CALCULATING IN KS1

MATHEMATICS AT ST BOTOLPH'S

AIMS AND OBJECTIVES

- Consider the developmental stages of number and calculation.
- Explore how we teach counting and place value and analyse the resources we use.
- Understand the basic end of year expectations within the KS1 framework for mathematics.

- **To provide parents and carers with a clear guide as to which algorithms their children are being taught.**

NATIONAL CURRICULUM

Fluency: flexibility (making connections), speed and accuracy;
Problem solving (not just word problems); and
Reasoning (using mathematical language to clearly explain patterns, hypothesise or enquiries).

St Botolph's children learn to:

- Confidently and accurately **mentally calculate**, without reliance on formal written methods;
- Identify **when** to mentally calculate and when to use formal written methods;
- Identify which **reliable** method of calculating is the **most efficient**;
- Confidently and accurately **reason** in relation to their calculating;
- Confidently and accurately use a varied **vocabulary** when reasoning;
- Use their mental maths and understanding of number to acknowledge whether their answer is feasible.

THE IMPORTANCE OF GUIDED PROGRESSION

- There are lots of progressions for addition, subtraction, multiplication and division. All have advantages and disadvantages – pupils will quickly find their favourites.
- All children need time to consolidate their knowledge to ensure they understand the concepts that underpin the methods.
- The speed at which pupils move through the progressions is very individual.

Fact : it is important that children’s mental methods of calculation are practised and secured alongside their learning and use of efficient written methods for calculations.

Implications for parents and carers: if you want to support the learning and understanding of your children’s written methods, then helping them with mental calculations is imperative!

NATIONAL CURRICULUM

Year 1 Key Objectives - Mathematics

Number and place value

- count to and across 100, forwards and backwards, beginning with 0 or 1, or from any given number
- count, read and write numbers to 100 in numerals
- count in multiples of twos, fives and tens
- given a number, identify one more and one less
- identify and represent numbers using objects
- identify and represent numbers using pictorial representations including the number line
- use the language of: equal to, more than, less than (fewer), most, least
- read and write numbers from 1 to 20 in numerals and words.

Year 2 Key Objectives- Mathematics

Number and place value

- count in steps of 2, 3, and 5 from 0, and in tens from any number, forward and backward
- recognise the place value of each digit in a two-digit number (tens, ones)
- identify, represent and estimate numbers using different representations, including the number line
- compare and order numbers from 0 up to 100; use <, > and = signs
- read and write numbers to at least 100 in numerals
- read and write numbers to at least 100 in words
- use place value and number facts to solve problems.

NATIONAL CURRICULUM

Calculation

- read, write and interpret mathematical statements involving addition (+), subtraction (–) and equals (=) signs
- represent and use number bonds and related subtraction facts within 20
- add and subtract one-digit and two-digit numbers to 20, including zero
- solve one-step problems that involve addition and subtraction, using concrete objects and pictorial representations, and missing number problems such as 7 = $\square$ – 9.

- solve one-step problems involving multiplication and division, by calculating the answ using concrete objects,
- solve one-step problems involving multiplication and division using pictorial representations and arrays with the support of the teacher.

NATIONAL CURRICULUM

Calculation

- solve problems with addition and subtraction:
  - using concrete objects and pictorial representations, including those involving numbers, quantities and measures
  - applying their increasing knowledge of mental and written methods
- recall and use addition and subtraction facts to 20 fluently
- derive and use related facts up to 100
- add and subtract numbers using concrete objects, pictorial representations, and mentally, including:
  - a two-digit number and ones
  - a two-digit number and tens
  - two two-digit numbers
  - adding three one-digit numbers
- show that addition of two numbers can be done in any order (commutative) and subtraction of one number from another cannot
- recognise and use the inverse relationship between addition and subtraction and use this to check calculations and solve missing number problems.

- recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers
- calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs
- show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot
- solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in contexts.

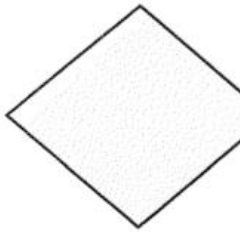
Statistics

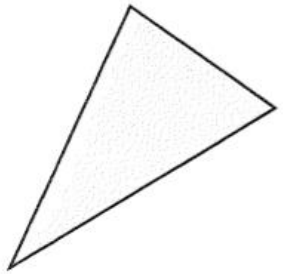
- interpret and construct simple pictograms, tally charts, block diagrams and simple tables
- ask and answer simple questions by counting the number of objects in each category and sorting the categories by quantity

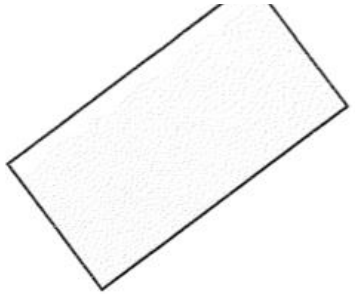
END OF KS1 EXPECTATIONS

6 Look at the shapes.

Tick (✓) the hexagon.







19 Amy buys an ice-cream for 90p.

(a) Tick (✓) **three** coins to show how Amy can make **90p**.

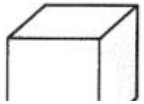
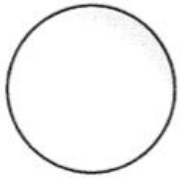
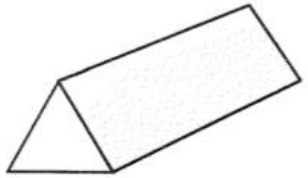
(b) Tick (✓) **four** coins to show anoth

8 Complete the table.

words	digits
thirty-eight	38
	40
ninety-four	

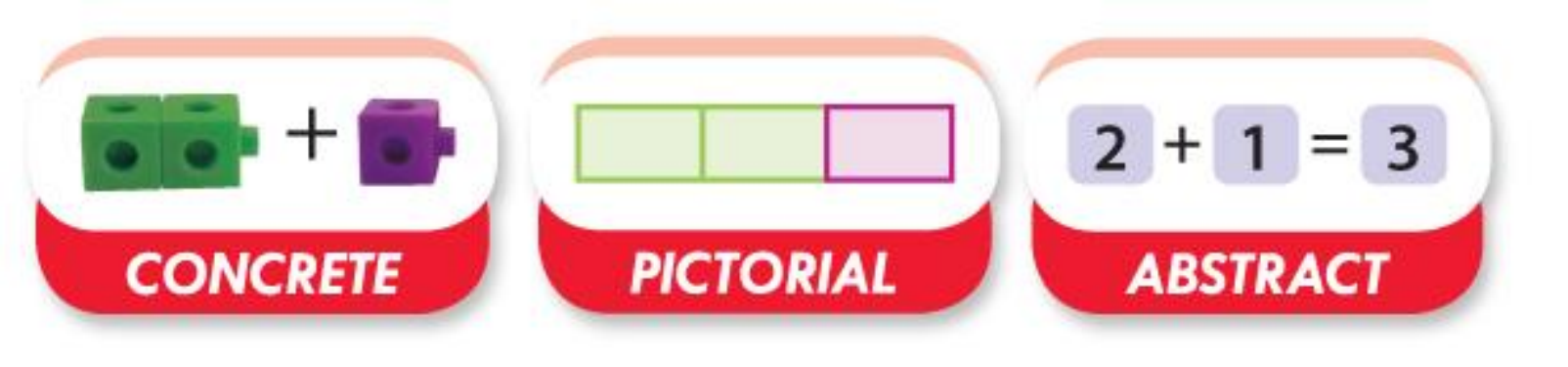
14 **One** shape is in the **wrong** place on the sorting grid.

