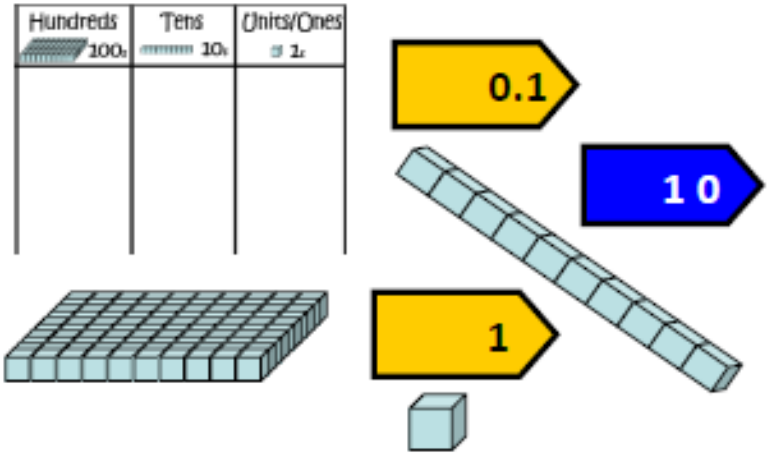
Notre Dame Du Rosaire Catholic Primary School

Calculations Policy
Whole School

bead string

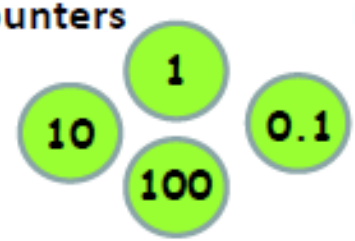
count stick

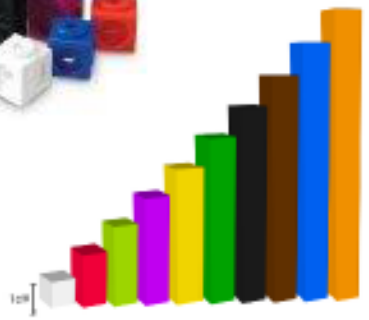
place value apparatus



Multilink

place value counters

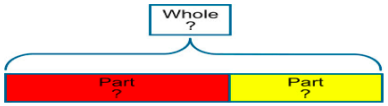




Cuisenaire

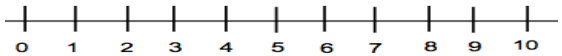
Numicon

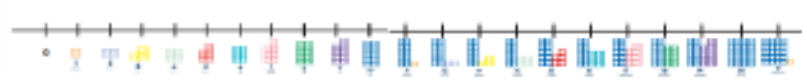
double sided counters



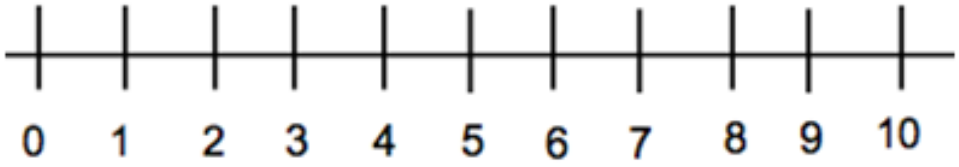
number grids 100 and 200

number line





PROGRESSION OF NUMBERLINES

Number track	Has the numbers inside the sections, rather than on the divisions	
Calibrated, numbered numberline	Equal divisions marked on the numberline and each division is numbered	
Calibrated, unnumbered numberline	Equal divisions are marked, but left unnumbered for children to add relevant numbers to	
Blank numberline	No divisions or numbers marked for the children	

Background to policy.

This policy contains the key pencil and paper procedures that will be taught within Notre Dame du Rosaire Catholic Primary. It has been written to ensure consistency and progression throughout the school and reflects a whole school agreement.

Although the focus of the policy is on pencil and paper procedures it is important to recognise that the ability to calculate mentally lies at the heart of mathematics. The mental methods for teaching mathematics will be taught systematically from Reception onwards and pupils will be given regular opportunities to develop the necessary skills. However mental calculation is not at the exclusion of written recording and should be seen as complementary to and not as separate from it.
In every written method there is an element of mental processing. Sharing written methods with the teacher encourages children to think about the mental strategies that underpin them and to develop new ideas. Therefore written recording both helps children to clarify their thinking and supports and extends the development of more fluent and sophisticated mental strategies.

During their time at this school children will be encouraged to see mathematics as both a written and spoken language. Teachers will support and guide children through the following important stages:

- Developing the use of pictures and a mixture of words and symbols to represent numerical activities;
- Using standard symbols and conventions;
- Use of jottings to aid a mental strategy;
- Use of pencil and paper procedures;
- Use of a calculator.

This policy concentrates on the introduction of standard symbols, the use of the empty number line as a jotting to aid mental calculation and on the introduction of pencil and paper procedures. It is important that children do not abandon jottings and mental methods once pencil and paper procedures are introduced. Therefore children will always be encouraged to look at a calculation/problem and then decide the best method to choose – pictures, mental calculation with or without jottings, structured recording or a calculator. Our long-term aim is for children to be able to select an efficient method of their choice (whether this be mental, written or in upper Key Stage 2 using a calculator) that is appropriate for a given task. They will do this by always asking themselves:

- ‘Can I do this in my head?
- ‘Can I do this in my head using drawings or jottings?’
- ‘Do I need to use a pencil and paper procedure?
- ‘Do I need a calculator?

