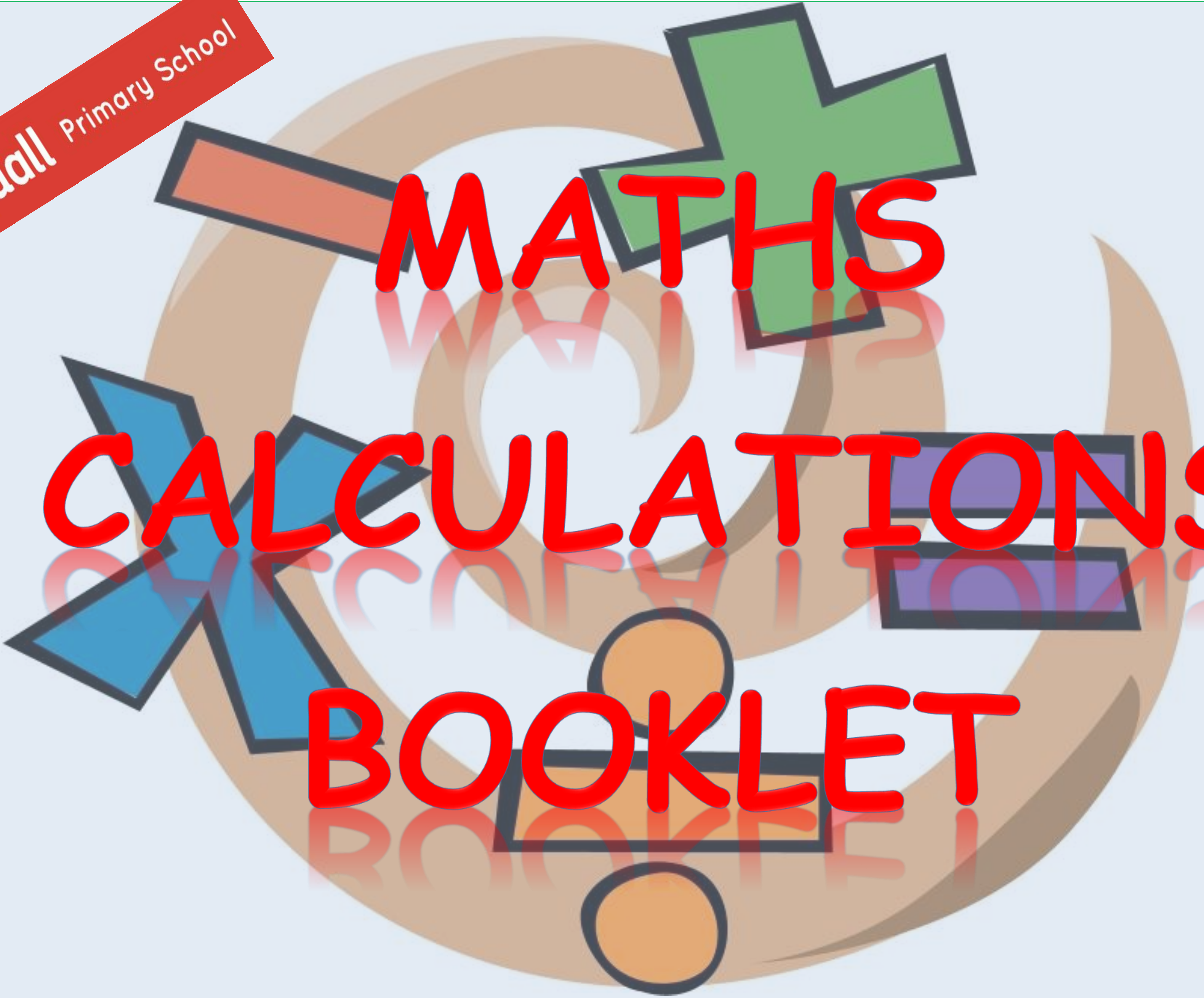
Twydall Primary School



MATHS CALCULATIONS BOOKLET

Mathematics at Twydall Primary

We have produced this booklet to allow parents to better understand how maths calculations are delivered at Twydall Primary School.

