Friday Bridge Primary School

Calculation Policy

September 2020

Approved by:	N Fitzpatrick	**Date:**	Sept 2020
Last reviewed on:	Sept 2020		
Next review due by:	July 2022		

Friday Bridge Primary School
Calculation Policy

Contents

Page

1. **Addition**
   a. Big ideas 3
   b. Stem Sentences 4
   c. Progression in written methods (Yr1- Yr6) 5

2. **Subtraction**
   a. Big ideas 8
   b. Stem Sentences 9
   c. Progression in written methods (Yr1- Yr6) 10

3. **Multiplication**
   a. Big ideas 13
   b. Stem Sentences 15
   c. Progression in written methods (Yr1- Yr6) 16

4. **Division**
   a. Big ideas 19
   b. Stem Sentences 20
   c. Progression in written methods (Yr1- Yr6) 20

5. **Principle of Constant Difference**
   a. Application of the Principle of Constant Difference 24
   b. Teaching the Principle of Constant Difference 25

Addition

Big Ideas

addend + addend = sum

Addition is **commutative** because the parts can be added in any order.

There are two structures of addition: aggregation and augmentation.

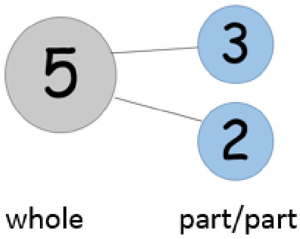
Aggregation structure:

Combining two or more parts to make a whole is called **aggregation.**

Ben had 3 footballs and Zoe had 2 footballs. How many footballs are there altogether?

$3 + 2 = 5$

addend   addend   sum



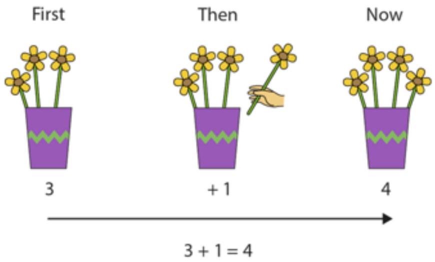
The sum of the parts is equal to the whole.

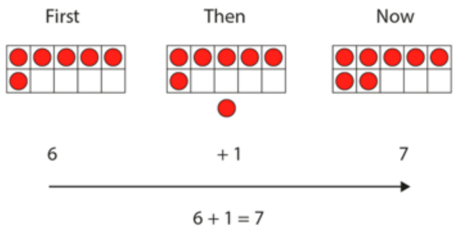
Augmentation structure:

An addition context described by a **first, then, now** story is an example of **augmentation**.

Harry had 3 footballs, then he was given 2 more. How many does he have now?

Both structures can be represented on a part/whole diagram.





When formal written methods are introduced, please encourage children to continue to use **NUMBER SENSE**.

Stop, think, consider the numbers involved in the calculation before choosing an efficient method for solving.
245 + 98 could be solved by adjusting + 100 and subtracting 2 rather than using a column method.

Prior to calculating, start with a **stem sentence** “I think that the best way of working this out …”

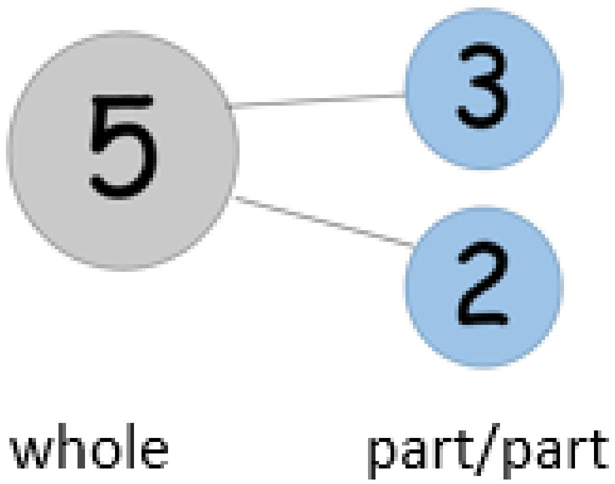
Simple numbers are used to teach formal algorithms initially. 23 + 14 can be worked out mentally but is used to show how the algorithm works. We are not suggesting that a column method is usually used for this calculation.

At FBPS, **carried figures are put at the bottom of the columns**.
NB. White Rose puts carried figures at the bottom.

Sentence Stems

- A whole can be broken into a number of parts.
- The sum of the parts is equal to the whole.
- We can add the parts in any order. *(Addition is associative)*
- We can only add things with the same noun.
- If you change the order of the addends, the sum remains the same. *(Addition is commutative)*
- In addition, we can add to one set to make it bigger. The total is the sum. *(Augmentation structure*)
- In addition, we can combine one or more sets. The total is the sum. *(Aggregation structure)*

Teacher notes are in italics.



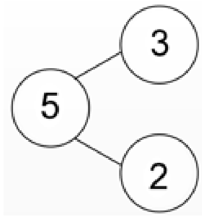
Progression in written methods (Yr1 – Yr6)

Y1 Objectives

- **Number bonds an related addition facts within 20**
- **Add 1 and 2 digit numbers to 20, including zero**

Key skills:
Adding 0 and 1 to a number
+ bonds within 10 e.g. 5 = 4 + 1
+ bonds = 10

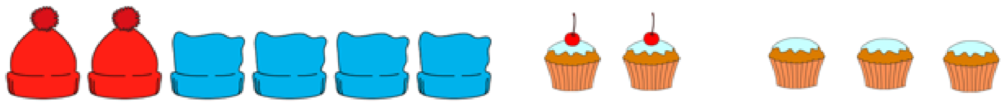
Use part whole diagram (include zero)
Zero is not a part



Start with expressions (no = sign)

Move on to equations (has = sign)