Addition

Guernsey Curriculum – Early Phase (E1g)

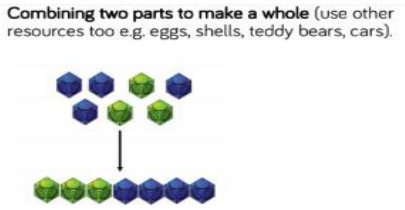
- To understand the concepts of more than and less than, progressing onto concepts of addition and subtraction.
- To use appropriate written methods of addition and subtraction with whole numbers.

Guernsey Curriculum – Middle Phase (M1g)

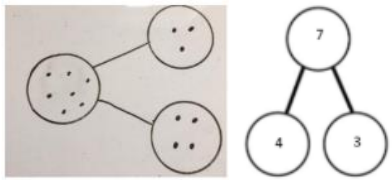
- To use appropriate written methods of addition and subtraction with whole numbers up to 1000.

Stage 1

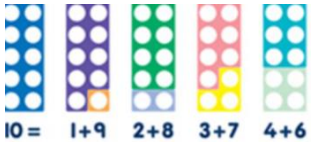
+ = signs and missing numbers



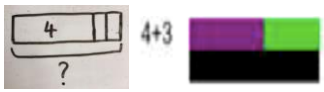
Children to represent the cubes using dots and then in numbers. So four is a part, 3 is a part and the whole is 7.



3 + 4 = □ □ = 3 + 4
3 + □ = 7 7 = □ + 4
□ + 4 = 7 7 = 3 + □
□ + ∇ = 7 7 = □ + ∇



3 + 4 is the same as 7 as modelled using Numicon
Use Numicon to further understand the equivalence in a number sentence. Promoting covering up of operations and numbers.



A bar model encourages the children to count on,

Using Number lines -Teacher model number tracks and lines with numbers and with missing numbers)

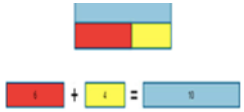
7 + 4 = 11 Children go up in 1s

Stage 2

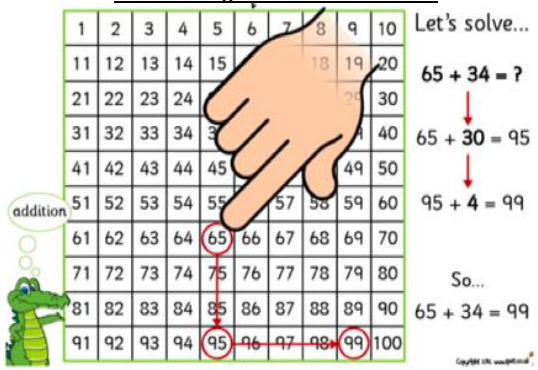
+ = signs and missing numbers

Adding three numbers

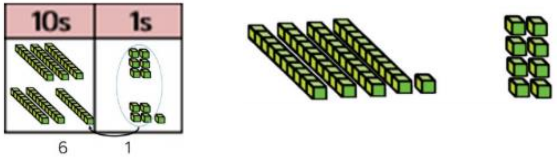
34 + 5 = 30 + □ + □
32 + □ + □ = 100 35 = 1 + □ + 5



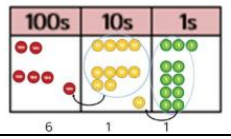
Partitioning into tens and ones

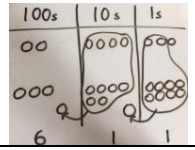


TO + O using base 10. Continue to develop understanding of partitioning and place value.



Use of place value counters to add HTO + TO, HTO + HTO etc. When there are 10 ones in the 1s column- we exchange for 1 ten, when there are 10 tens in the 10s column- we exchange for 1 hundred.





243
+368
611
1 1

Stage 3

Partition into tens and ones and recombine

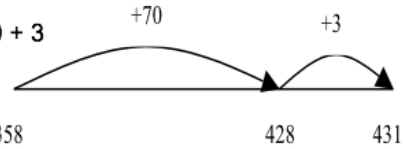
Consolidate:.

36 + 53 = 53 + 30 + 6
= 83 + 6
= 89

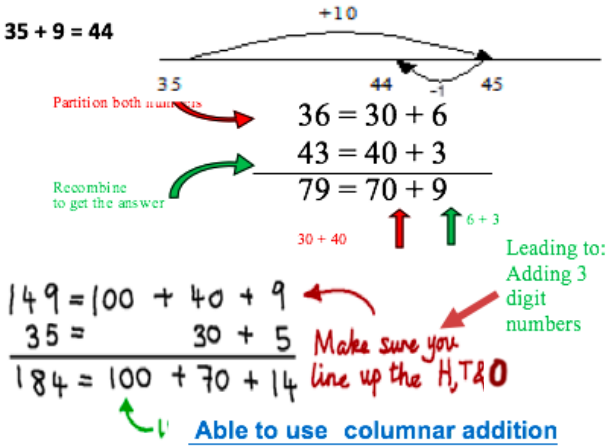
Partition into hundreds, tens and ones and recombine

Partition the second number only e.g.