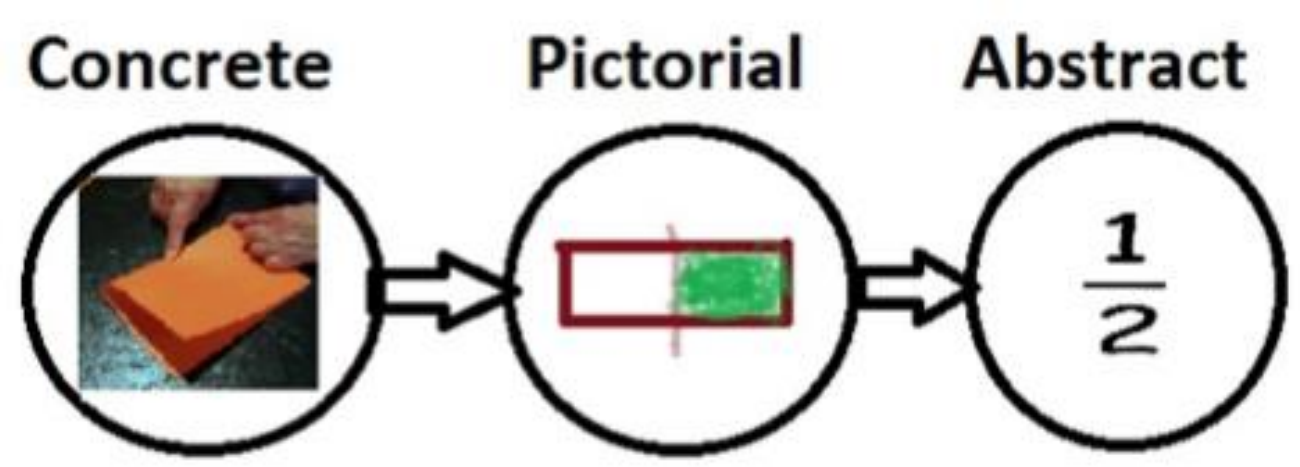
Draw a cross (✗) on it.

Shapes **with** a square face	Shapes **without** a square face
	 

SO HOW DO THEY GET THERE…

1. CONCRETE – PICTORIAL - ABSTRACT





2. VOCABULARY

Number and Place Value

- zero, one, two… up to twenty and beyond
- zero, ten, twenty… one hundred
- none
- count, count up to
- count on (from, to)
- count back (from, to)
- ones, twos, threes, tens
- more, less, many, few
- odd, even
- every other
- pair, pattern, sequence, rule
- digit, place value, place holder
- represents, stands for
- the same as/as many as
- equal to

greater, more, larger, bigger
less, fewer, smaller
greatest, most, biggest, largest
least, fewest, smallest
one more, ten more
one less, ten less
compare
order
size, value
first, second, third… twentieth
last, last but one
before, after, next
between, half-way

General

start from, start at
show me
arrange, rearrange
split, separate, partition
change
continue, what comes next
find, choose
collect
tell me, describe
in order, in a different order
best way, another way
same way, different way
missing, different, same number
solve, check, interpret
explain how…
give an example of…

2. VOCABULARY

Calculation (Addition and Subtraction)

- + add, more, plus, make, sum, total
- altogether, = equal to
- how many more make…
- how many more is…
- how much more is…
- subtract, take (away), minus
- how many are left
- how many have gone
- how many fewer…
- how much less…
- difference between
- number bonds
- boundary, exchange

Calculations (Multiplication and Division)

count in 2, 5, 10
array
row, column
= equal to, sign, the same as
grouping, sharing, share equally
half, halving
doubling, double, near double
lots of, groups of
multiply, times, multiple of
divide, divide into/by

Calculations (Estimating)

guess how many
nearly, roughly, close to
about the same as
just over, just under
too many, too few
exactly, exact

Calculations (Solving Problems)

puzzle, pattern
calculate, calculation
answer
right, correct, wrong, incorrect
what could we try next
how did you work it out
count out, share out, left, left over
equation
sign, operation, symbol
predict

3. 'MASTERY'

Mastery means that children are able to:

- use mathematical knowledge and understanding flexibly and fluently;
- recall key number facts with speed and accuracy;
- use accurate, rapid recall of number facts to be able to calculate unknown number facts efficiently;
- reason and explain mathematical concepts and use this reasoning to solve a variety of problems.

Examples of mastery:

- Can they describe their work in their own words, using mathematical vocabulary?
- Can they explain it to someone else, so that they too understand?
- Can they show their work in a variety of ways, i.e. using objects, pictures, symbols?
- Can they make up their own examples or questions using the concept that they have mastered?
- Can they see/make connections with other areas of mathematics, i.e. fractions and partitioning numbers?
- Can they recognise the same concept in a new situation or context, i.e. do they understand in any way it can be shown?
- Can they make use of their knowledge to work more efficiently, i.e. the quickest, easiest, most accurate way?

ADDITION AND SUBTRACTION

Written methods taught…

Year One – Numbered Number Line

Year Two – Empty Number Line and Partitioning

No formal written methods

… but there are many mental methods that support these.

NUMBER SENSE

Number sense

Number bonds

Known facts

In Year 1 and 2, we learn the pattern for 10 more and 10 less.

$0+7=7$
$1+6=7$
$2+5=7$
$3+4=7$
$4+3=7$
$5+2=7$
$6+1=7$
$7+0=7$

$0+7=7$
$7+0=7$

$1+6=7$
$6+1=7$

$2+5=7$
$5+2=7$

$3+4=7$
$4+3=7$

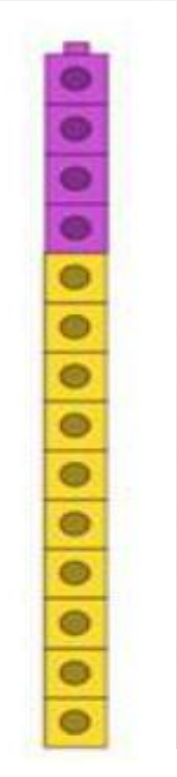
In Year 2, this would stretch to missing values and reverse equations, i.e. 7 = ? + ?

Year 2 work on fact families and working systematically.

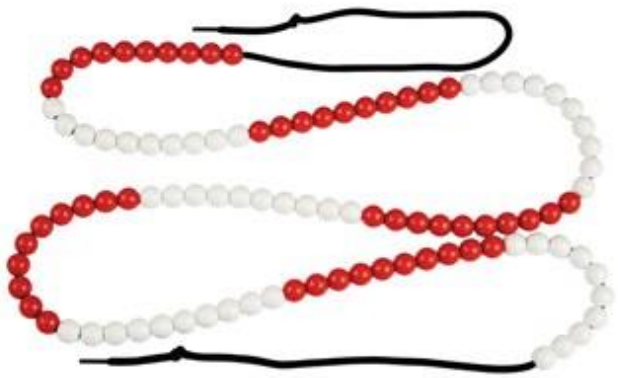
Commutativity

Using known facts to derive known facts

CONCRETE – PICTORIAL – ABSTRACT (Y1&Y2)



