+4=223$

$9+4=\cancel{13}\ 10+3$

$10+0=10$

$200+0=200$

$200+10+10+3 = 223$

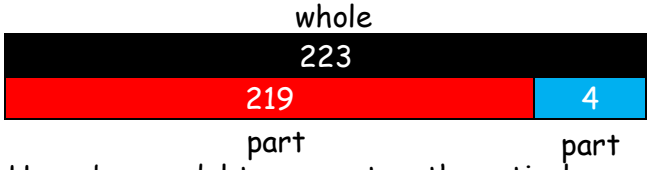
Record as a partition column method.

Use base 10 alongside a place value grid to develop understanding of mathematical process when having to **carry**.

What is the missing part?

$219+\square=223$?

Stage 2



Use a bar model to support mathematical reasoning.

I have noticed that you can **add** either **part** and it **equals** the **total**. But you can only **subtract** the **whole** from a **part** to find the **total** of the other **part**.

Record as a fact family:

$4+219=223$ $219+4=223$

$223-4=219$ $223-219=4$

219 has 2 lots of a hundred 1 lot of ten and 9 lots of ones.

Stage 3- Introducing more formal methods of recording calculation.

Note: Only introduce expanded column method when:

Children are able to recognise the value of hundreds, tens and ones without recording with partitioning.

```
  219
+   4
-----
  213
  210
  200
-----
  223
```

Record using expanded column method.

219 + 4 partitioned on a place value grid.

Hundreds place	Tens place	Ones place
100 100	10	1 1 1 1 1 1 1 1 1
		1 1 1 1

Use a place value grid to support mathematical understanding alongside the expanded column method.

Note: Only introduce compact column method when:

Children are **very secure** and confident with using expanded column method for addition.

```
 hundreds tens ones
    2    1    9
+              4
---------------
    2    2    3
---------------
         1
```

Note: Add **ones** first.

Carry underneath the line.

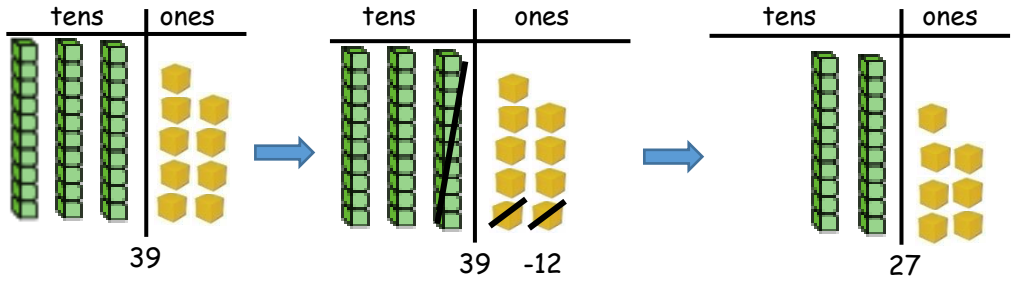
Record using compact column method.

Subtraction- Calculating the difference (The process of taking away and counting how many are left)

Phase 1- Subtracting a two or three digit number from a one, two or three digit **when no exchange is required**

What is 12 less than 39?

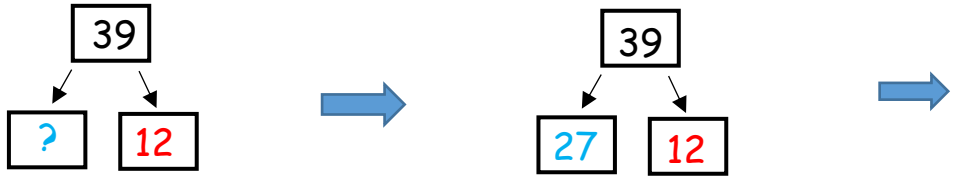
Stage 1



Use base 10 to develop understanding of mathematical language.