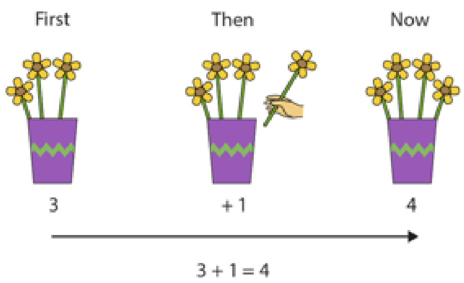
Aggregation structure

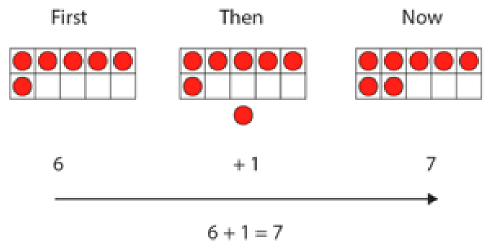


2 + 4
4 + 2

5 = 3 + 2

Augmentation structure





Teacher to model the bar model in summer term

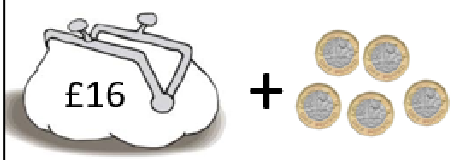
Y2 Objectives

- **1dn + 1dn + 1dn**
- **2dn + 1dn**
- **2 dn + 2dn (sum<100)**

Key skills:
2dn + 1dn
2dn + multiples of 10

2dn + 1dn Use numbers in a context

What does each number represent?

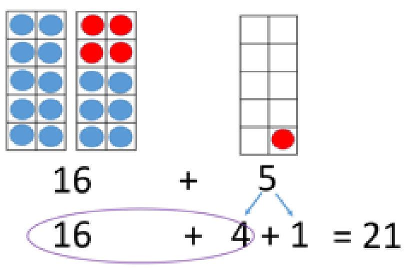


2dn + 1dn Use numbers in a context

Augmentation structure

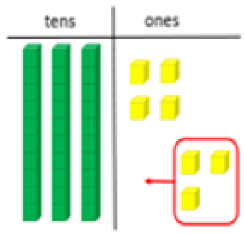
At **first** Fiona had saved £34 and **then** she added her £3 pocket money to that.

How much does she have **now**?



Children to use the bar model

?	
34	3

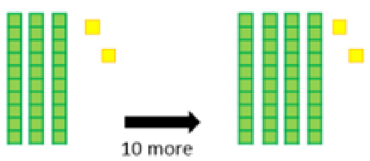


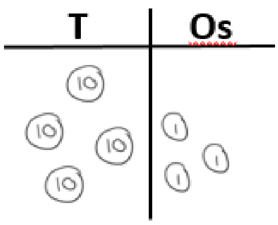
27 + 14

27 + 10 + 4

37 + 4 = 41

2dn + multiples of 10





43 + 20 = 63

2dn + 2dn

Keep the first number whole

Y3 Objectives

- 2dn + 2dn (sum>100)
- 3 dn + 3dn (column method)

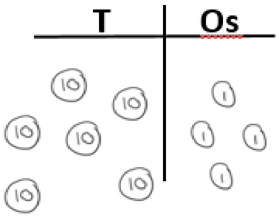
Key skills:
2dn + 1dn
2dn + multiples of 10
Column method

2dn + 1dn

26 + 5

26 + 4 + 1 = 31

2dn + multiples of 10



64 + 30 = 94

Children to use the bar model

2dn + 2dn

Keep the first number whole

27 + 14

27 + 10 + 4

37 + 4 = 41

```
  23
+ 14
----
  37
```

Column method

Unitise initially:
8 ones + 4 ones equals 12 ones. We rename this: it is 1 ten and 2 ones.
4 tens add 1 ten add the 1 carried ten equals 6 tens (not 40 + 10 + 10 = 60)
Move on to the shortened version when children can estimate the sum and use number sense:
8 add 4 equals 12, carry the 1. 4 add 1 add the carried 1 equals 6. The sum is 62.

2dn + 2dn with renaming
Carried figure at the bottom

```
  48
+ 14
----
  62
----
 +1
```

3dn + 3dn with renaming
Carried figure at the bottom

```
  258
+ 165
-----
  423
-----
 +1 +1
```

Solve missing box problems

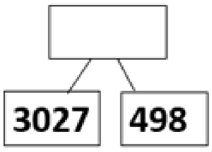
```
  58
+ 1■
----
  75
----
```

Y4 Objectives

- Numbers up to 4 digits
- Choose appropriate method

Key skills:
2dn + 1dn
2dn + multiples of 10
Column method

Children to use the part whole and bar model to develop estimation and number sense



?	
3027	498

Column method
Estimate first and choose a method of calculation using number sense.
Use the shortened version in the addition algorithm.
8 add 5 equals 13, carry the 1. 5 add 6 add the carried 1 equals 12 etc.

Solve missing box problems

```
   7 5 8
+  ■ 1 5
--------
 1 0 ■ 3
--------
```

3dn + 3dn with renaming
Carried figure at the bottom

```
  258
+ 165
-----
  423
-----
 +1 +1
```

4dn + 4dn with renaming
Carried figure at the bottom

```
  7289
+ 5145
------
 12434
------
 +1 +1
```

Y5 Objectives

- Numbers with more than 4 digits
- Decimal numbers

?	
375.5	14.3

Children to use the part whole and bar model to develop estimation and number sense

Problem solving

Amy and Matthew are playing their favourite
computer game. Amy's current high score is 8,524.
Matthew's high score is bigger than Amy's and when
you add them together their combined total is19,384.
What is Matthew's high score?

Decimal numbers
Different number of digits

$$\begin{array}{r} 57.30 \\ +\ \ 6.08 \\ \hline 63.38 \\ \hline \end{array}$$

+1

- **Vary the number of digits in the number**
- **= sign on the RHS**
- **Balanced equations**

65 + 577 =

? = 4277 + 656

648 + ? = 1036 + 58

Work out the missing numbers.

$$\begin{array}{r} \square 4 \square 3 \square \\ +\ 2 \square 5 \square 2 \\ \hline 78529 \\ \hline \end{array}$$

Y6 Objectives

- Numbers with more than 4 digits
- Decimal numbers
- Multi-step problems

Children to use the part whole and bar model to develop estimation and number sense

?	
487.3	2.9

- **Vary the number of digits in the number**
- **= sign on the RHS**
- **Balanced equations**

247 + 14,699 =

? = 6.9 + 14.32

$\frac{2}{5} + \frac{3}{10} + \frac{1}{2} =$

Problem solving

A is an odd number which rounds to 100,000 to the nearest ten thousand.
It has a digit total of 30.
B is an even number which rounds to 500,000 to the nearest hundred thousand.
It has a digit total of 10.
A and B are both multiples of 5 but end in different digits.