Beadstring



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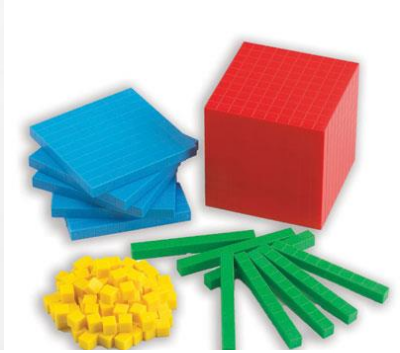
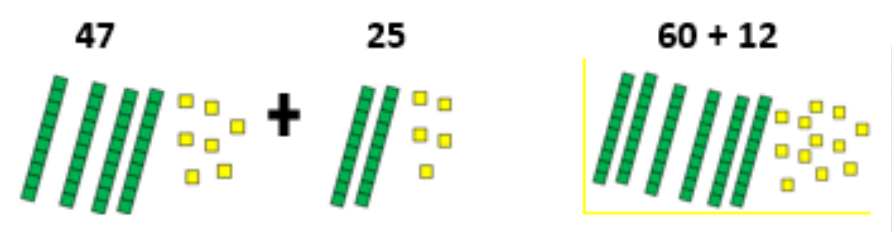
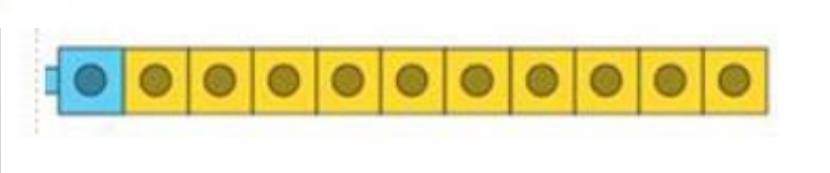




Year 1 use dienes to regroup.
Year 2 regroup, calculate and problem solve.

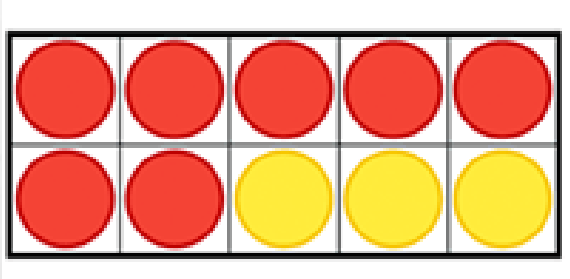
Cubes



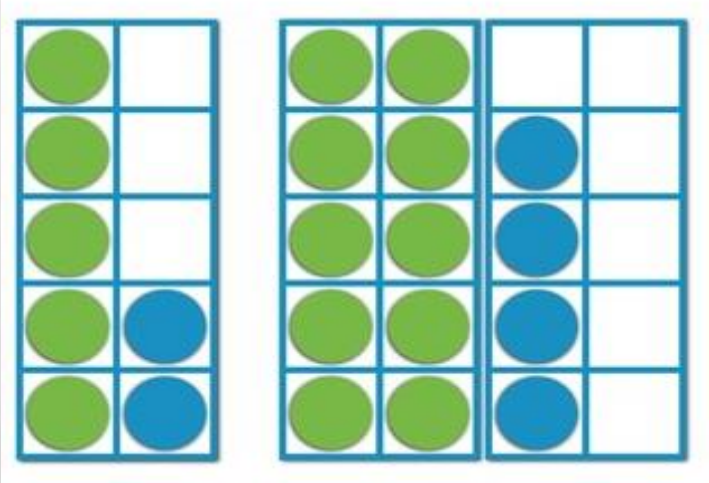
Using known facts to derive facts

CONCRETE – PICTORIAL – ABSTRACT (Y1&Y2)

Tens Frame

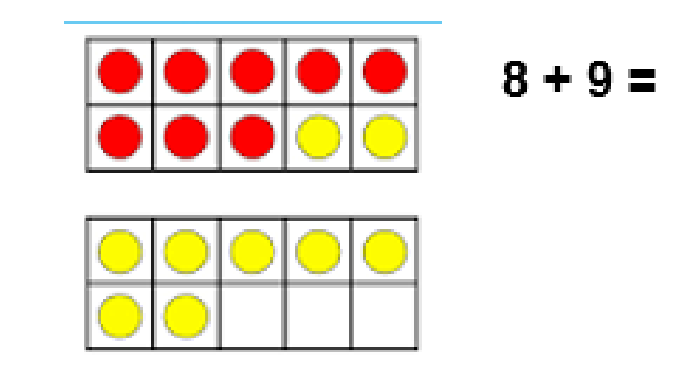


7 + 3 = 10
3 + 7 = 10
10 – 7 = 3
10 – 3 = 7



10 + 4 = 14
4 + 10 = 14
14 – 4 = 10
14 – 10 = 4

Inverse



Make 10 Strategy

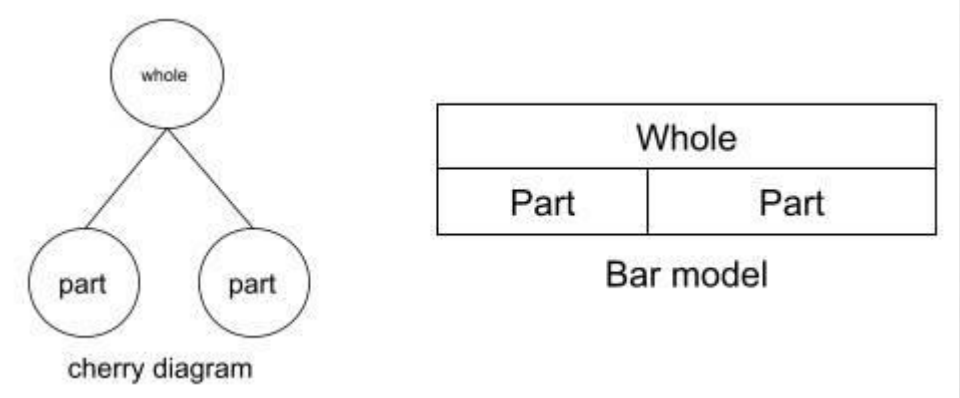
'I have 10 and 7 so that answer is 17.'

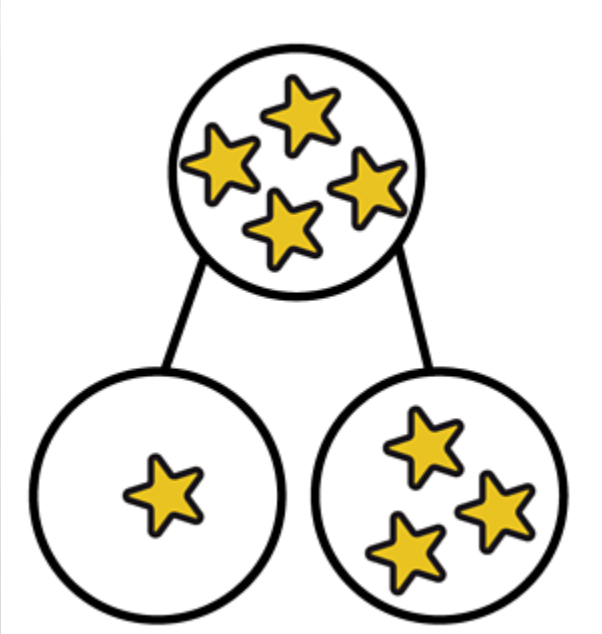
Using known facts to derive facts

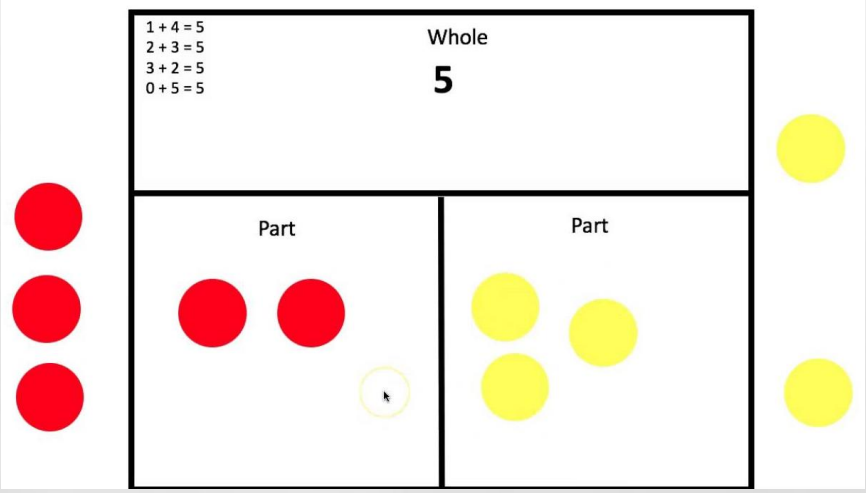
Year 1 work on numbers to 20, then to 50 and end with up to 100. Year 2 work with numbers within 100.