The **whole** is 39. One of the **parts** is 12. I know that 39 **minus** 12 will be the missing part.

The **whole** is 39 and the **parts** are 27 and 12.



Record using whole part model.

Note: Introduce partitioned column subtraction method when children are secure at partitioning a given number into hundreds, tens and ones.

39 - 12 = 27

30 and 9

- 10 and 2

20 and 7 =27

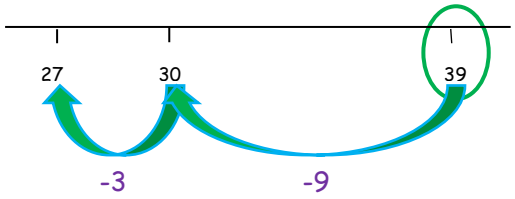
Record using partitioned column subtraction method.

What is the missing part?

39- □ =27?

Note: To support mental calculations subtract to the nearest ten and then subtract the remainder.

Stage 2

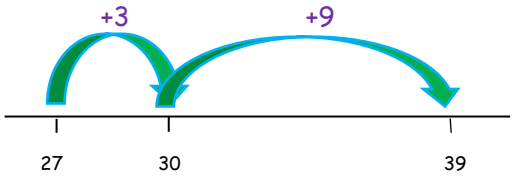


Use a blank number line to support mathematical process.

Record using a number equation:

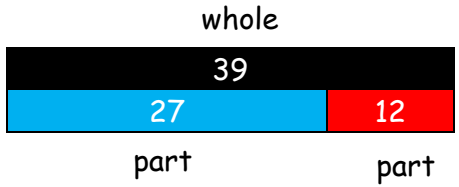
$39-12=27$

Note: Use counting on **or** finding the difference as a strategy for close-together numbers to support as a mental strategy for subtraction.



Note: To support mental calculations count on to the nearest 10 (**magic 10 strategy**).

Stage 3



Use a bar model to support mathematical reasoning.

Record as a fact family:

$39-27=12 \quad 39-12=27$

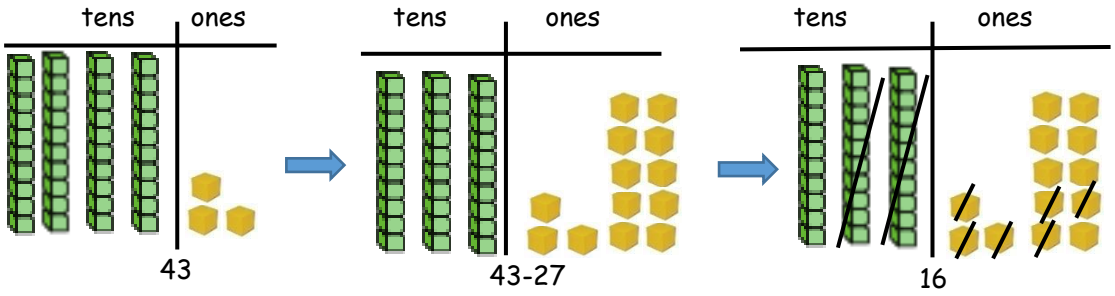
$27+12=39 \quad 12+27=39$

Phase 2- Subtracting a two or three digit number from a one, two or three digit **when exchanging is required**

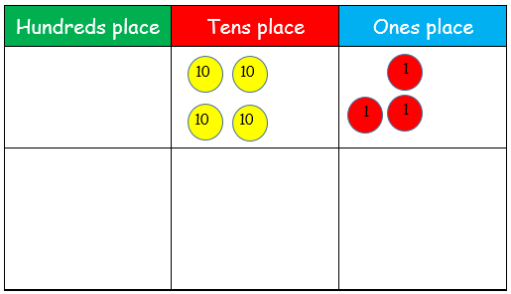
What is 43 **take away** 27?