Our aim is to develop mathematicians who are engaged, inspired and confident. To achieve this, a strong and assured grasp of the four number operations (addition, subtraction, multiplication and division) is important for both written methods as well as mental calculations.

This booklet contains the stages in teaching for each mathematical operation. In any given class or year group children will be working at different stages and will only move on when it is appropriate for them.

Essential Ideas

Children should

- Estimate calculations
- Consider whether to calculate mentally or using a written method
- Check answers: Is it reasonable? Can I do the inverse?
- Use equipment when it is helpful: counters, bead string, place value cards
- Be fluent in knowing times tables facts : children should aim to know:
    - ✓ x2, x5 and x10 and related division facts by the end of year 2;
    - ✓ x3, x4 and x6 and related division facts by the end of year 3;
    - ✓ all tables including x7, x8, x9 by the end of year 4

Addition

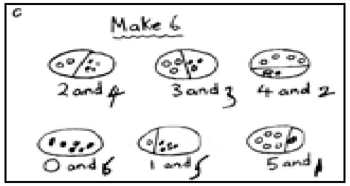
Stage 1

Practical activities and discussions e.g. Using two objects, how can I make a given total?

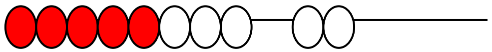
Finding one more than a number from 1 to 10

Using vocabulary associated with addition questions should be real life and related to children's experiences

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



Bead strings or bead bars can be used to illustrate addition

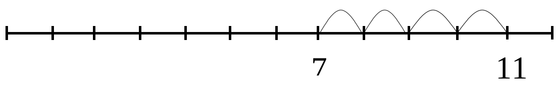


8+2=10

They use numberlines and practical resources to support calculation and teachers demonstrate the use of the numberline.

Number lines (blank) with teacher support

7 + 4 = 11



Children go up in 1s

+ = signs and missing numbers

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

Show that 3 + 4 is the same as 7 using 2 separate bead strings.

Stage 2

+ = signs and missing numbers

Extend to
14 + 5 = 10 + □
Opportunities to explore place value

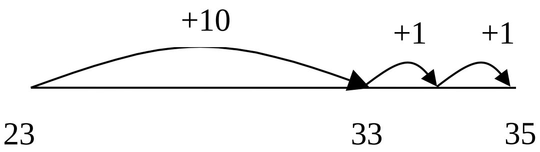
and adding three numbers
32 + □ + □ = 100   35 = 1 + □ + 5

Partition into tens and ones and recombine

12 + 23 = 10 + 2 + 20 + 3
= 30 + 5
= 35

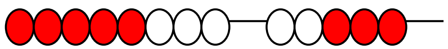
refine to partitioning the second number only:

23 + 12 = 23 + 10 +1 + 1
= 33 + 1 + 1
= 35



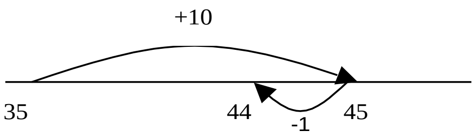
This can also be represented using more than 1 bead string (23 on one and 12 on the other) so that the colours can be used to identify tens and ones.

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



Children then begin to use numbered lines to support their own calculations using a numbered line to count on in ones. More confident learners can begin to use an empty.

Mental Method:
Add 9 or 11 by adding 10 and adjusting by 1
35 + 9 = 44

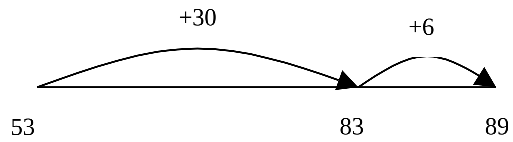


Stage 3

+ = signs and missing numbers

Partition into tens and ones and recombine

Partition **both** numbers and recombine. Refine to partitioning the second number only e.g.
36 + 53 = 53 + 30 + 6
= 83 + 6
= 89



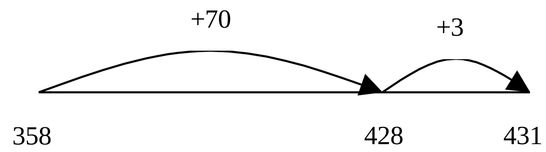
Add a near multiple of 10 to a two-digit number

Partition into hundreds, tens and ones and recombine

With larger numbers children can use their individual reasoning when partitioning

Either partition both numbers and recombine
or partition the second number only e.g.