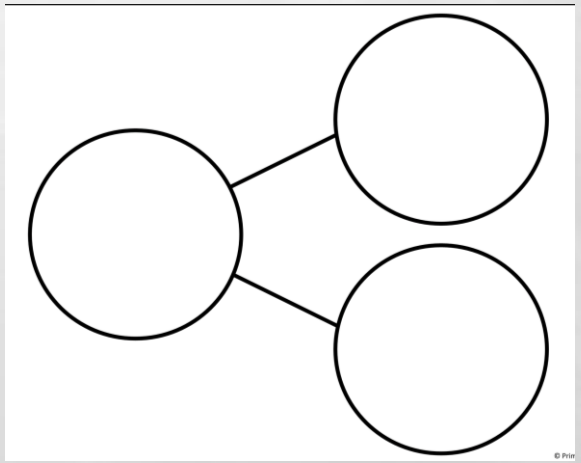
CONCRETE – PICTORIAL – ABSTRACT (Y1&Y2)

Part Whole Model









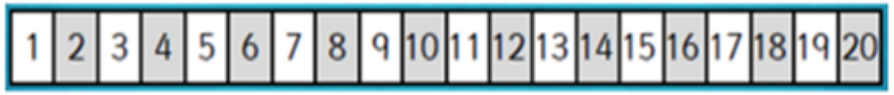
Year 1 work on numbers to 20, then to 50 and end with up to 100. Year 2 work with numbers within 100.

ABSTRACT (Y1&2)

Number track.

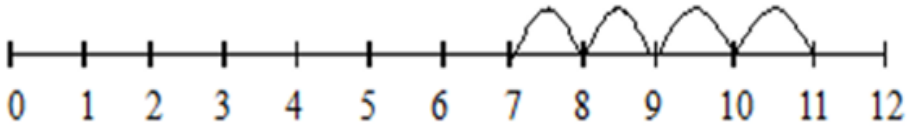
In Year One, addition starts with the children using a number track counting on, ensuring that they count on from the largest value number, i.e.

6 + 3 = 9



Marked Number Line.

7+ 4 =



With both the Number Track and the Marked Number line, children must acknowledge that they start on the first number (the largest in value) and count from there; not counting the starting number. For example,

7 + 6 = *means the answer is the sixth number after 7* 8 9 10 11 12 13

Year 1

Number track and numbered number line – one to one counting.

Year2

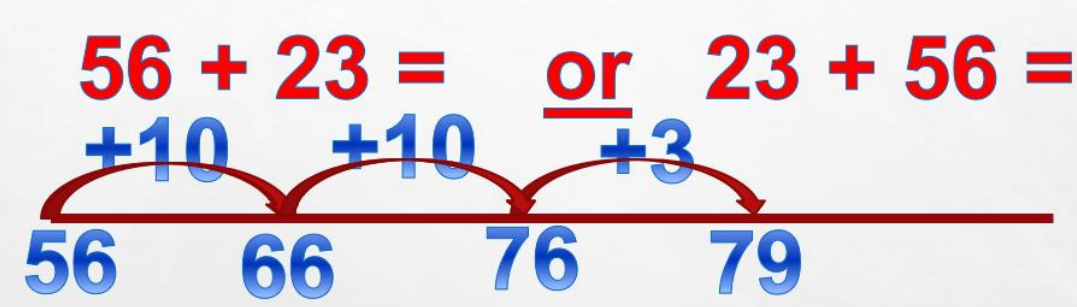
Numbered number line

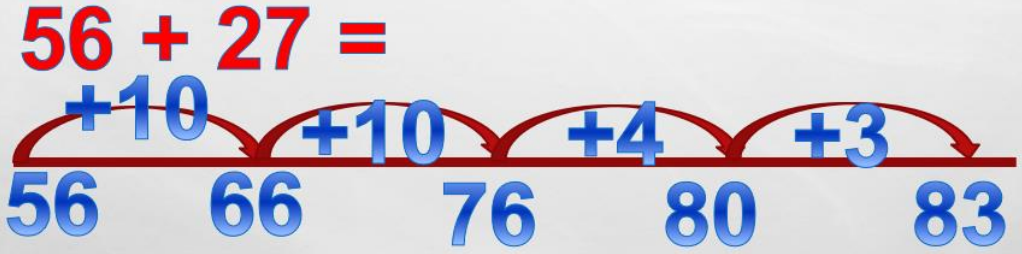
- **counting on in ones**
- **partitioning tens and ones**
- **using number bonds on a number line**

They learn to count on in a way that they are most comfortable with.

ABSTRACT (Y2)

Addition



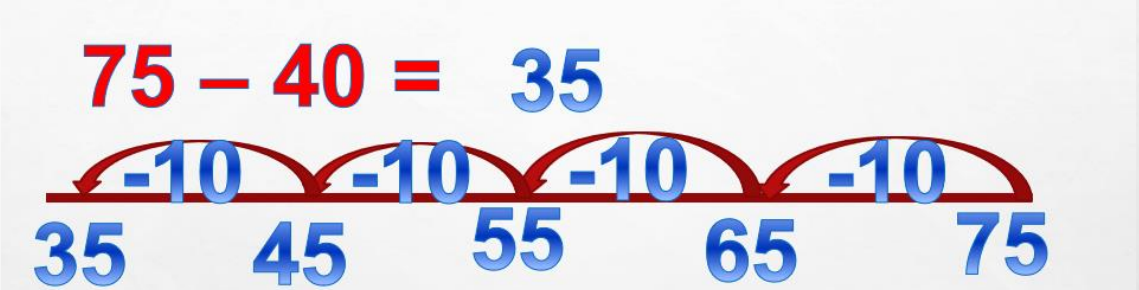


Starting with the largest value

Partitioning tens and ones

Using number bonds

Subtraction



Counting back

Partitioning (getting to a boundary)

ABSTRACT (Y2)

Partitioning

T	O		T	O		T	O
4	2	+	4	3	=		
4	0	+	4	0	=	8	0
	2	+		3	=		5

80 + 5 = 85

'If I know 4 and 4 makes 8, then I know 40 and 40 make 80.'

Because this method is abstract, we do not go through the boundary in Year 2.

T	O		T	O		T	O
4	6	-	3	2	=		
4	6	-	3	0	=	1	6
1	6	-		2	=	1	4

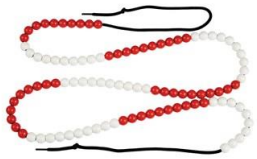
We do not partition BOTH numbers for subtraction because...

46 – 38 =

40 – 30 =

6 – 8 =

there are not enough ones here and we go into negative numbers.



Finding the difference, i.e. 32 – 25

Find 32 and 25 on a bead string and look at how many beads are between.

YOUR TURN

Have a go at calculating these equations using different methods (both informal (mental concrete or pictorial) or formal (written abstract).