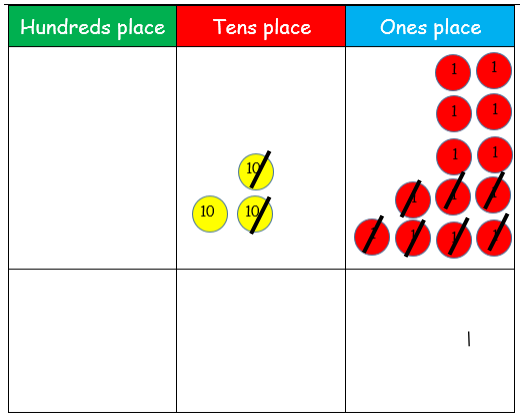
There is still a **total** of 43.

Stage 1



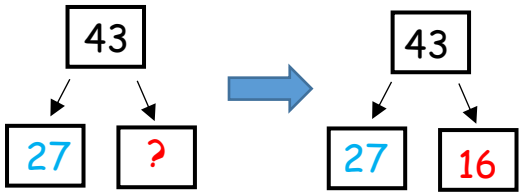
Use base 10 alongside a place value grid to develop understanding of mathematical process of exchanging.





There were only 3 ones in the ones column and I needed to take away 7 so I had to **exchange** a ten.

Record using whole part model.



Note: Introduce partitioned column subtraction method alongside a place value grid to support children with **exchanging**.

Children should be secure at partitioning a given number into hundreds, tens and ones.

I have noticed that 40+3 = 30+13

43 - 27 = 16

30 and 13

40 and 3

20 and 7

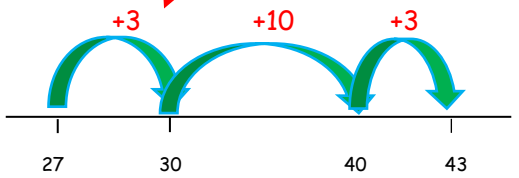
10 and 6 =16

Record using partitioned column subtraction method.

What is the missing part?

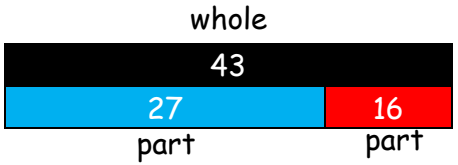
43- □ =27?

Note: Use counting on **or** finding the difference as a strategy for close-together numbers to support as a mental strategy for subtraction



Note: To support mental calculations count on to the nearest 10 (**magic 10 strategy**).

Stage 2



Use a bar model to support mathematical reasoning.

Record as a fact family:

43 - 27 = 16 43 - 16 = 27

27 + 16 = 43 16 + 27 = 43

Number- Multiplication and division

Write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two digit numbers times one digit numbers, using mental methods then progressing to formal written methods.
Solve problems, including missing number problems, involving multiplication and division, including positive integer scaling problems and corresponding problems in which n objects are connected to m objects.

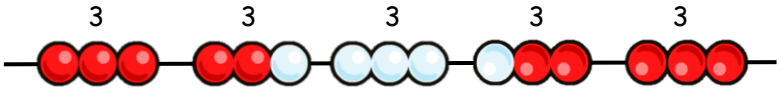
What are 5 lots of 3?

Multiplication

Multiply a two digit number by a 'friendly' (multiples of 1,2,3,5,4,8 and 10) one digit number

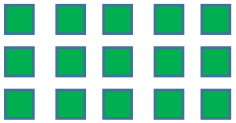
What is 35 x 4 equal to?

Stage 1



Use a beadstring alongside a number line to count on using repeated addition to develop understanding of mathematical process and language.

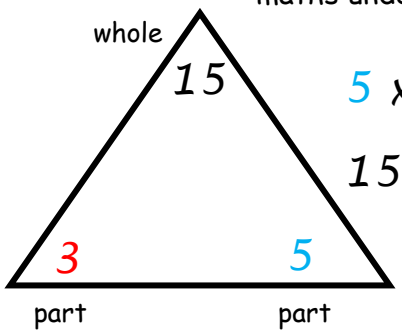
Record using an array:



5 x 3 =15

3 x 5 =15

Record using a trio alongside a bar model to help develop mental maths understanding.