358 + 73 = 358 + 70 + 3
= 428 + 3
= 431



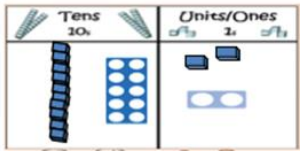
Adding 9 or 11 by adding 10 and adjusting by 1



61	62	63	64	65	
71	72	73	74	75	

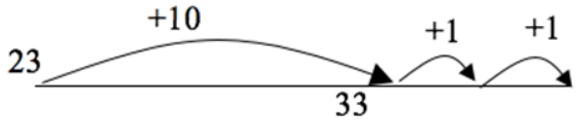
100 square (*61 + 12 = 73*)

Children to use a hundred square securely for addition.



(Partition the second number only)

23 + 12 = 23 + 10 +1 + 1 = 33 +



□ + □ = □ → □ = □ + □

123 = 100 + 20 + 3
+ 45 = 40 + 5
168 = 100 + 60 + 8

Is the same as:

H	T	U
1	2	3
+	4	5
1	6	8

□ = □ + □ → □ + □ = □ + □

Remember to line up the HTO

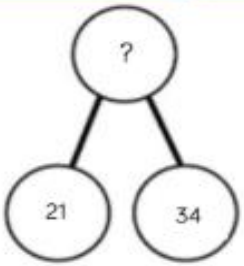
	H	T	O
	4	6	7
+	2	1	5
	6	8	2
	1		

Because 7 + 5 = 12 we have to carry the 10.

□ + □ = □ + □ →

□ + □ = □ + □ → □ + □ = □ - □

Conceptual variation; different ways to ask children to solve 21 + 34



?	
21	34

Word problems:
In year 3, there are 21 children and in year 4, there are 34 children.
How many children in total?

21 + 34 = 55. Prove it

21
+34
___

21 + 34 =

□ = 21 + 34

Calculate the sum of twenty-one and thirty-four.

Missing digit problems:

10s	1s
?	
?	5

Addition

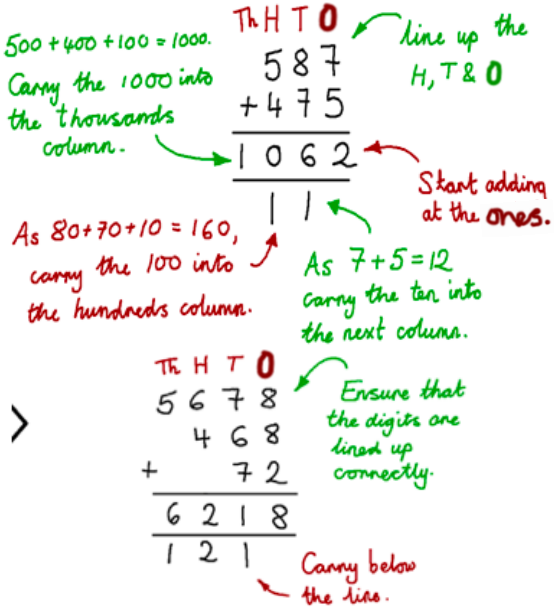
Guernsey Curriculum – Bridging Phase (B1g)

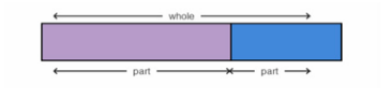
- To use appropriate written methods of addition and subtraction

Stage 4

Pencil and paper procedures

Leading to formal method, showing numbers carried underneath

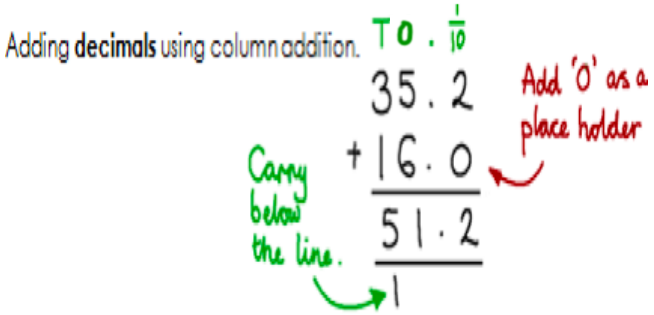


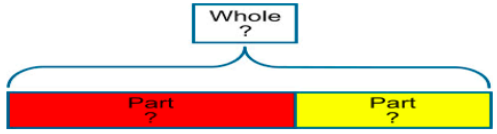


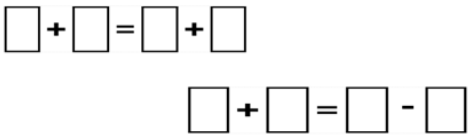
Stage 5

Pencil and paper procedures

Extend to decimals (same number of decimals places) and adding several numbers (with different numbers of digits).



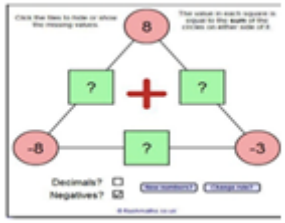


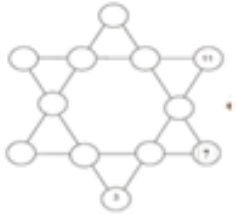


Stage 6

Pencil and paper procedures

Explore addition of numbers through games, puzzles, arithmagons Extend to use of decimals.