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



Addition

Stage 4

Children must be confident within their understanding of the value of each digit.

They need to add the ones first. Therefore they will know how many tens they might have, from adding the ones. They can then add this to the total from the tens column.

Record steps in addition using partitioning:

Partitioned numbers are then written under one another:

```
  47   =   40 + 7
+ 76       70 + 6
          110 + 13 = 123
```

Add the ones first as this will help the children with later calculations as they move through the progression.

<u>Using more formal columns (pairs of 2 digit numbers)</u>

47 + 76 = 123
Write the larger number written on top

Add the ones first

```
   7 6
 + 4 7
    13
   110
   123
```

NB vocab: use 70 + 40, not 7 + 4

```
  358
+  73
   11
  120
  300
  431
```

Stage 5

<u>Pencil and paper procedures</u>

Leading to formal method, showing numbers carried underneath

```
  358
+  73
  431
  1 1
```

Extend to numbers with **at least four digits**

3587 + 675 = 4262

```
  3587
+  675
  4262
  111
```

Extend to decimals (same number of decimals places) and adding several numbers (with different numbers of digits).
Model negative numbers using a number line.

Stage 6

<u>Pencil and paper procedures</u>

Extend to numbers with any number of digits and decimals with 1 and 2 decimal places.
124.9 + 117.25 = 242.15

```
  124.90
+ 117.25
  242.15
   1 1
```

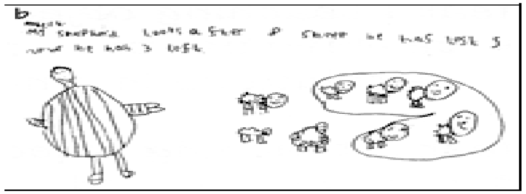
add in a zero to keep the place value digits of similar value are in line.

Subtraction

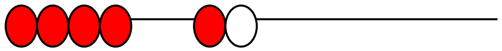
Stage 1

Children are encouraged to develop a mental picture of the number system in their heads to use for calculation.

They develop ways of recording calculations using pictures etc.



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



6-2=4

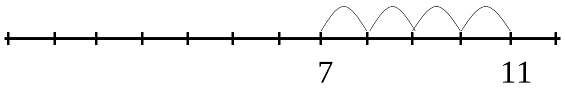
They use numberlines and practical resources to support calculation. Teachers demonstrate the use of the numberline to develop visual links with a bead string.

<u>- = signs and missing numbers</u>

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

<u>Visual / practical activities</u>
Number lines

The difference between 7 and 11
(Counting on)
To reinforce concept. Practical strategies essential to see 'difference'.

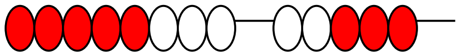


Recording by - drawing jumps on prepared lines
- constructing own lines, if appropriate

(Teachers model jottings appropriate for larger numbers)

Stage 2

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



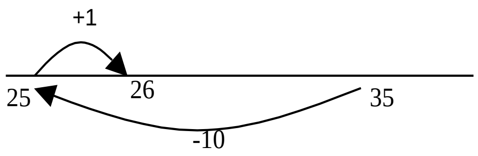
13-5=8

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

<u>- = signs and missing numbers</u>
Continue using a range of equations with appropriate numbers.