A	B
631,255	

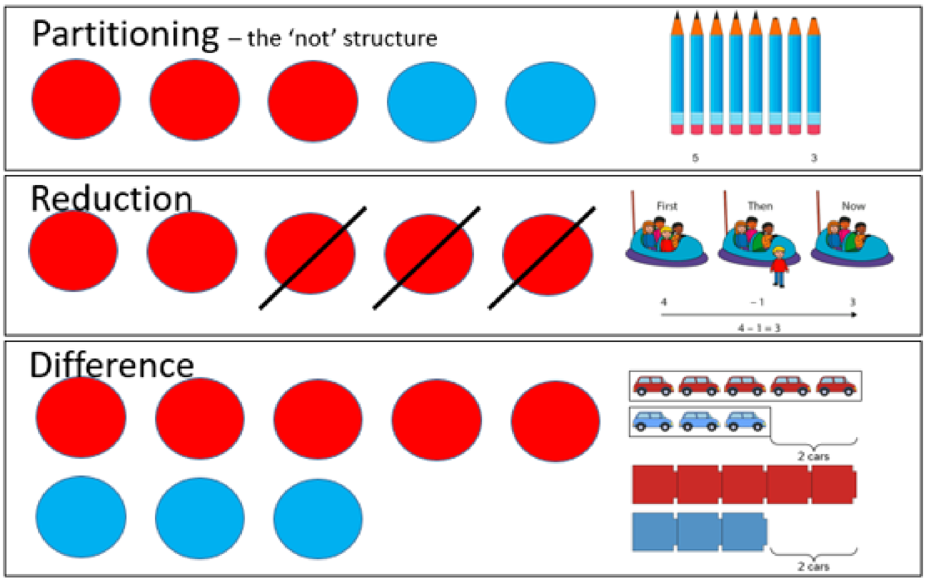
Subtraction

Big Idea

$$8 - 1 = 7$$

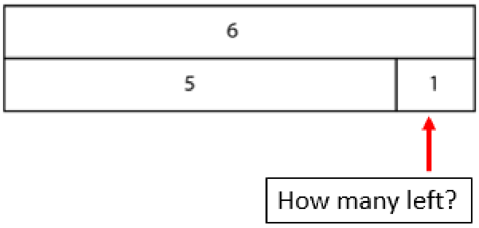
minuend subtrahend difference

There are three structures of subtraction: partitioning, reduction and difference.



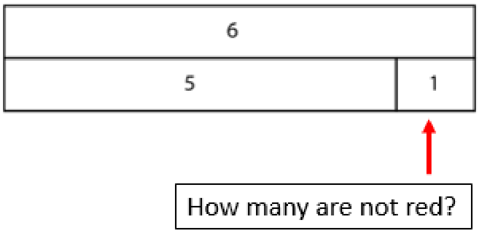
Reduction:
There are 6 flowers in a vase. I take out 5. How many have I got left?

6 is the whole. 5 is a part. 1 is a part.



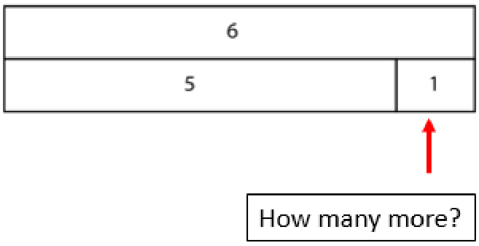
Partitioning:
There are 6 flowers in a vase, 5 are red. How many are not red?

6 is the whole. 5 is a part. 1 is a part.



Difference:
Sarah has 6 flowers in a vase. Gary has 5 flowers in a vase.
How many more flowers does Sarah have?

This is a comparative structure of subtraction.
It can be represented clearly on a bar model.



Stem sentences

- The whole can be split into parts.
- The sum of the parts is equal to the whole.
- Whole subtract a part equals a part.
- Subtraction cannot be done in any order as we cannot swap the whole and the part.
- The minuend is the whole.
- The subtrahend is a part.
- The difference is a part.

whole	
part	part

whole	
part	part

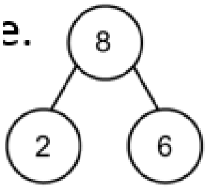
$$7 - 4 = 3$$

7	
4	3

minuend	
subtrahend	difference

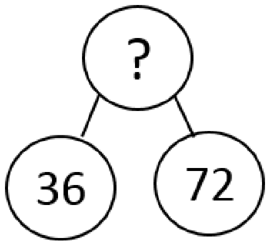
$$\square - 4 = 3$$

?	
4	3



8	
2	6

$$\square - 36 = 72$$



Progression in written methods (Yr1 – Yr6)

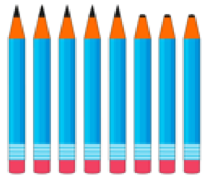
Y1 Objectives

- Number bonds an related subtraction facts within 20
- Subtract 1 and 2 digit numbers within 20, including zero

Key skills:
- bonds within 10
- bonds from 10

subtracting 0 and 1 from a number

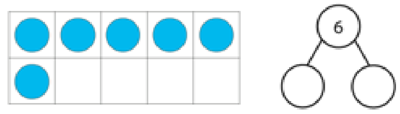
Start with expressions (no = sign)

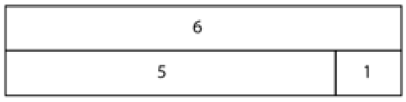


8 - 3

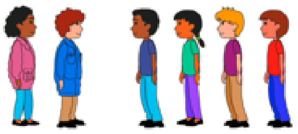
Use part whole diagram (include zero)

Partitioning single digit numbers





Move on to equations (has = sign)
Partitioning

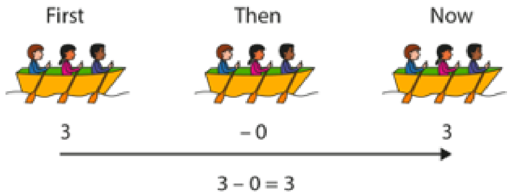


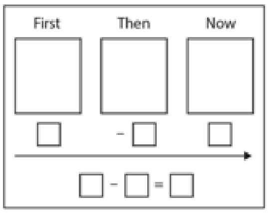
6 - 2 = 4

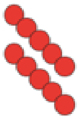
Teacher to use the bar model in the summer term