Year 1

1. 5 + 5
2. 12 + 8
3. 9 + 4
4. 11 + 6

Year 2

1. 23 + 8
2. 32 + 20
3. 12 + 13
4. 3 + 6 + 2

YEAR 1

1. 10 - 3
2. 20 - 6
3. 9 - 4
4. 14 - 7

YEAR 2

1. 25 - 10
2. 25 - 9
3. 34 - 11
4. 16 - 3 - 3

YEAR ONE – MASTERY - ADDITION

Children understand and can explain:

- **= means equal to so both sides of this symbol will be equal (it does not just indicate where to put an answer to a calculation), i.E. 3+4 = 1+6;**
- **a number of different ways to make the same number, i.E. 6 = 5 + 1 = 4 + 2 = 3 + 3 etc (including using the bar model);**
- **the role of inverse in mathematics and knowing the relationship between addition and subtraction can be used to find unknown number facts, i.E. If 3 + 7 = 10, then 10 – 7 = 3; and**
- **Rules and patterns can be used to make connections, i.E. If 7 + 3 = 10, then 17 + 3 = 20 <u>as 20 is 10 more than 10</u>.**

Mastery

Complete:

3 + □ = 10	10 – □ = 3	13 + □ = 20	20 – □ = 13
□ + 5 = 10	10 – 5 = □	15 + □ = 20	20 – □ = 15
□ + □ = 10	10 – □ = □	16 + □ = 20	20 – □ = 16

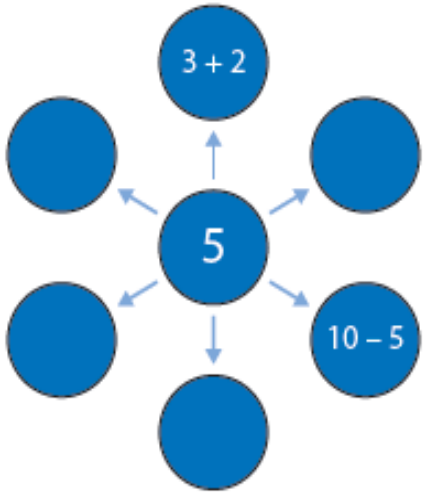
What do you notice?

Children may 'know' number pairs totalling ten but are they able to use them to support other calculations? For example, when probed to say, 'If you know 3 + 7 = 10, what else do you know?' They should reply with answers, such as 13 + 7 = 20 or 4 + 7 = 11

Mastery with Greater Depth

If you know one fact, what other facts do you know?

Complete:



YEAR TWO – MASTERY - ADDITION

Children know and can explain:

- the commutative rule (that numbers can appear in any order and give the same total);
- odd + odd = even; odd + even = odd;
- the use of the inverse relationship between addition and subtraction for checking their calculations and solving missing number problems (i.E. Bar model);
- The number patterns, i.E. When adding tens to a given number; and
- Using rules to make connections, i.E. If 7 + 3 = 10, then 70 + 30 = 100 <u>as this is ten times greater</u> and to solve missing number problems, i.E. 35 + □ + □ = 100 and knowing that they are multiple correct answers.

Mastery	Mastery with Greater Depth
What do you notice about each set of calculations? What's the same and what's different about the three sets of calculations?	Complete the calculations. 30 + 40 + □ = 100 40 + □ + 20 = 100 36 + 44 + □ = 100 36 + 54 + □ = 100 47 + □ + 20 = 100 47 + □ + 30 = 100

10 – 9 =	20 – 19 =	100 – 90 =
10 – 8 =	20 – 18 =	100 – 80 =
10 – 7 =	20 – 17 =	100 – 70 =
10 – 6 =	20 – 16 =	100 – 60 =
10 – 5 =	20 – 15 =	100 – 50 =
10 – 4 =	20 – 14 =	100 – 40 =
10 – 3 =	20 – 13 =	100 – 30 =
10 – 2 =	20 – 12 =	100 – 20 =

YEAR ONE – MASTERY - SUBTRACTION

Children understand and can explain:

- **= means equal to so both sides of this symbol will be equal (it does not just indicate where to put an answer to a calculation), i.E. 3+4 = 1+6;**
- **a number of different ways to make the same number, i.E. 6 = 7 - 1 = 8 - 2 = 9 – 3 etc (including using the bar model);**
- **knowing that difference means subtraction (finding the difference between two numbers);**
- **the role of inverse in mathematics and knowing the relationship between addition and subtraction can be used to find unknown number facts, i.E. If 10 – 7 = 3, then 3 + 7 = 10; and**
- **rules and patterns can be used to make connections, i.E. If 10 - 3 = 7, then 20 - 3 = 17 <u>as 20 is 10 more than 10 so 17 is 10 more than 7</u>.**

Captain Conjecture says, 'If you add 0 to a number, the number stays the same.' Do you agree? Explain your reasoning. 	Captain Conjecture says, 'If you add together six 0s the answer is 6.' Do you agree? Explain your reasoning. 

YEAR TWO – MASTERY - SUBTRACTION

Children know and can explain:

- **how the commutative law for addition does <u>not</u> apply to subtraction;**
- **odd - odd = even; odd - even = odd;**
- **the use of the inverse relationship between addition and subtraction for checking their calculations and solving missing number problems (i.E. Bar model);**
- **know that subtraction is also known referred to in many other ways (take away, difference etc);**
- **the number patterns, i.E. When subtracting tens from a given number; and**
- **using rules to make connections, i.E. If 7 + 3 = 10, then 70 + 30 = 100 <u>as this is ten times greater</u> and to solve missing number problems, i.E. 35 + □ + □ = 100 and knowing that they are multiple correct answers.**

Dan needs 80 g of sugar for his recipe. There are 45 g left in the bag. How much more does he need to get?

The temperature was 26 degrees in the morning and 11 degrees colder in the evening. What was the temperature in the evening?

A tub contains 24 coins. Saj takes 5 coins. Joss takes 10 coins. How many coins are left in the tub?

Together Jack and Sam have £12.
Jack has £2 more than Sam.
How much money does Sam have?
A bar model can be very helpful in solving these types of problems.

£12 – £2 = £10
£10 ÷ 2 = £5
Sam has £5

MULTIPLICATION AND DIVISION

Written methods taught…

Year One – Arrays and Repeated Addition/Subtraction Number Line

Year Two – Same as year one and Partitioning

… but there are many mental methods that support these.

NUMBER SENSE

Number sense

Known facts

Sequence

Patterns

Commutativity

0	0
2	5
4	10
6	15
8	20
10	25
12	30

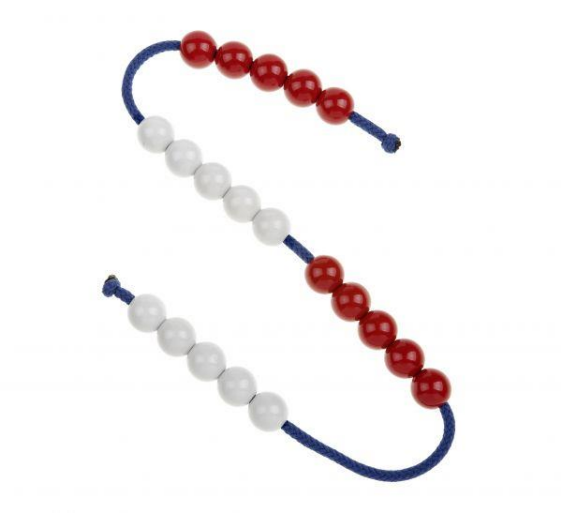
In Year 2, this would stretch to missing values and reverse equations, i.e. 7 = ? + ?