Subtraction

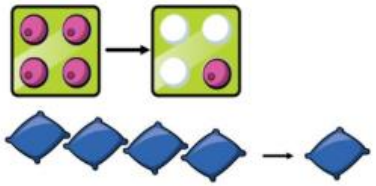
Guernsey Curriculum – Early Phase (E1g)
- To understand the concepts of more than and less than, progressing onto concepts of addition and subtraction.
- To use appropriate written methods of addition and subtraction with whole numbers.

Guernsey Curriculum – Middle Phase (M1g)
- To use appropriate written methods of addition and subtraction with whole numbers up to 1000

Stage 1

Physically taking away and removing objects from a whole (ten frames, Numicon, cubes and other items such as beanbags could be used).

4 – 3 = 1

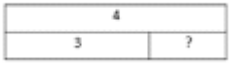


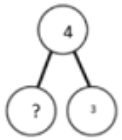
Pictures / marks

Sam spent 4p. What was his change from 10p

4 - 3 =

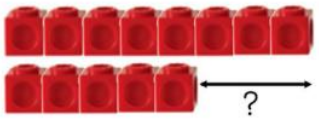
□ = 4 – 3

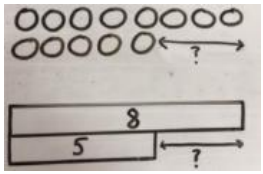




Understanding subtraction is finding the 'difference'

Calculate the difference between 8 and 5.

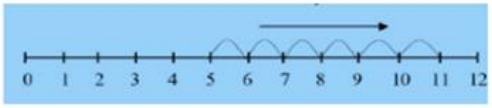




7 - 3 = □
7 - □ = 4
□ - 3 = 4
□ - ∇ = 4

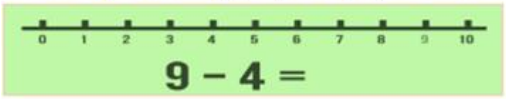
□ = 7 - 3
4 = □ - 3
4 = 7 - □
4 = □ - ∇

Stage 2



Establish **counting on** as a strategy when the numbers are

Record by - drawing jumps on prepared lines

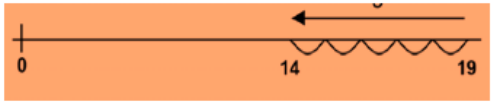


Understand subtraction as take-away

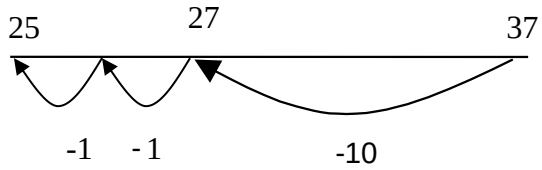
Establish **counting back** as a strategy.

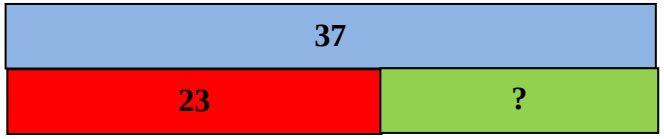
10 – 3 = _____

Constructing own lines, if appropriate: -5



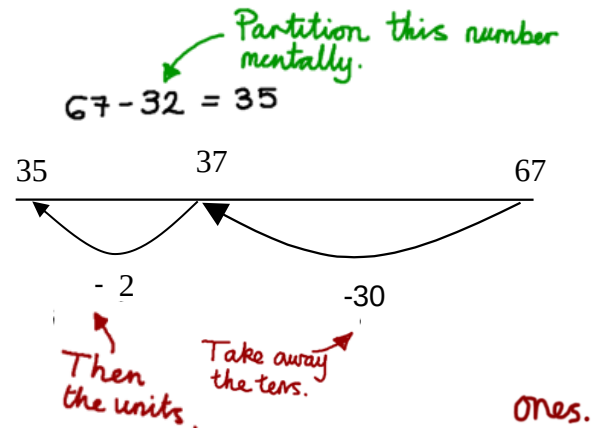
Leading to **counting back,** first in 10s then 1s



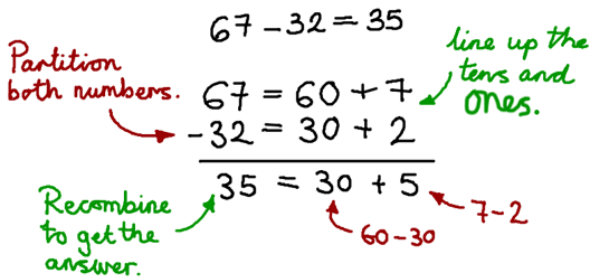


Stage 3

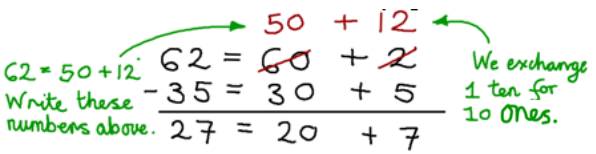
Counting back on a number line.



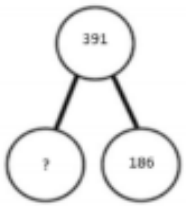
Expanded method of subtraction.



Expanded method with carrying.



Conceptual variation; different ways to ask children to solve 391 - 186



391	
186	?

Raj spent £391, Timmy spent £186.
How much more did Raj spend?