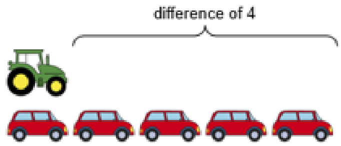
Reduction

Difference









Y2 Objectives

- 2dn - 1dn
- 2dn – multiples of 10
- 2 dn - 2dn (sum<100)

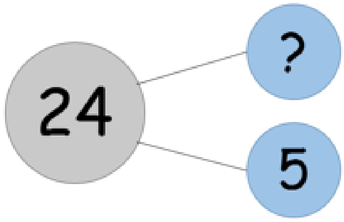
Children to use the part whole and bar model

2dn - 1dn Use numbers in a context

Key skills:
2dn - 1dn
2dn - multiples of 10

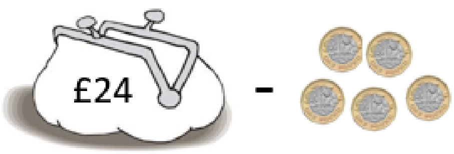
At **first** Fiona had £24 and **then** she spent £5.

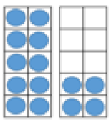
How much does she have **now**?



2dn - 1dn Use numbers in a context

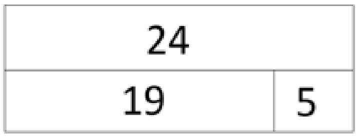
What does each number represent?



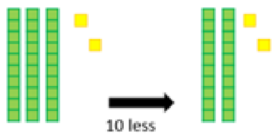


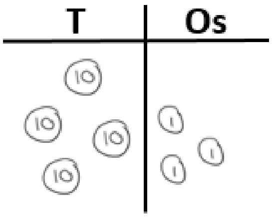
24 - 5

24 - 4 - 1 = 19



2dn - multiples of 10





43 - 20 = 23

2dn - 2dn

Keep the first number whole

58 - 17

58 - 10 - 7

48 - 7 = 41

Y3 Objectives

- **2dn - 2dn (without renaming)**
- **3dn – 3dn (without renaming)**

Subtraction is not commutative

Mental calculation strategies

Count on
If the numbers are close together

203 - 199

Count back
If subtracting a single digit or multiple of 10

342 – 5 or 257 – 40

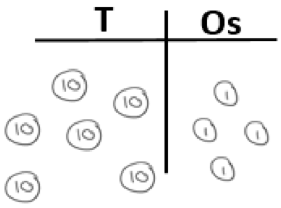
Key skills:
2dn - 1dn
2dn - multiples of 10
Column method

Constant difference
If subtracting a 'near tens' number

64 - 19

Problem solving with the written method

2dn - multiples of 10



64 - 30 = 34

3dn - 3dn without renaming

2dn - 2dn

Keep the first number whole

58 - 17

58 - 10 - 7

48 - 7 = 41

Column method

Unitise initially:
8 ones - 7 ones equals 1 one.
5 tens - 1 ten equals 4 tens (not 50 - 10 = 40)
Move on to the shortened version when children can estimate the difference and use number sense:
8 subtract 7 equals 1. 5 subtract 1 equals 4. The difference is 41.

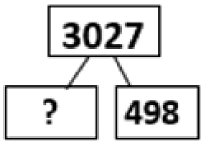
$$\begin{array}{r} 58 \\ -\ 17 \\ \hline \\ \hline \end{array}$$

Y4 Objectives

- **Numbers up to 4 digits**
- **Choose appropriate method**

Children to use the part whole and bar model to develop estimation and number sense

Key skills:
2dn - 1dn
2dn - multiples of 10
Column method



3027	
?	498

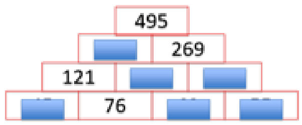
Column method

Unitise initially:
3 tens subtract 1 ten is two tens
4 hundreds subtract 2 hundreds is 2 hundred
Then move on to the shortened version (see Y3)

3dn - 3dn with renaming

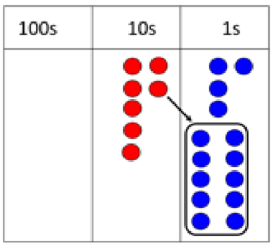
Problem solving

Can you complete the wall?



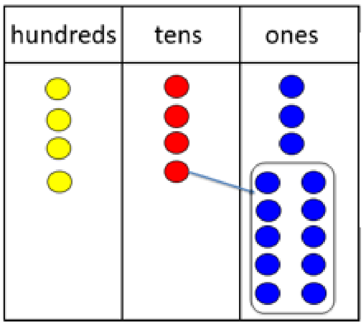
2dn - 2dn with renaming

$$\begin{array}{r} {}^{6}\cancel{7}{}^{1}4 \\ -\ 27 \\ \hline 47 \\ \hline \end{array}$$



74 - 27 = 47

$$\begin{array}{r} 4{}^{3}\cancel{4}{}^{1}3 \\ -218 \\ \hline 225 \end{array}$$



443 – 218 = 225

Y5 Objectives

- **Numbers with more than 4 digits**
- **Decimal numbers**

Select an appropriate method using number sense.