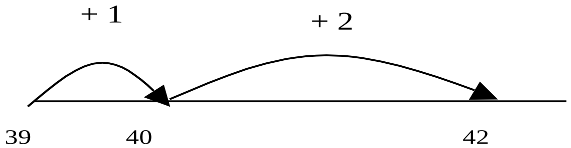
Extend to 14 + 5 = 20 - □

<u>Find a small</u> difference by counting on 42 – 39 = 3

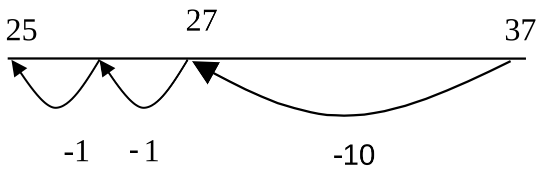


<u>Mental Method</u>
Subtract 9 or 11. Begin to add/subtract 19 or 21

eg. 35 – 9 = 26



<u>Use known number facts and place value to subtract</u>
(partition second number only)
37 – 12 = 37 – 10 – 2
= 27 – 2
= 25



Stage 3

<u>Find a small difference by counting on</u>

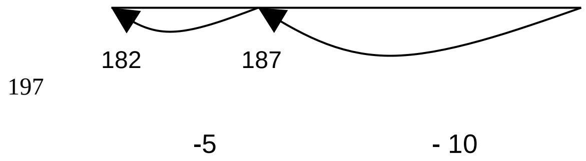
Use of larger numbers (hundreds) e.g. 102 – 97 = 5

<u>Use known number facts and place value to subtract</u>

e.g. 3 digit number – 2 digit number

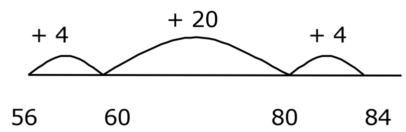
Estimate first….
200 – 20 = 180

197 – 15 = 182



Pencil and paper procedures
Complementary addition and mental instant recall facts eg. number bonds, adding tens

84 – 56 = 28

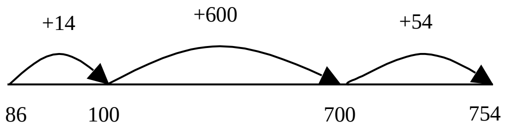


Subtraction

Stage 4

Pencil and paper procedures

Complementary addition
754 – 86 = 668



98
\- <u>24</u>
4 (8-4)
<u>70</u> (90-20)
74

Use decomposition with confident children when appropriate

9 2
\- <u>3 8</u>
5 4 (explain what happens…see below)

90 + 2 → 80 + 12
<u>30 + 8</u> - <u>30 + 8</u>
50 + 4

Stage 5

Find a difference by counting on

e.g. 8006 – 2993 = 5013
This can be modelled on an empty number line

<u>Pencil and paper procedures</u>

8 1
~~9~~ 2
\- <u>3 8</u>
5 4

Develop the stages of decomposition introducing ‘zero’

2 4 1
~~3~~ ~~5~~ 2
\- <u>1 7 8</u>
1 7 4

4 9 9 1
~~5~~ 0 0 0
\- <u>4 5 7</u>
4 5 4 3

Stage 6

<u>- = signs and missing numbers</u>

<u>Pencil and paper procedures</u>

Develop the use decomposition

extend to up to 2 decimal places

48.42 – 37.61 =

7 1
4 ~~8~~ . 4 2
<u>3 7 . 6 1</u>
1 0 . 8 1

extend to up to 3 decimal places if appropriate

302.63 – 178.124 =

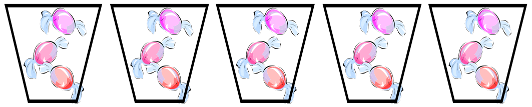
2 9 1
~~3~~ ~~0~~ 2 . 6 2~~3~~ 1 0
\- <u>1 7 8 . 1 2 4</u>
1 2 4 . 5 0 6

Multiplication

Stage 1

<u>Pictures and symbols</u>

There are 3 sweets in one bag.
How many sweets are there in 5 bags?



Use of bead strings to model groups of.

(Recording on a number line modelled by the teacher when solving problems)

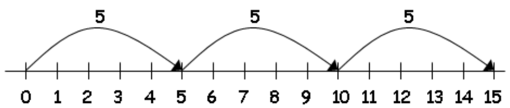
Modelling to begin to show the link between multiplication and repeated addition. Emphasise use of vocabulary to develop this.