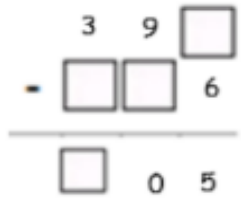
Calculate the difference between 391 and 186.

□ = 391 – 186

391
-186
___

What is 186 less than 391?

Missing digit calculations



Subtraction

Guernsey Curriculum – Bridging Phase (B1g)

- To use appropriate written methods of addition and subtraction

Stage 4

Formal Method for Subtraction.

H	T	O
7	9	6
5	4	2
2	5	4

Place Value titles to be shown in all calculations. Ones to be used.

Formal Method with exchanging.

H	T	O
4	$^{7}\cancel{8}$	$^{1}2$
1	5	9
3	2	3

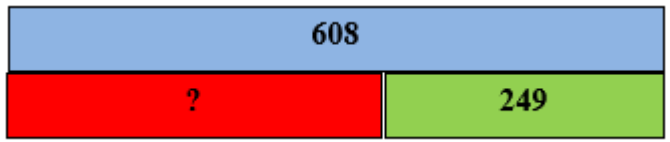
H	T	O
$^{3}\cancel{4}$	$^{12}\cancel{3}$	$^{1}4$
2	5	5
1	7	9

Formal Method with 0 as a place holder.

H	T	O
$^{5}\cancel{6}$	$^{9}\cancel{0}$	$^{1}8$
2	4	9
3	5	9

Subtraction must start from the right.

Bar Method



Stage 5

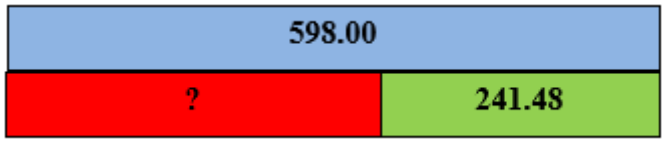
Formal Method for Subtraction using more than 4 digits.

TTh	Th	H	T	O
5	2	$^{6}\cancel{7}$	$^{12}\cancel{3}$	$^{1}3$
1	1	5	7	6
4	1	1	5	7

Formal Method for Subtraction involving decimals up to two places.

	H	T	O	.	$\frac{1}{10}$	$\frac{1}{100}$
	5	9	$^{7}\cancel{8}$	.	$^{9}\cancel{1}0$	$^{1}0$
	2	4	1	.	4	8
	3	5	6	.	5	2

Bar Method



Stage 6

Mastery

Choose digits to go in the empty boxes to make these number sentences true.

14 781 – 6 ☐ 53 = 8528

23·12 + 22·☐ = 45·23

Two numbers have a difference of 2·38. The smaller number is 3·12.
What is the bigger number?

Two numbers have a difference of 2·3. They are both less than 10.
What could the numbers be?

Can you use five of the digits 1 to 9 to make this number sentence true?

☐☐.☐ - ☐.☐ = 23.8

Two numbers have a difference of 2·38. What could the numbers be if:

- the two numbers add up to 6?
- one of the numbers is three times as big as the other number?

Two numbers have a difference of 2·3. To the nearest 10, they are both 10.
What could the numbers be?

For other examples see Mastery documentation NCETM and progression maps for reasoning. (Upper KS2.)

Multiplication

Guernsey Curriculum – Early Phase (E1i)

E1i. To understand the concept of multiplication as repeated addition through arrays, diagrams or pictures.

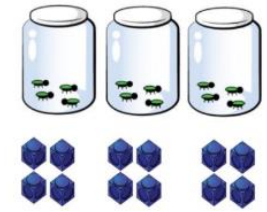
Guernsey Curriculum – Middle Phase (M1i)

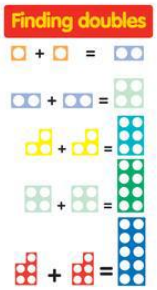
- To multiply a 2 digit number by a single digit number and 10, using an appropriate written method.

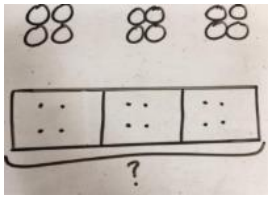
Stage 1

X = signs and missing numbers

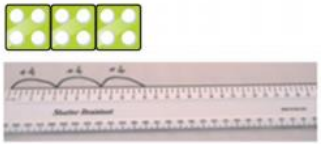
Repeated grouping/repeated addition
3 × 4
4 + 4 + 4
There are 3 equal groups, with 4 in each group.





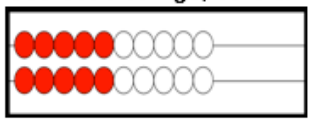


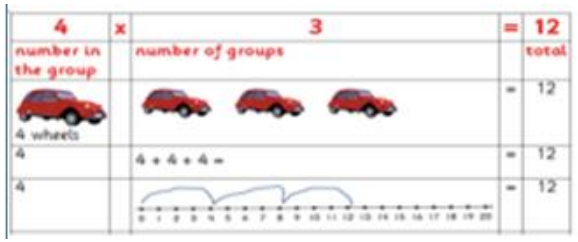
Number lines to show repeated groups-
3 × 4



Cuisenaire rods can be used too.