Decimal numbers

$$\begin{array}{r} \overset{6}{\cancel{7}}\,{}^{1}1\,.\,8 \\ -\ 3\,4\,.\,5 \\ \hline 3\,7\,.\,2 \\ \hline \end{array}$$

Children to use the part whole and bar model to develop estimation and number sense

375.5	
?	14.3

Problem solving

Work out whether each problem is true or false and say how he could solve the problem if it is wrong.

a) 3801 + 1499 = 3800 + 1500

b) 3801 + 2307 = 3800 + 2310

c) 5678 – 1212 = 5670 – 1220

d) 5678 – 152 = 5676 – 150

Y6 Objectives

- **Numbers with more than 4 digits**
- **Decimal numbers**
- **Multi-step problems**

Children to use the part whole and bar model to develop estimation and number sense

487.3	
?	2.9

- **Vary the number of digits in the number**
- **Missing boxes**
- **Balanced equations**

15.743 - 214.9 =

? – 200 = 2,307

$\frac{5}{6} - \frac{1}{4} =$

Address difficult points – zero as a place holder

$$\begin{array}{r} 57.\overset{2}{\cancel{3}}\,{}^{1}0 \\ -\ \ 6.08 \\ \hline 51.22 \\ \hline \end{array}$$

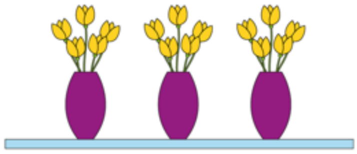
$$\begin{array}{r} \overset{2}{\cancel{3}}\,\overset{9}{\cancel{0}}\,\overset{12}{\cancel{3}}\,{}^{1}1\,.\,8 \\ -\ 1\,8\,6\,7\,.\,3 \\ \hline 1\,1\,6\,4\,.\,5 \\ \hline \end{array}$$

Multiplication

Big Idea

Multiplication can be a repeated addition structure or a scaling structure.

Repeated addition structure.

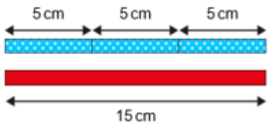


5+5+5 3×5

10 + 10 + 10 + 10 4 × 10

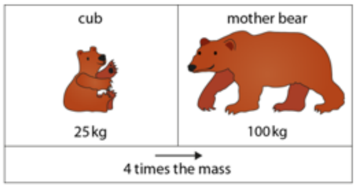
Scaling structure.

Describe the length of the plain ribbon.



The plain ribbon is 3 times the length of the spotty ribbon.

5 cm × **3** = 15 cm



25 kg × **4** = $\boxed{100}$ kg

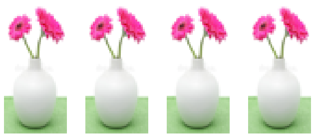
factor x factor = product A factor is a whole number, so this wouldn't be appropriate language when multiplying decimals

multiplicand x multiplier = product
2 multiplied by 4; 2, four times

multiplier x multiplicand = product
4 lots of 2; 4 times 2

When we have a picture or a context, we can tell which number is the multiplier and which number is the multiplicand.

Multiplicand is **2**	Multiplier is **4**



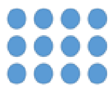
The **2** represents the number of flowers, the **4** represents the number of vases.

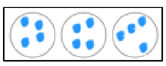
MULTIPLICATION KEY TEACHING POINTS

3 x 4 Is this 3 groups of 4 or 4 groups of 3?

At FBPS we say: without a picture or a context to tell us which is the multiplicand and which is the multiplier, it can be either.
(N.B. White Rose follow the Shanghai way of working which only allows the multiplier first, so this would be 3 groups of 4; NCETM encourages children to see this both ways so is in line with our policy.)

Start by representing this with an array so that children can see both 3 lots of 4 and 4 lots of 3.



Also represent as repeated groups  and 

Start by exploring unequal groups

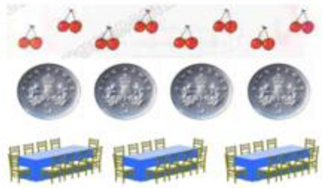
There are some pencils. The pencils have been grouped. There are 3 groups.

There are some footballs. The footballs have been grouped. There are 3 groups.

Move on to exploring equal groups

There are 3 groups of 5 eggs. There are 3 fives. 1 five, 2, fives, 3 fives.

- Developing fluency in counting in 2, 5 and 10:



5, ____, 15, 20, ___, ___

etc

Move from repeated addition to using the multiplication sign

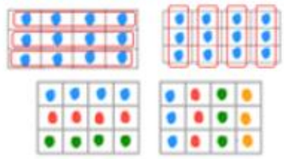
2 + 2 + 2 + 2

2 x 4 or 4 x 2

What does each number represent?

Use arrays to draw attention to the commutative structure of multiplication

4 x 3
and
3 x 4

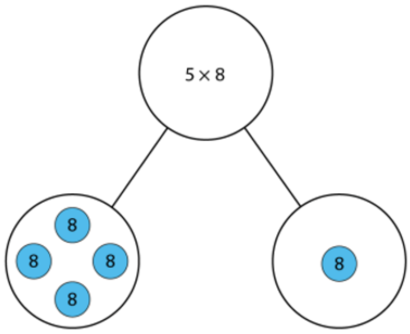


3 x 4 = 4 x 3

12 is equal to 3 groups of 4 or 4 groups of 3

The distributive law

We can split one factor into two parts, calculate each product separately and then add them together.

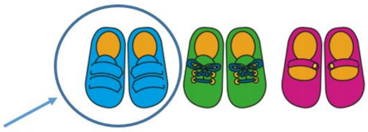


$\mathbf{5} = \mathbf{4} + \mathbf{1}$ $\mathbf{5} \times 8 = \mathbf{4} \times 8 + \mathbf{1} \times 8$ $= 32 + 8$ $= 40$ *'Five is equal to four plus one, so five times eight is equal to four times eight plus one times eight.'*	$\mathbf{4} = \mathbf{5} - \mathbf{1}$ $\mathbf{4} \times 8 = \mathbf{5} \times 8 - \mathbf{1} \times 8$ $= 40 - 8$ $= 32$ *'Four is equal to five minus one, so four times eight is equal to five times eight minus one times eight.'*

Stem sentences

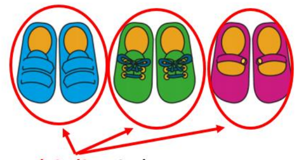
Multiplication:

- factor x factor = product
- When zero is a factor, the product is zero.
- Multiples of 4 make equal groups of 4.
- The multiplicand is the size of the group.



multiplicand is the size of the group.

- The multiplier is the number of groups.



multiplier is how many groups.

- Finding 10 times as many is the same as multiplying by 10 (for positive numbers);
- To multiply a whole number by 10, place a zero (not add a zero) after the final digit of that number (for integers).
- Finding 100 times as many is the same as multiplying by 100 (for positive numbers);
- To multiply a whole number by 100, place two zeros (not add two zeros) after the final digit of that number (for integers).