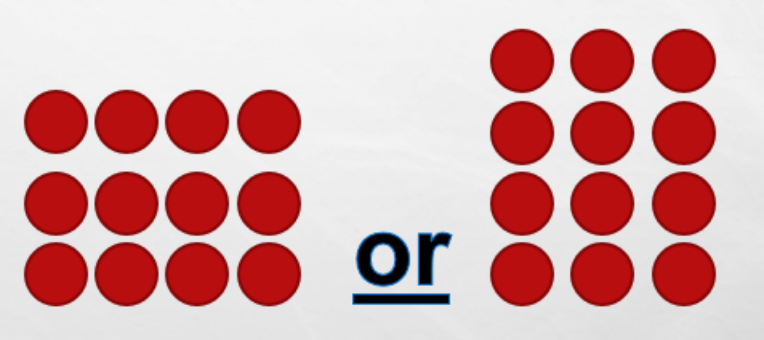
Year 2 work on fact families and working systematically.

Using known facts to derive known facts

CONCRETE – PICTORIAL – ABSTRACT (Y1&Y2)

Beadstring

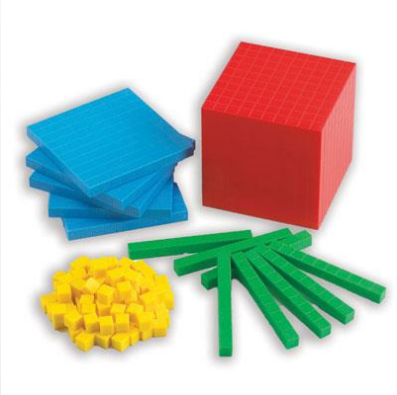


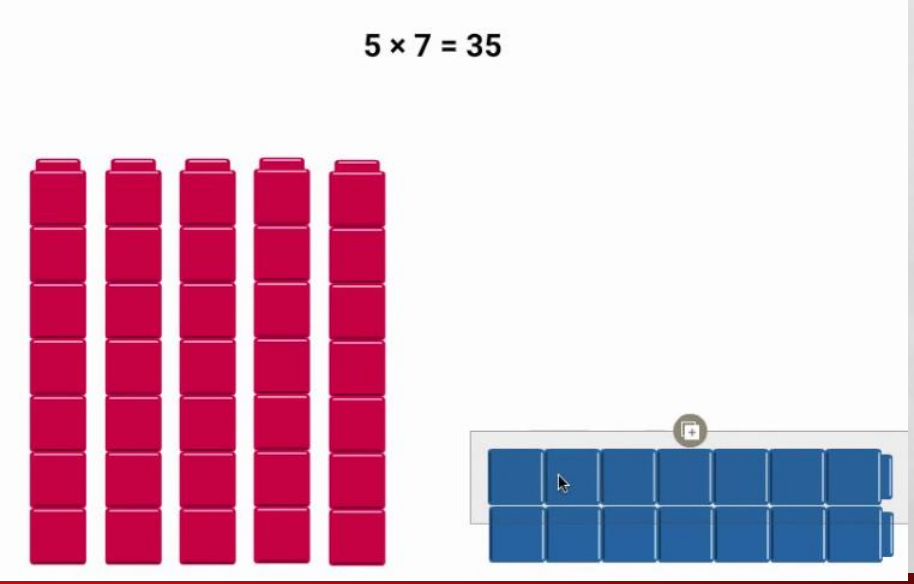


Counters

Dienes

Cubes



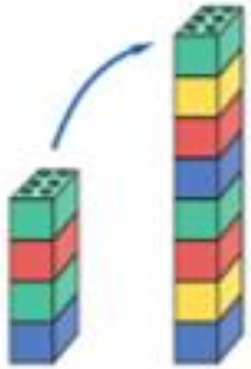


Using known facts to derive facts

CONCRETE – PICTORIAL – ABSTRACT (Y1&Y2)

12 is divided into 3 groups
= 4 in each group OR

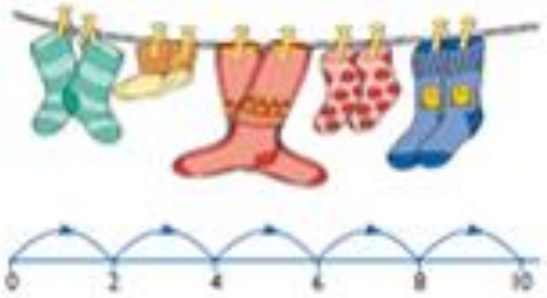
3 groups with 4 in each
= 12 altogether.



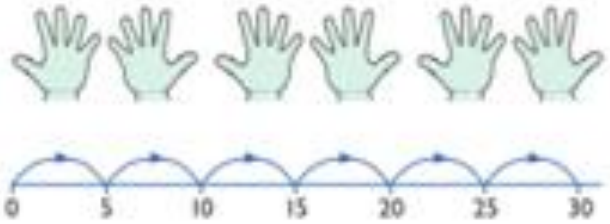
double 4 is 8
$4 \times 2 = 8$

$4 \times 3 = 12$

Grouping **Repeated addition (multiplication)** **Repeated subtraction (division)**



$2 + 2 + 2 + 2 + 2 = 10$
$2 \times 5 = 10$
2 multiplied by 5
5 pairs
5 hops of 2



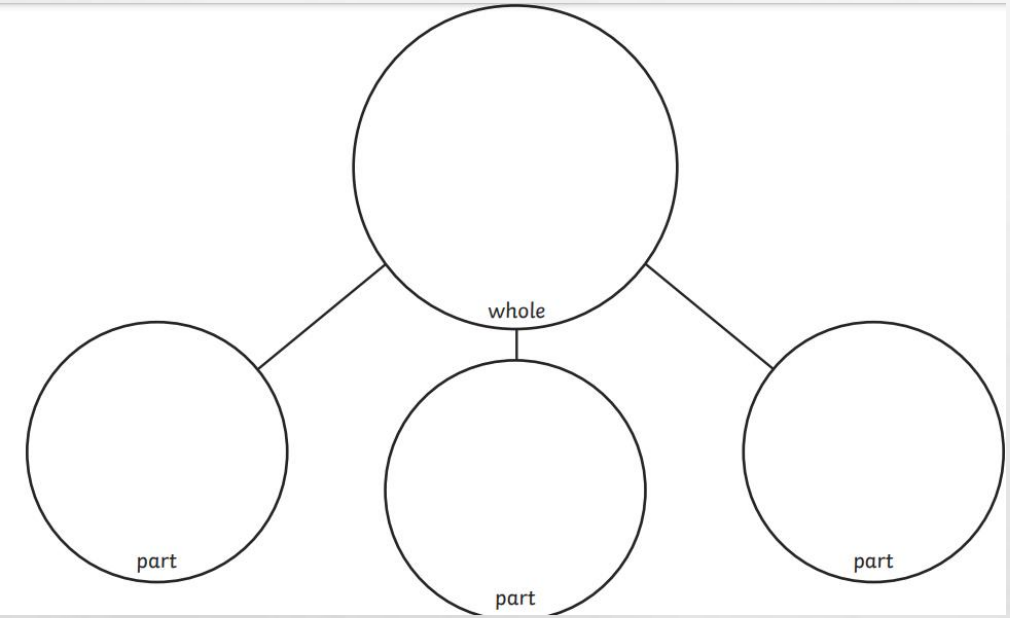
$5 + 5 + 5 + 5 + 5 + 5 = 30$
$5 \times 6 = 30$
5 multiplied by 6
6 groups of 5
6 hops of 5