<u>Repeated addition</u>

3 times 5 *is* ***5 + 5 + 5*** *= 15* *or* ***3 lots of 5*** then introduce multiplication sign 5 x3

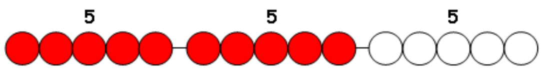
Repeated addition can be modelled on a number line:

5 x 3 = 5 + 5 + 5



Children can use a bead string independently:

5 x 3 = 5 + 5 + 5

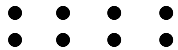


Stage 2

<u>Use of a bead string to investigate x = signs and missing numbers</u>

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

<u>Arrays and repeated addition</u>

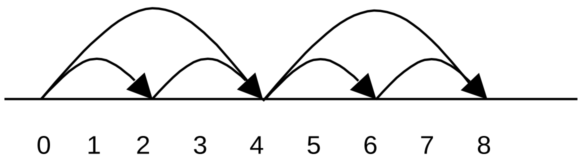


4 x 2 or 4 + 4

2 x 4

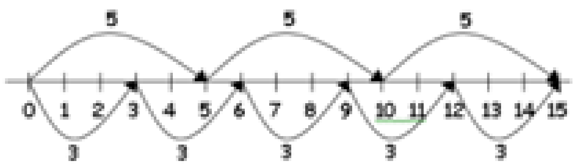
or repeated addition

2 + 2 + 2 + 2



<u>Commutativity</u>

Children should know that 3 x 5 has the same answer as 5 x 3. This can also be shown on the number line.



Stage 3

<u>Doubling multiples of 5 up to 50</u>

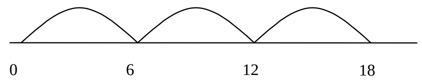
15 x 2 = 30

Partition

(10 x 2) + (5 x 2)
20 + 10 = 30

<u>x = signs and missing numbers</u>

Continue using a wider range of equations.
Number lines
6 x 3



35 x 2 = 70

Partition

x	30	5
2	60	10

= 70

Multiplication

Stage 4

Pencil and paper procedures

Grid method
TU x U
36 x 4 =

	Tens	Ones
X	30	6
4	120	4

120 + 24 = 144 (add the partial products)
36 x 4 = 144

HTU x U
123 x 3 = 369

X	H 100	T 20	O 3
3	300	60	9

Note Change in orientation for larger numbers

Stage 5

Pencil and paper procedures

Grid method
72 x 38

Estimate and check
is approximately 70 x 40 = 2800

x	70	2
30	2100	60
8	560	16

= 2160
= 576 +
2736
1

Moving on to formal method when appropriate.
'Carried' numbers to sit on top line of answer box

1125 x 7 = 7875

X	Th 1000	H 100	T 20	O 5
7	7000	700	140	35

Formal method for long multiplication

			1	
			7	**2**
		X	**3**	**8**
		5	7	6
+	2	1	6	0
	2	7	3	6
		1		

Note:
When multiplying by 8
2x8=16 70 x 8 =560

when multiplying by 30
2x30=60 70 x30 =2100

From 2016 end of KS2 assessments, only evidence of long multiplication will gain working marks (assuming errors in the final answer)

Stage 6

x = signs and missing numbers

Pencil and paper procedures

Grid method
Estimate and check

372 x 24 is approximately 400 x 20 = 8000

x	300	70	2
20	6000	1400	40
4	1200	280	8

th	h	t	u
	1		
6	0	0	0
1	4	0	0
1	2	0	0
	2	8	0
		4	0
			8 +
8	9	2	8

Grid method for decimals

7.2 x 3.8

x	7	0.2
3	21	0.6
0.8	5.6	0.16

= 21.60
= 5.76 +
27.36
1

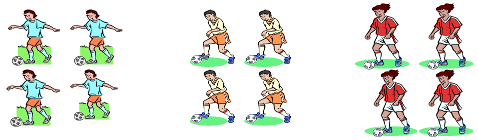
Only for children who already know this method (and are accurate with it).

Division

Stage 1

<u>Pictures / marks</u>

12 children get into teams of 4 to play a game. How many teams are there?



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

12 ÷3 =

Stage 2

<u>Understand division as sharing and grouping</u>

Sharing – 6 sweets are shared between 2 people. How many do they have each?