Multiple Stem Sentences:

- A multiple of a number can be divided into equal groups of that number.
- A multiple of 4 can be divided into equal groups of 4.
- A multiple of 4 is the product of 4 and a whole number.
- 12 is a multiple of 4 because you can make equal groups of 4.
- 13 is not a multiple of 4 because you can't make equal groups of 4.

A **multiple** of 4 is the product of 4 and a whole number.

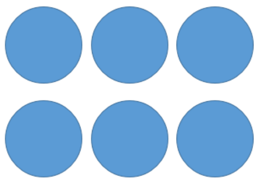
4 x …… = ……

Factor stem sentences:

- The factors of a number are all the numbers that divide into it exactly.
- A factor is a number that can be divided into another number without leaving a remainder.
- For example, 1, 2, 3, 4, 6 and 12 are all factors of 12.
- 3 is a factor of 12 because you can make 4 equal groups of 3.
- 4 is a factor of 12 because you can make 3 equal groups of 4.
- 5 is not a factor of 12 because you can't make equal groups of 5, there will be some left over.

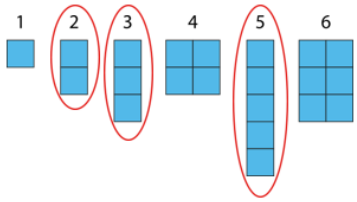
3	×	2	=	6
factor	×	factor	=	product

6	=	3	×	2
product	=	factor	×	factor



Prime Number stem sentences:

- A number which has only two factors is a prime number.
- 2 is the first, and only even, prime number.



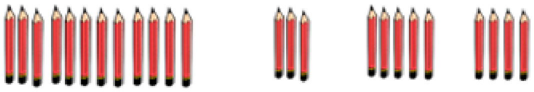
Progression in written methods (Yr1 – Yr6)

Y1 Objectives

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

Key skills:
Explore equal and unequal groups
Skip count in 2s, 5s and 10s.
Recognise the structure of multiplication as repeated addition

Start by exploring unequal groups



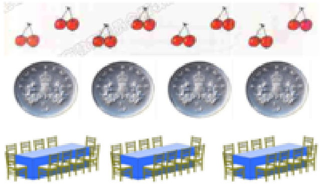
There are some pencils. The pencils have been grouped. There are 3 groups.

There are some footballs. The footballs have been grouped. There are 3 groups.

Move on to exploring equal groups

There are 3 groups of 5 eggs. There are 3 fives. 1 five, 2, fives, 3 fives.

- Developing fluency in counting in 2, 5 and 10:



5, ____, 15, 20, ____, ____

etc

Language used: unequal, equal, groups of, counting sets eg. 1 group of 5, 2 groups of 5 etc.

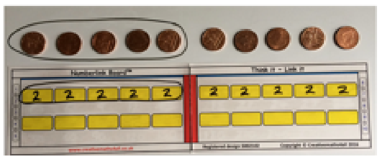
Y2 Objectives

- **recall and use multiplication facts 2, 5 and 10 multiplication tables**
- **calculate mathematical statements using symbolic representation 2 x 5 = 10**
- **show that multiplication is commutative eg. 2 x 3 = 3 x 2**
- **solve problems involving multiplication using materials, arrays, repeated addition, mental methods, and multiplication facts, including problems in contexts**

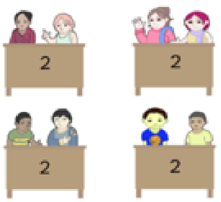
Use real life context examples

Recap on unequal and equal groups

Show me five lots of 2



Move from repeated addition to using the multiplication sign

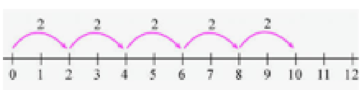


2 + 2 + 2 + 2

2 x 4 or 4 x 2

What does each number represent?

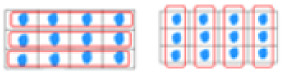
Skip counting, counting in the … times table

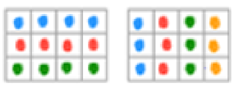


If children need support working out multiples initially, they can draw dots to show the cardinality of the number and count the dots.

Use arrays to draw attention to the commutative structure of multiplication

4 x 3
and
3 x 4





3 x 4 = 4 x 3

12 is equal to 3 groups of 4 or 4 groups of 3

Y3 Objectives

- **3, 4 and 8 times tables**
- **Multiply 2dn by 1dn using an appropriate method, including column multiplication**

Use context problems
eg. There are 23 pens in a pot and I have got 3 pots. How many pens are there altogether?

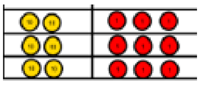
Represent the calculation using **place value counters/Dienes** initially. Estimate the answer using the Numberlink Boards.

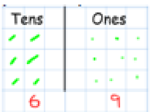
The expanded method of multiplication is not used.

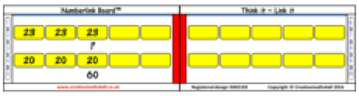
Unitise to avoid errors.

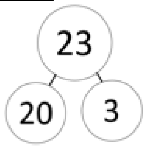
23 x 3

Initially use numbers which don't involve renaming.







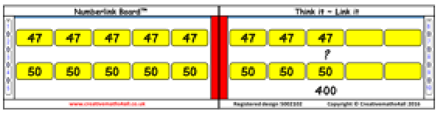


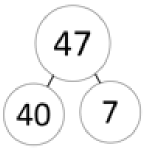

```
  2 3
x   3
  6 9
```

"**3 ones** times 3 equals 9 ones. **2 tens** times 3 equals 6 tens."

Move on to using numbers which involve renaming.

47 x 8






```
 +5
  4 7
x   8
3 7 6
```

"**7 ones** times 8 equals 56 ones. The 50 ones are renamed into 5 tens and written above the tens column. **4 tens** times 8 equals 32 tens, add the 5 tens equals 37 tens."