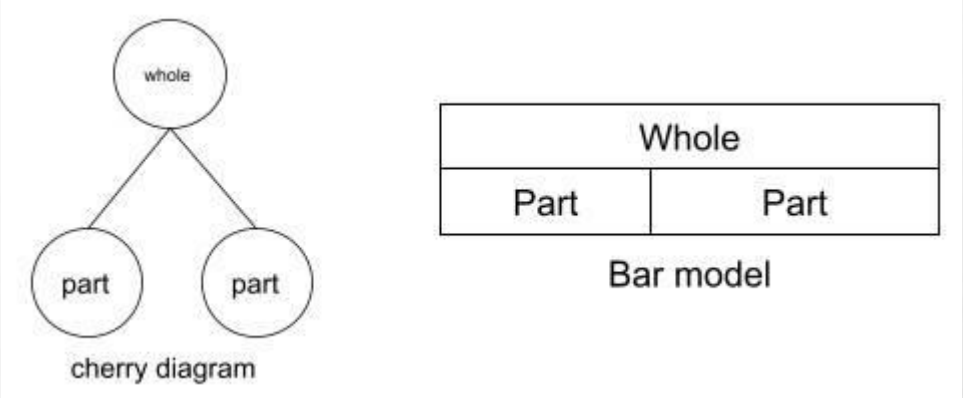
CONCRETE – PICTORIAL – ABSTRACT (Y1&Y2)

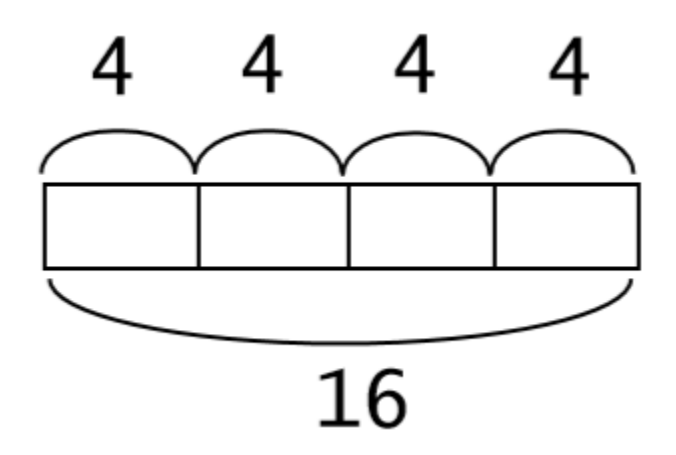
Grouping **Repeated addition (multiplication)** **Repeated subtraction (division)**

CONCRETE – PICTORIAL – ABSTRACT (Y1&Y2)

Part Whole Model



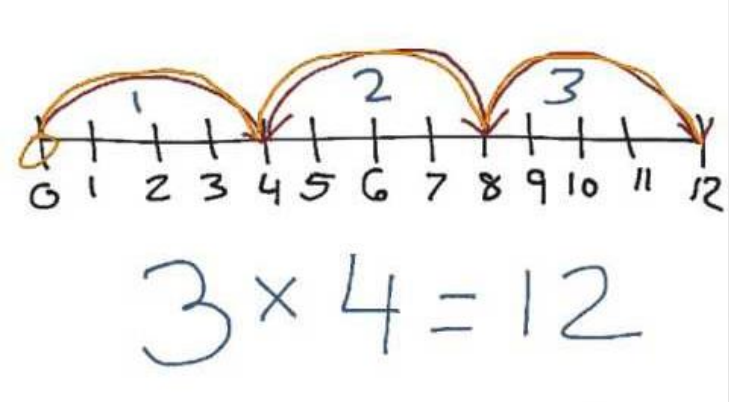




Year 2 are the first year group to work on Times Tables explicitly (2, 5, 10)

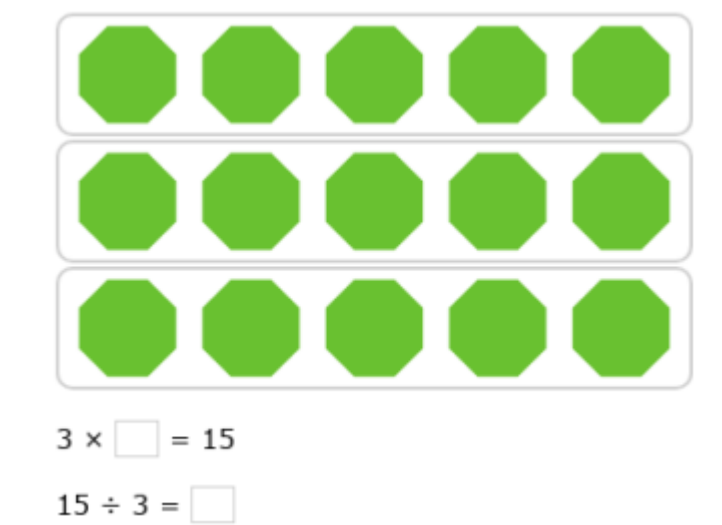
CONCRETE – PICTORIAL – ABSTRACT (Y1&Y2)

Number tracks (doubling and halving)



Skip counting and skip counting on a number line

Arrays



Inverse

ABSTRACT (Y2)

12 x 2 =

10 x 2 = 20

2 x 2 = 4

20 + 4 = 2 4

60 ÷ 5 =

50 ÷ 5 = 1 0

10 ÷ 5 = 2

1 2

YOUR TURN

Have a go at calculating these equations using different methods (both informal (mental concrete or pictorial) or formal (written abstract).

YEAR 1	YEAR 2
1. 0 X 2	1. 6 X 2
2. 2 X 2	2. 5 X 5
3. 2 X 3	3. 9 X 10

YEAR 1	YEAR 2
1. 10 ÷ 1	1. 20 ÷ 2
2. 4 ÷ 2	2. 20 ÷ 5
3. 6 ÷ 6	3. 20 ÷ 10
	4. 24 ÷ 2

YEAR ONE – MASTERY - MULITIPLICATION

Children should:

- **Understand 6 counters can be arranged as 3+3 or 2+2+2; and**
- **Understand that when counting in twos, the numbers are always even.**

Mastery	Mastery with Greater Depth
Ask pupils to use concrete objects to answer questions such as: ■ What is double 4? ■ What is half of 6?	Captain Conjecture says, 'I can double any number, but I can only halve some numbers'. Do you agree? Explain your reasoning. 

YEAR TWO – MASTERY – MULTIPLICATION

Children should:

- **Understand that you always count from zero in times tables;**
- **Understand that 0 x by anything is always zero;**
- **Know the commutative law and be able to demonstrate it;**
- **Know the inverse relationship between multiplication and division; and**
- **Start to notice patterns with numbers, i.E. The 4 x table is double the 2 x table.**

Mastery	Mastery with Greater Depth
Complete and compare the 5 and 10 times tables. What do you notice?	True or false?
$5 \times 1 =$ $10 \times 1 =$	$5 \times 4 = 4 \times 5$
$5 \times 2 =$ $10 \times 2 =$	$5 \times 4 = 10 \times 2$
$5 \times 3 =$ $10 \times 3 =$	$5 \times 4 = 2 \times 10$
$5 \times 4 =$ $10 \times 4 =$	Explain your reasoning.
	What do you notice?

YEAR ONE – MASTERY - DIVISION

Children should be able to identify:

- **True or false? I can only halve even numbers.**
- **That grouping and sharing are different types of problems. Some problems need solving by grouping and some by sharing.**

Mastery	Mastery with Greater Depth
Sarah is filling party bags with sweets. She has 20 sweets altogether and decides to put 5 in every bag. How many bags can she fill?	How else could 20 sweets be put into bags so that every bag had the same number of sweets? How many bags would be packed each time?