5 x 3 = 15 3 x 5 = 15

15 ÷ 5 = 3 15 ÷ 3 = 5

I have noticed that you can multiply 3 x 5 or 5 x3 and it still totals 15.

Stage 2

35 x 4 =

x	4
30	120
5	20
	140

Note: Introduce grid method when children are secure at partitioning a given number into tens and ones.

Note: Once calculated children can use expanded column addition to find the total.

Use grid method alongside place value counters to develop mathematical understanding.

Record as an equation:

35 x 4 = 140

30 x 4 = 120

+ 5 x 4 = 20

120+20 = 140

Division

Phase 1- Dividing a two-digit number by a single digit number **when each digit is a multiple of the divisor** and when there **is no remainder in the final answer.**

What is 18÷3=?

Stage 1

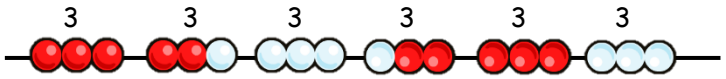
Multiple

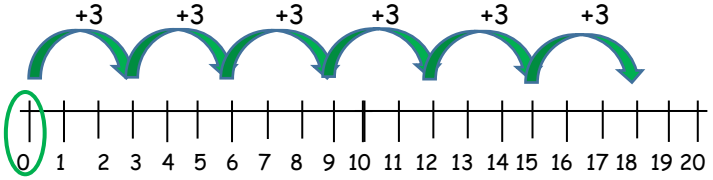
A number that may be divided by another a certain number of times.

Divisor

A number by which another number is to be divided by.

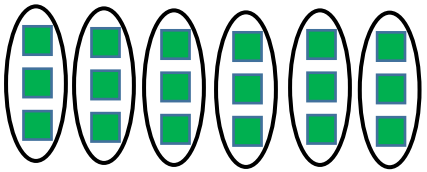
18 ÷ 3 = 6





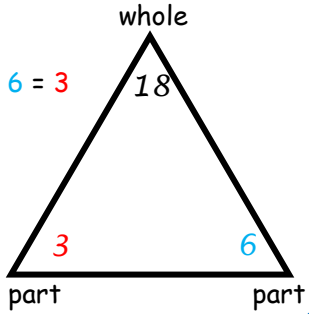
Use a beadstring alongside a number line to count on using repeated addition to develop understanding of mathematical process.

Record using an array and trio with equation:



18 ÷ 3 = 6

18 ÷ 6 = 3



I have noticed that when you **divide** you start with the **whole**.

18÷3=6

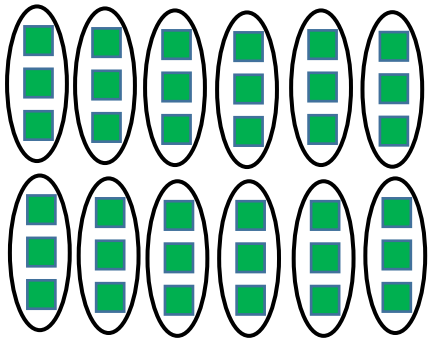
18÷6=3

Stage 2

Ensure that both multiple digits are divisible by the divisor

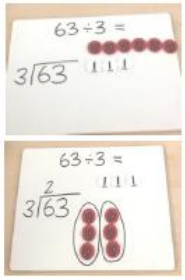
Note: Only introduce short division when:

Children are secure with division as grouping using an array, object, beadstring or number line.



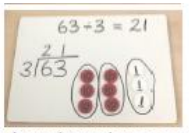
36÷3=

Use an array alongside place value counters to develop understanding of mathematical process.



1. Create the dividend using Place Value counters.

2. Group the 10s counters according to the divisor. Write the number of groups above the line in the tens column.



The quotient can be seen across the groups.