Y4 Objectives

- **All times tables up to 12 x 12**
- **Multiply 2dn by 1dn using an appropriate method, including column multiplication**
- **Multiply 3dn by 1dn using an appropriate method, including column multiplication.**

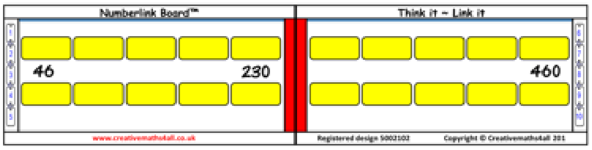
Use numbers in context, eg. I have 6 jars of marbles. Each one has 245 marbles in. How many marbles are there in all 6 jars?
Children build on previous steps to represent a three-digit number multiplied by a one-digit number initially with place value counters.
Teachers should be aware of misconceptions arising from 0 in the tens or ones column of a dividend.
Children then move on to explore multiplication with renaming in one column first and then more than one column.

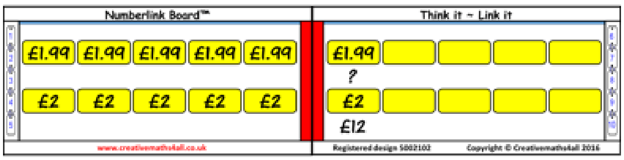
Encourage children to use flexible methods to solve multiplication calculations.

Practise multiplying by 5

£1.99 x 6

46 x 5 = 46 x 10 halved = 230



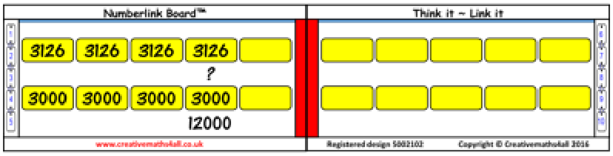


This is a really easy strategy to use with large numbers and decimals!
Try 32 x 5, or 126 x 5 or 6.4 x 5!

Y5 Objectives

- multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers
- multiply and divide numbers mentally drawing upon known facts
- multiply and divide whole numbers and those involving decimals by 10, 100 and 1000

Use number link boards to support estimation of a 'sensible' answer



+1+2

$$\begin{array}{r} 3126 \\ \times \quad 4 \\ \hline 12504 \\ \hline \end{array}$$

Move from short to long multiplication.

COMPACT METHOD

+5 +4

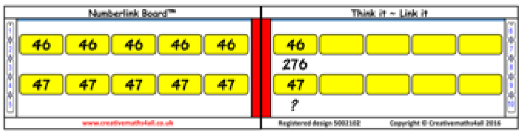
Carried figure at the top

$$\begin{array}{r} 376 \\ \times \ 17 \\ \hline 2632 \\ 3760 \\ \hline 6392 \\ \hline \end{array}$$

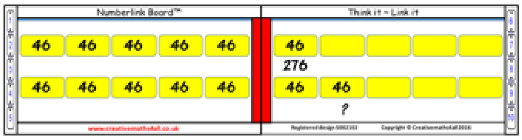
Look at how the product changes when we increase the multiplicand or the multiplier.

Procedural variation 46 x 6 = 276

What happens to the product when we increase the multiplicand by 1? Does the product increase by 1?



What happens to the product when we increase the multiplier by 1? Does the product increase by 1?

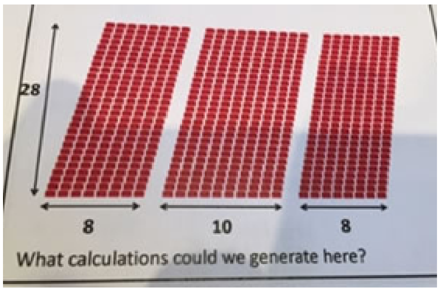


Use real life context examples

Y6 Objectives

- multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication
- multiply one-digit numbers with up to 2 decimal places by whole numbers
- perform mental calculations, including with mixed operations and large numbers

Use real life context examples and reasoning to build depth of understanding.
Eg. present children with an image of seats in a stadium to represent the calculation 28 × 26. How could this calculation be solved?



Use long multiplication to multiply number with up to 4 digits by 2 digit numbers

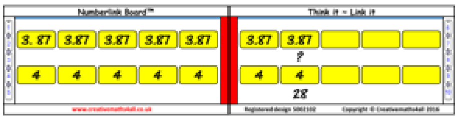
COMPACT METHOD

+1 +3 +1

Carried figure at the top

$$\begin{array}{r} 4308 \\ \times \quad 24 \\ \hline 17232 \\ 86160 \\ \hline 103392 \\ \hline \end{array}$$

Use the number link board to support estimation of a 'sensible' answer.



+6 +4

$$\begin{array}{r} 3.87 \\ \times \quad 7 \\ \hline 27.09 \\ \hline \end{array}$$

Division

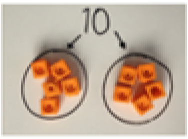
Big Ideas

dividend ÷ divisor = quotient

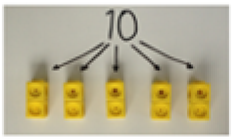
Division has two different structures which are explored separately: **Quotitive** (division as grouping) and **Partitive** (division as sharing)

10 objects put in groups of 5

10 objects shared into 5 groups

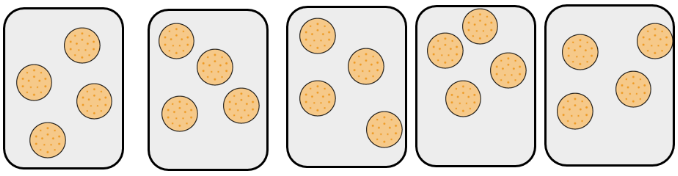


How many 5s are there in 10?
The 5s are either kept together (quotitive) or the 5s are distributed (partitive).



- Objects can be grouped equally, sometimes with a remainder.
- Division equations can be used to represent 'grouping' problems *(Quotitive structure)*
- Division equations can be used to represent 'sharing' problems *(Partitive structure)*
- We think about how many of the divisor fit into the dividend.
  12 ÷ 4 How many '4's are there in 12.
- Division is not commutative. We start with the whole and think about how many equal parts there are in the whole.

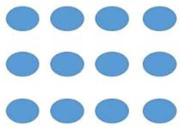
Quotitive (grouping) structure of division



20 is divided into groups of 4. There are 5 groups.
20 ÷ 4 = 5
20 divided into groups of 4 is equal to 5.

Partitive (sharing) structure of division

12 chicken nuggets are shared equally between 4 children. How many for each child?



1 lot of 4
1 lot of 4
1 lot of 4

12 divided between 4 is equal to 3 nuggets each. 12 ÷ 4 = 3.