Use bead strings, bars & Numicons to model groups of

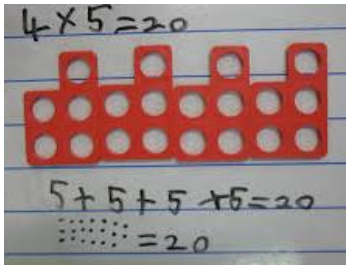




Stage 2

X = signs and missing numbers

7 x 2 = □ □ = 2 x 7 □ x 2 = 14 14 = 2 x □

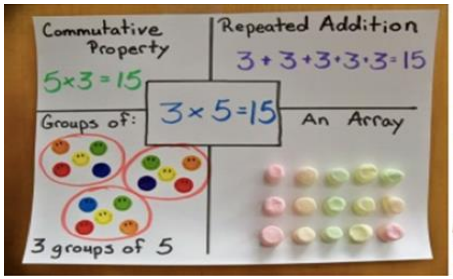


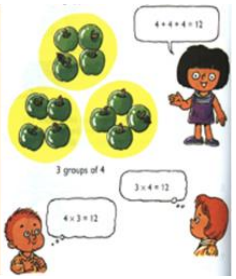
Arrays and repeated addition

Understanding multiplication as repeated addition is crucial to developing a secure understanding of formal methods of multiplication.

5 'lots of/groups of' 2 is...
5 x 2
2 + 2 + 2 + 2 + 2

2 'lots of/groups of' 5 is...
2 x 5
5 + 5





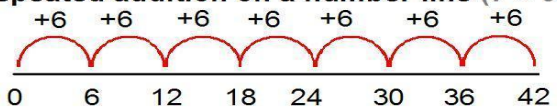
Stage 3

X = signs and missing numbers

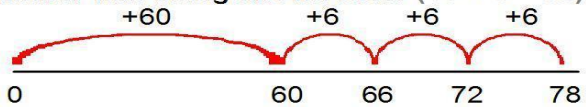
Cuisenaire rods to model and scaffold learning

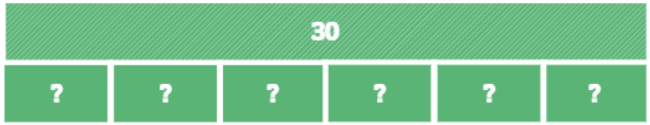
Use Cuisenaire rods and number tracks alongside blank number lines to scaffold learners understanding of multiplication.

Repeated addition on a number line (*7 × 6 = 42*)



Number line using known facts (*13 × 6 = 78*)





Conceptual variation; different ways to ask children to solve 6 × 23

23	23	23	23	23	23

?

Mai had to swim 23 lengths, 6 times a week.
How many lengths did she swim in one week?

With the counters, prove that 6 x 23 = 138

Find the product of 6 and 23

6 × 23 =

☐ = 6 × 23

6	23
× 23	× 6
___	___

What is the calculation?
What is the product?

100s	10s	1s
		

Multiplication

Guernsey Curriculum –Bridging Phase (B1i)

- To use appropriate written methods of multiplication with whole numbers and decimals.

Stage 4

Partitioning TU × U using a grid *(23 × 8 = 184)*

23 × 8 ⇒ (20 x 8) + (3 x 8)

×	20	3
8	160	24

= 184

0
23
× 8
20 × 8 = 160
3 × 8 = 24
184

Partitioning in columns *(23 × 8 = 184)*

Partition the number into H, T & U

123 x 4 = 492

	100	+	20	+	3	
4	400	+	80	+	12	= 492

Put the single digit here. 4 x 100 4 x 20 4 x 3 Recombine to get the answer.

56 x 43 = 2408

Partition both numbers. Recombine the rows.

×	50		6		
40	2000	+	240	=	2240
3	150	+	18	=	+ 168
					2408

Multiply the top numbers by the side. Add to get the total.

Stage 5

x = signs and missing numbers

Pencil and paper procedures

Th H T O

324 (3 x 4) + (3 x 20) + (3 x 300)

× 23

9 72

6 480 (20 x 4) + (20 x 20) + (20 x 300)

7452

11

Multiply the top number by the ones of the bottom.

Multiply the top number by the tens of the second number.

Add to get the answer.

Th	H	T	U	
		5	3	
x		2	6	
	3	1	8	← Answer line 1
1	0	6	0	← Answer line 2
1	3	7	8	← Answer line 3

123
x 45
615 (123 x 5)
4920 (123 x 40)
5535 (615 + 4920)
1

628
x 237
4396 ones
18840 tens
125600 hundreds
148836

Multiplying **decimal numbers** using the grid method.

×	5	+	0.2		
6	30	+	1.2	=	31.20
0.3	1.5	+	0.06	=	1.56
					32.76

0.3 x 0.2

Take care to line up the digits. Adding a place holder will help.

Stage 6

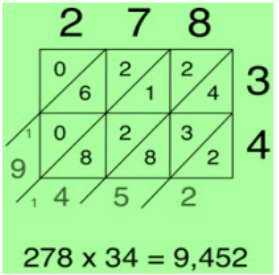
x = signs and missing numbers

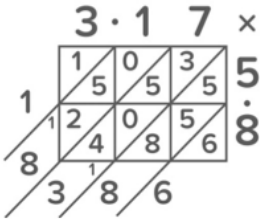
Pencil and paper procedures

3.77 x 2.8

3.77 (2 decimal places)
2.80 (2 decimal places)
Remove the decimals and multiply, then add the decimal point after counting the decimal places in the question.