3. Now, group the 1s counters according to the divisor. Write the number of groups above the line in the ones column.

Record using short division method along with a trio and fact family to develop mathematical reasoning:

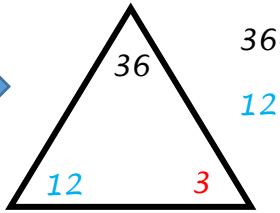
36÷3= 12

How many 3s in 3 ?=1, record it above the 3 tens.

How many 3s in 6? =2, record it above the 6 ones.

12

3)36



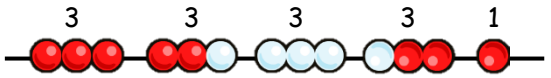
36÷3=12 36÷12=3

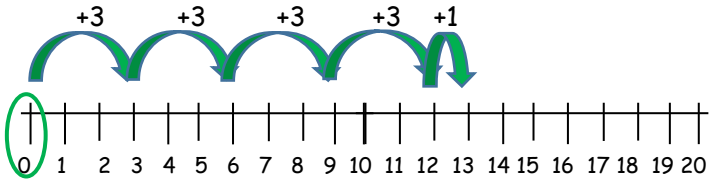
12x3=36 3x12=36

Phase 2- Dividing a two-digit number by a single digit number when **there may be a remainder in the final answer**

What is 13÷3=?

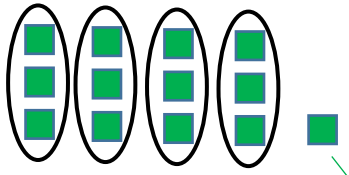
Stage 1





Use a beadstring alongside a number line to count on using repeated addition to develop understanding of mathematical process.

Record using an array with equation:



13 ÷ 3 = 4 r 1

13 ÷ 4 = 3 r 1

remainder

I have noticed that when you **divide** you start with the **whole**.

How many 4s in 7? =1 remainder 3, record the 1 above the 7 tens and the remainder (3 tens) next to the 2 ones.

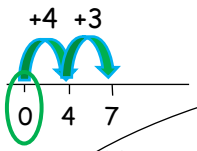
How many 3s in 32? =8, record it above the 32 ones.

Stage 2

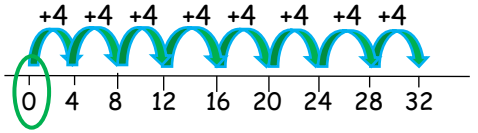
Children must demonstrate a full understanding of remainders and also short division method of calculation.

72÷4=

7÷4= 1 r 3



32÷4= 8

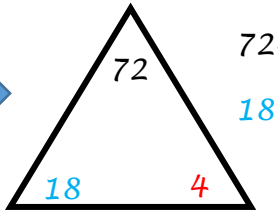


Use a number line to support mathematical process calculating division facts.

Record using short division method alongside a trio with fact family to develop mathematical reasoning:

72÷4= 18

$$\begin{array}{r} 18 \\ 4\overline{)7^{3}2} \end{array}$$



72÷4=18 72÷18=4

18x4=72 4x18=72

Recall and use multiplication and division facts for the 3,4 and 8 multiplication tables.

Use a hundred square to investigate place value and number patterns developing children's mathematical reasoning.

Counting on in 3s

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Counting on in 4s

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Counting on in 8s

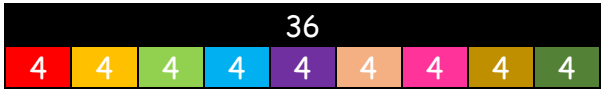
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

I have noticed when finding **multiples** of 4 the **ones digit** is either 2,4,6,8 or 0.

Use a bar model to develop mathematical reasoning when children are secure with the principle of multiplication and division.

David has 36 tiles and he sells them in packs of 4. How many packs can he make to sell?