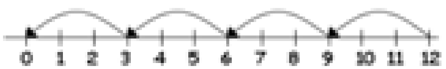
6 ÷ 2 can be modelled as:

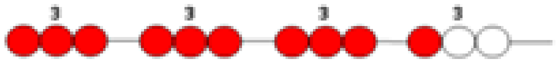
Grouping or repeated subtraction

There are 6 sweets, how many people can have 2 sweets each?

Repeated subtraction using a number line or bead string

12 ÷ 3 = 4





This will help interpret the statement 'how many 3s make 12'

Using symbols

Using symbols to stand for unknown numbers to complete equations using inverse operations

□ ÷ 2 = 4   20 ÷ △ = 4   □ ÷ △ = 4

Stage 3

<u>÷ = signs and missing numbers</u>

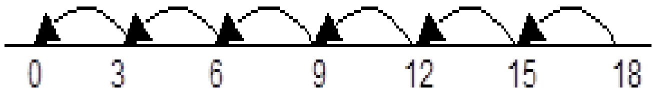
Continue using a range of equations as in Level 2 but with appropriate numbers.

<u>Understand division as sharing and grouping</u>

18 ÷ 3 can be modelled as:

Sharing – 18 shared between 3 (see Level 2 diagram)

Grouping - How many 3's make 18?



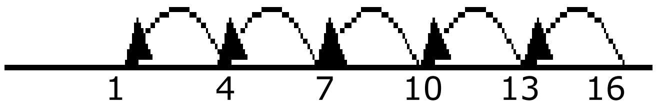
<u>Remainders</u>

Sharing - 16 shared between 3, how many left over?

Grouping – How many 3's make 16, how many left over?

e.g.

16 ÷ 3 =



16 ÷ 3 = 5 r1

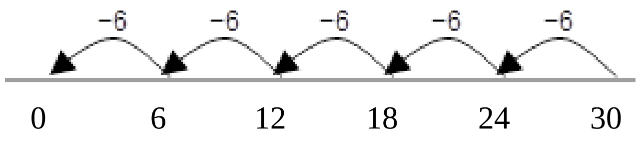
Division

Stage 4

÷ = signs and missing numbers

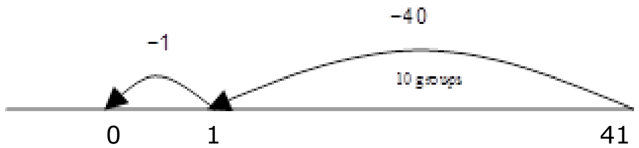
Sharing and grouping

30 ÷ 6 can be modelled as:
grouping – groups of 6 taken away and the number of groups counted
e.g. sharing among 6, the number given to each person



Grouping

41÷ 4 = 10 r1



OR 41 = (10 x 4) + 1

Stage 5

÷ = signs and missing numbers

Remainders

Quotients expressed as fractions or decimal fractions
61 ÷ 4 = 15 ¼ or 15.25

Pencil and paper procedures

BUS STOP METHOD

$$\begin{array}{r|l} & 2\ 1\ 5\ .\ 2\ \ 5 \\ \hline 4 & 8\ 6\ {}^{2}1\ .\ {}^{1}0\ {}^{2}0 \end{array}$$

Break into steps instead of chunking

Stage 6

÷ = signs and missing numbers

Remainders

Quotients expressed as fractions or decimal fractions using larger numbers

676 ÷ 8 = 84.5

Pencil and paper procedures
977 ÷ 36 is approximately 1000 ÷ 40 = 25

Using chunking for division of larger number and dividing by 2-digit numbers.

BUS STOP METHOD

									.
		0	2	7	.	1	3	8	8
3	6	9	7	7	.	0	0	0	0
		0							
		9	7						
	-	7	2						
		2	5	7					
	-	2	5	2					
				$^{4}\cancel{5}$	.	$^{1}0$			
				3	.	6			
				1	.	$^{3}\cancel{4}$	$^{1}0$		
				1	.	0	8		
				0	.	$^{2}\cancel{3}$	$^{11}\cancel{2}$	$^{1}0$	
						2	8	8	
							3	2	0