377
x 280
30160
75400
10.5560





(6 - 9) x 10 ÷ -3 = ?

(6 − 9) x 10 ÷ -3
= -3 x 10 ÷ -3
= -3 x 10 ÷ -3
= -30 ÷ -3
= +10
= 10 ✓

BODMAS Pemdas

BODMAS Pemdas
Do Division and Multiplication working from left to right.

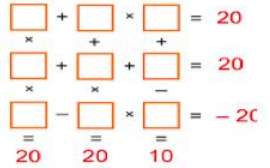
B O D A
or or
M S

Exponent (index or power)

Base $6^3 = 6 \times 6 \times 6$

Shorthand way of representation

Normal representation (Base multiplied exponent number of times)



Division

Guernsey Curriculum –Early Phase (E1j)

- To understand the concept of division through grouping, sharing and repeated subtraction.

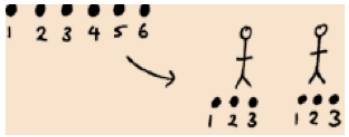
Guernsey Curriculum – Middle Phase (M1j)

- To divide 2 digit numbers by a single digit number and with remainders, using an appropriate written method.

Stage 1

Pictures / marks

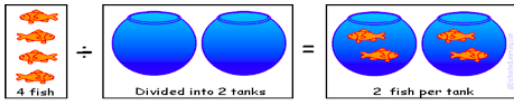
6 mince pies are shared equally between 2 people. How many does each one get?

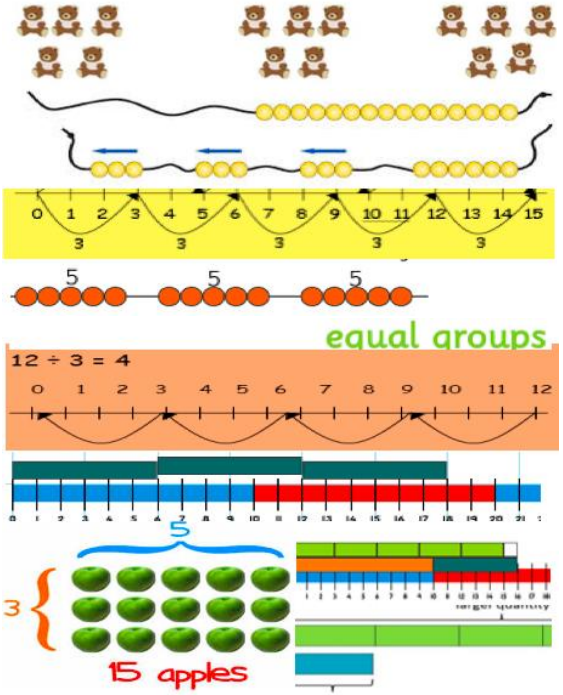


Use practical resources – cubes & counters

6 ÷ 2 = □
6 ÷ □ = 3
□ ÷ 2 = 3
□ ÷ ∇ = 3

□ = 6 ÷ 2
3 = 6 ÷ □
3 = □ ÷ 2
3 = □ ÷ ∇

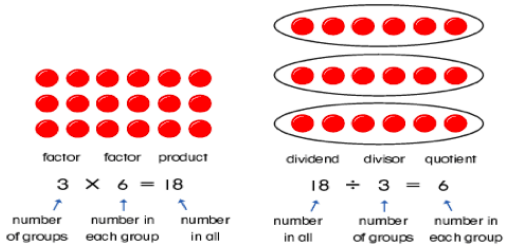




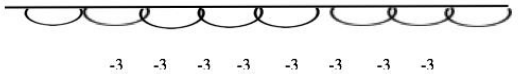
Stage 2

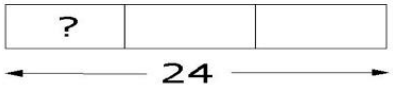
÷ = signs and missing numbers

Understand division as sharing and grouping

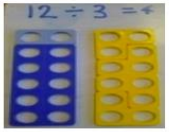


24 ÷ 3 =

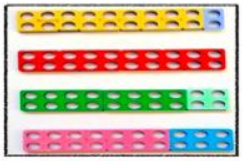




24 ÷ 3 = ?



20 ÷ 3 = 6r2
20 ÷ 5 = 4
20 ÷ 8 = 2r4
20 ÷ 7 = 2r6



Stage 3

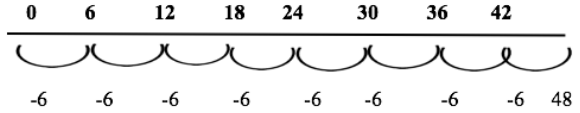
÷ = signs and missing numbers

Continue using a range of equations as in Stage 2 but with appropriate numbers.