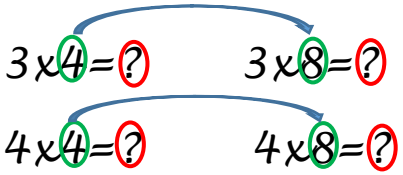
The **whole** is 36 and the **parts** are 4.



David can make 9 packs to sell. I know that 9x4=36

Double known multiplication facts to get others.

What do you notice about these calculations?



I have noticed that the ones digit has been **doubled**. So the answer of the first **equation** will be **doubled** to find the answer to the second

Number- Fractions

Count up and down in tenths; recognise that tenths arise from dividing an object into 10 equal parts and in dividing one-digit numbers or quantities by 10.

Recognise, find and write fractions of a discrete set of objects: unit fractions and non-unit fractions with small denominators.

Recognise and use fractions as numbers: unit fractions and non-unit fractions with small denominators.

Recognise and show, using diagrams, equivalent fractions with small denominators.

Add and subtract fractions with the same denominator within one whole [for example, 5/7 +1/7= 6/7].

Compare and order unit fractions, and fractions with the same denominators.

Solve problems that involve all of the above.

Numerator

The number of groups that the objects are to be shared by.

Denominator

The total number of objects in the set.

$30 \div 10 = 3$

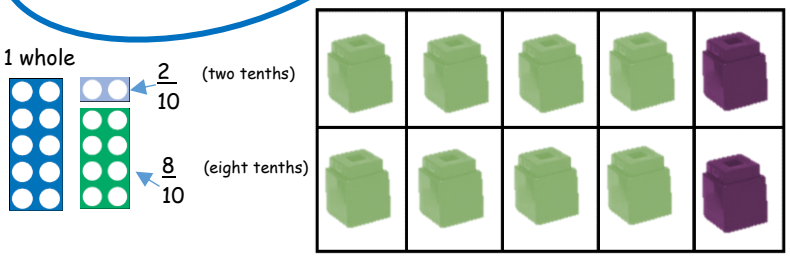
Can also be represented as: $\frac{30}{10} = 3$

Adam has 10 apples but he eats two, what **fraction** of the apples are left?

Adam has eight tenths left.

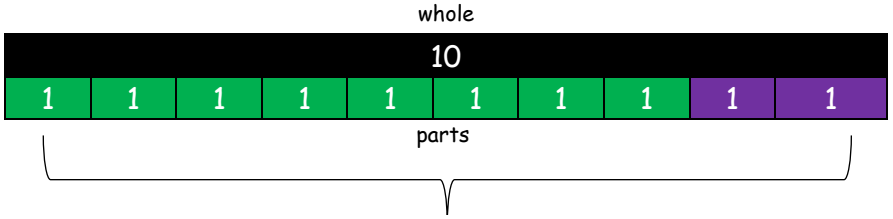
Stage 1

Representing tenths



Use a ten frame alongside Numicon to develop understanding of mathematical process and language.

Record using a bar model:

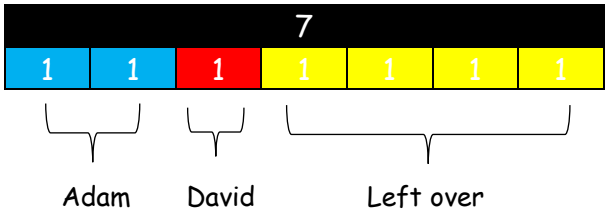


The bar model has been divided into 10 equal parts, each part represents the cubes in the ten frame. Therefore each part is 1/10 of the whole (in this case each 1/10 represents 1 apple).

Stage 2

Add and subtract equivalent fractions

There are 7 apples, Adam eats 2/7 and David eats 1/7 of them, how many apples are left?



Use a bar model to develop mathematical reasoning.

Record as a statement:

There are $\frac{4}{7}$ of the apples left over which is 4 apples.