YEAR TWO – MASTERY - DIVISION

Children should:

- Understand that dividing by 0 will leave the number unchanged;
- Know the commutative law does not apply to division (you cannot change the order);
- Know the inverse relationship between multiplication and division;
- Start to notice patterns with numbers, i.E. 5 x table is half the 10 x table;
- Understand the more you share between, the less each person will get (e.G. Would you prefer to share these grapes between 2 people or 3 people? Why?); And
- Have a secure understanding of grouping means you count the number of groups you have made. Whereas sharing means you count the number of objects in each group.

Did you know... ?
Do you teach...?

TIMES TABLES

Five times table

- Cut in half, then times 10
  Example: 5x6: Cut 6 in half to get 3, then times 10 for **30**
- Or times 10 then cut in half
  Example: 5x9: 9 times 10 is 90, then cut in half for **45**
- Also the last digit goes 5, 0, 5, 0, - like this: **5**, 1**0**...

Six times table

- Multiply by 5 and add your number on once more
- When you multiply 6 by an even number, they both end in the same digit.
  Examples: 6×**2**=1**2**, 6×**4**=2**4**, 6×**6**=3**6**, etc

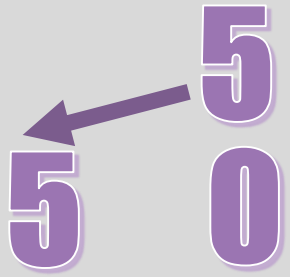
Eight times table

- Double, double, double!
  Example: 8×6: double 6 is 12, double 12 is 24, double 24 is **48**
- Multiply by ten, multiply by two and take the second number away from the first number.

Nine times table

10x your number and then minus your number once.
Example: 9×6 = 10×6−6 = 60−6 = 54

Ten times table



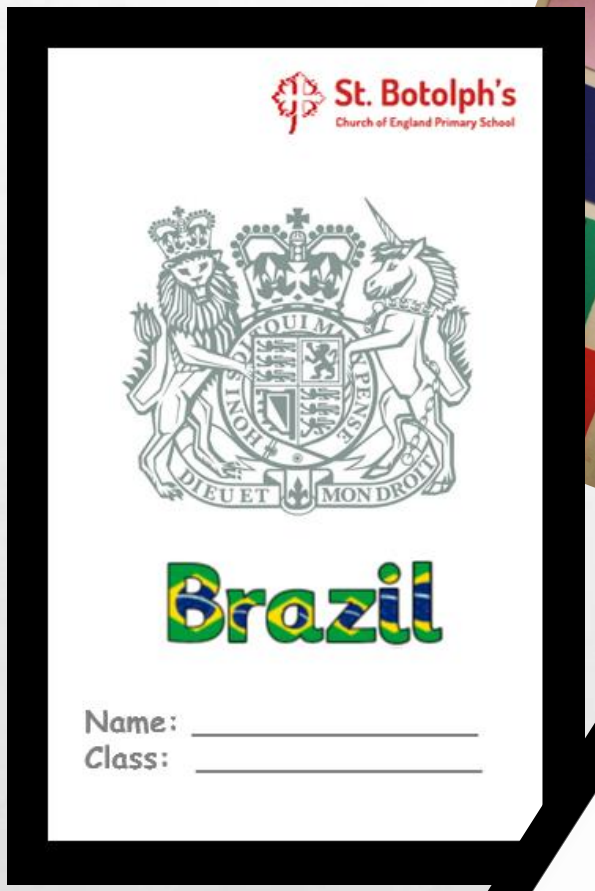
- Multiplying (move **all** digits to left) and Dividing (to the right)
- 10 (move once as one zero), 100 (twice as two zeroes) etc

Twelve times table

- is 10× plus 2×
  Example: 12×**4** = **40**+**8** = 48
- Double 6x

Learn OUT of sequence
(as well as in sequence)

2 x	12 x	18 ÷ 9 =	108 ÷ 9 =
4 x	1 x	36 ÷ 9 =	9 ÷ 9 =
8 x	3 x	72 ÷ 9 =	27 ÷ 9 =
5 x	0 x	45 ÷ 9 =	0 ÷ 9 =
10 x	7 x	90 ÷ 9 =	63 ÷ 9 =
9 x	5 x	81 ÷ 9 =	45 ÷ 9 =
3 x	2 x	27 ÷ 9 =	18 ÷ 9 =
6 x	11 x	54 ÷ 9 =	99 ÷ 9 =
12 x	10 x	108 ÷ 9 =	90 ÷ 9 =
1 x	6 x	9 ÷ 9 =	54 ÷ 9 =
0 x	4 x	0 ÷ 9 =	36 ÷ 9 =
11 x	9 x	99 ÷ 9 =	81 ÷ 9 =
7 x	8 x	63 ÷ 9 =	72 ÷ 9 =



Passports

Different destinations

+

Different maths objectives

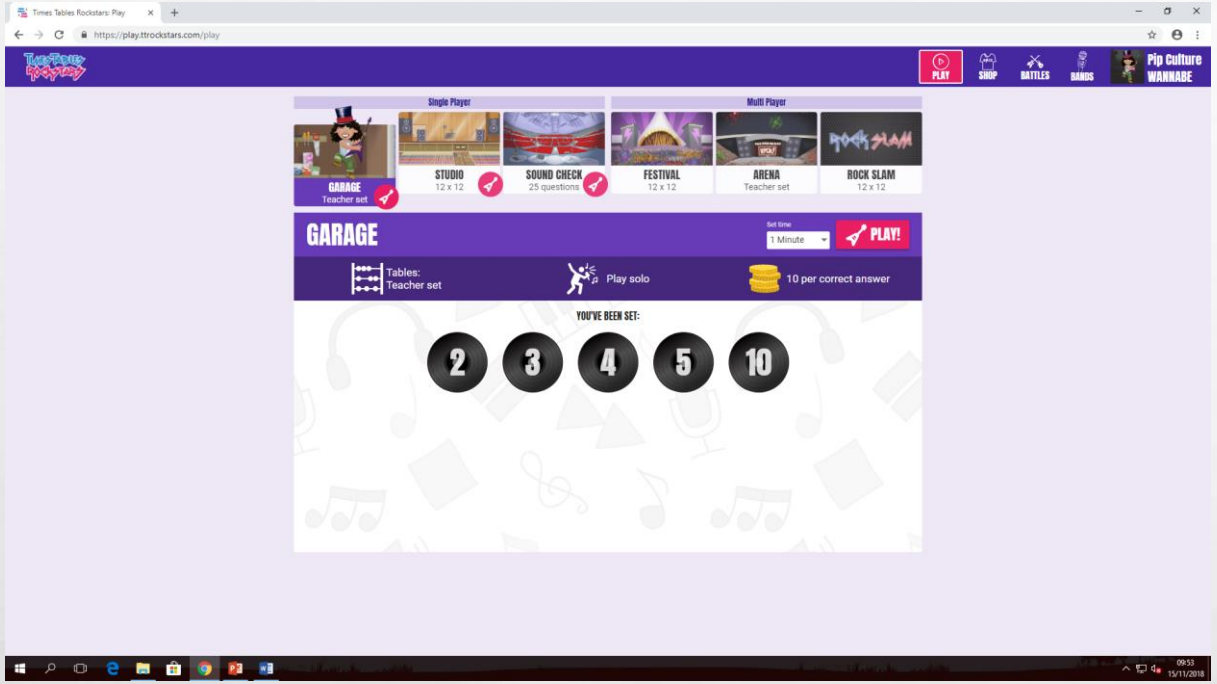
=

Travel around the world, mastering arithmetic skills (and much more)!

+

Prizes/rewards

Apps (Year Two)



doodlemaths

SUMMARY

- There is lots to remember – think about the poor children!
- Progressions are essential in facilitating an understanding of place value and mathematical process.
- A ‘rush’ through the progressions will hinder long term progress.