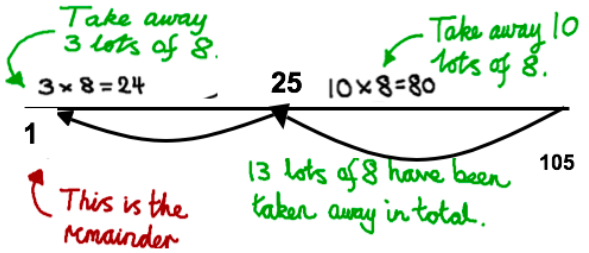
Understand division as sharing and grouping

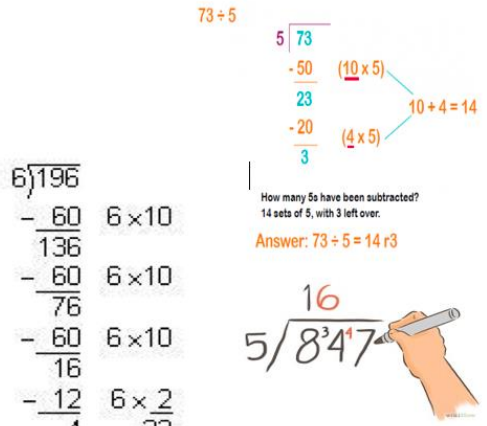
Use repeated subtraction. Subtract 6 repeatedly

48 ÷ 6 =



8 lots of 6 has been taken





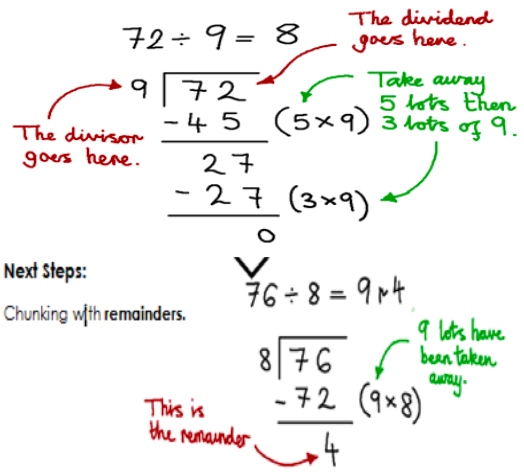
Division

Guernsey Curriculum –Bridging Phase (B1j)

- To use appropriate written methods of division with whole numbers and decimals, expressing remainders as a fraction or a decimal.

Stage 4

÷ = signs and missing numbers

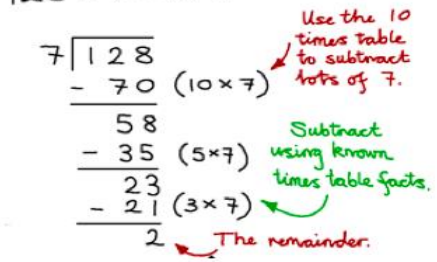


Next Steps:

Chunking with remainders.

Chunking using times table facts.

Children will continue to explore division as repeated subtraction. They will use their increasing knowledge of times tables to subtract in larger chunks.



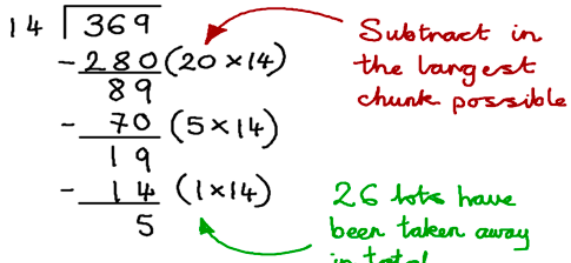
Chunking is best used for 2 or more digit divisors, whilst short division is better for 1 digit or simple 2 digit divisors

$$8\overline{)9^{1}2^{4}4}\quad 115\ r\ 4$$

Stage 5

Remainders

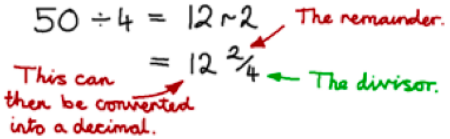
369 ÷ 14 = 26 r 5



Quotients expressed as fractions or decimal fractions

676 ÷ 8 = 84.5

Expressing the remainder as a fraction.



This leads to using short division using decimals

$$3\overline{)4.^{1}1^{2}4}\quad 1.38$$

$$7\overline{)9^{2}6^{5}4}\quad 137\ r\ 5$$

$$9\overline{)4.^{4}0^{4}5}\quad 0.45$$

$$8\overline{)1\,1.^{3}0^{6}0^{4}0}\quad 01.375$$

Stage 6

÷ = signs and missing numbers

$$\frac{4}{5} \quad 5\overline{)4.0}\quad -4.0\quad 0 \quad 0.8 \rightarrow 0.80 = 80\%$$

$$8\overline{)48.3} \qquad 2.4\overline{)38.4}$$

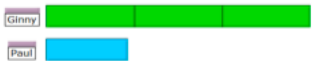
48 ÷ 8 = 6
4.8 0.8 = 6
480 ÷ 80 = 6
0.48 ÷ 0.08 = 6

30 ÷ -5 + 4 x -2 + 14 = ?

30 ÷ -5 + 4 x -2 + 14 BODMAS
= -6 + 4 x -2 + 14 BODMAS
= -6 + -8 + 14 BODMAS
= -6 + -8 + 14
= -14 + 14
= 0 ✓

Do Addition and Subtraction working from left to right.

1.	2.	3.	4.
B	O	D or M	A or S



7 + 63 ÷ 9 = = ?

1 7 r 7 14) 2 4 ^{10}5	Long division 1 2 r 6 24) 2 9 4 2 4 ^{4}5^{1}4 4 8 6	