Sentence Stems

- Dividend divided by the divisor equals the quotient.
- We can use our multiplication facts to help us with division
  12 ÷ 4 How many '4's are there in 12. 3 x 4 = 12
- When we divide into groups, the divisor is kept as a group.
- When we divide by sharing, the divisor is partitioned.
- When the dividend is zero, the quotient is zero;
- When the dividend is equal to the divisor, the quotient is one;
- When the divisor is equal to one, the quotient is equal to the dividend

Progression in written methods (Yr1 – Yr6)

Y1: solve one step problems involving division using concrete and pictorial representations.
Y2: calculate mathematical statements using the division sign. Show that division is not commutative.

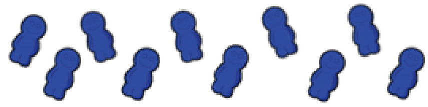
Use grouping (quotitive) and sharing (partitive) contexts as shown below.

Mo is putting 6 flowers into pots.

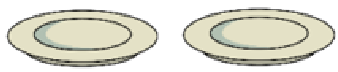
He puts 2 flowers into each pot.
How many pots does he need?

I have 12 pennies and I divide them between 3 children.
How many 3s are there in 12?

Dora has 10 sweets.



She shares them equally between 2 plates.



How many sweets are on each plate?

6 ÷ 2 = 3
What does each number represent?

12 ÷ 3 = 4
What does each number represent?

10 ÷ 2 = 5
What does each number represent?

For grouping and sharing contexts, move to a common language for division:
"How many …..s in …….?"

<u>Y3 Y4 division learning journey to 2dn ÷ 1dn/3dn ÷ 1dn</u>

The dividend at this stage will be not be greater than 20 times the divisor.

Ensure that **word problems** are in the form of **sharing** and **grouping contexts.**

1. Focus on the same times table; **link x and ÷** ; use fluency time to **focus on difficult facts** eg. 3xs, 4xs, 6xs, 7xs, 8xs, 9xs

Deepen understanding by varying the position of the empty box.

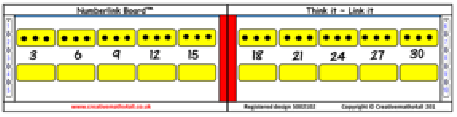
$24 \div \square = 8$ $\quad\quad$ $\square \div 3 = 8$

$8 = \square \div 3$ $\quad\quad$ $\square = 24 \div 3$

Using the Numberlink Board™ for Division

Before moving to division, explore multiples of 3 using multiplication.

24 = 3 x 8 $\quad$ 24 is equal to 8 groups of 3.



What is 24 divided by three? $\quad$ 24 ÷ 3 = 8

How many groups of three are there in 24?

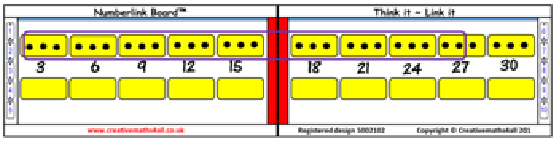
2. Explore numbers between multiples, this establishes understanding of division with remainders

"Give me a number which is 1 more than a multiple of 3."
"Give me a number which is 2 more than a multiple of 3."
"Give me a number which is 3 more than a multiple of 3. What do you notice?"

Using the Numberlink Board™ for Division

When moving to division with remainders, explore other numbers using multiplication.

26 = 3 x 8 + 2 $\quad$ 26 is equal to 8 groups of 3 plus two.

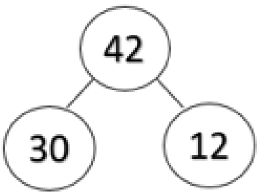


How many groups of three are there in 26?
There are eight groups of 3 and 2 remaining. $\quad$ 26 ÷ 3 = 8r 2

3. Move to dividends which are between 10 and 20 lots of the divisor e.g. 42 ÷ 3; 51 ÷ 3;
(These calculations will have no remainders.)

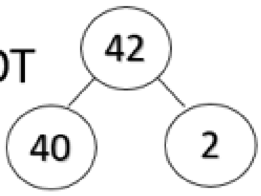
When introducing the concept, keep the divisor the same so the children focus on the changing structure.

Use the part whole model to split the dividend into ten lots of and then whatever is left.

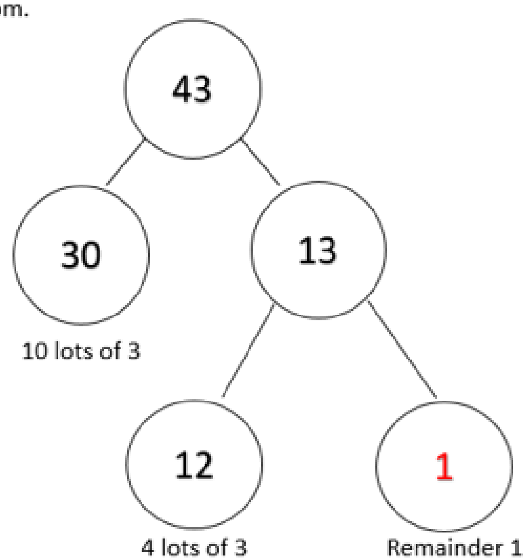


10 lots of 3 $\quad$ 4 lots of 3

NOT

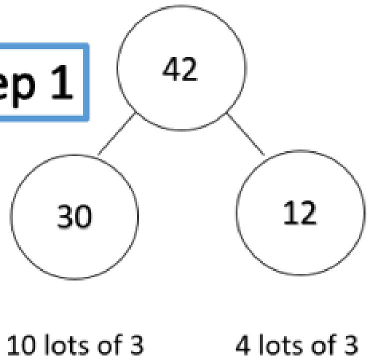


4. Repeat step 3 using numbers which are not multiples of the divisor. These calculations will have remainders.
Encourage children to explain where these remainders come from.



Moving from part/whole to compact division

Step 1



Step 2

$$\begin{array}{r} 10 \;+\; 4 \\ \text{How many } 3\text{s in}\overline{\big)\,30 \;+\; 12} \end{array}$$

Step 3

$$\begin{array}{r} 1\;4 \\ 3\,\overline{\big)\,\cancel{4}\,{}^{1}2} \end{array}$$

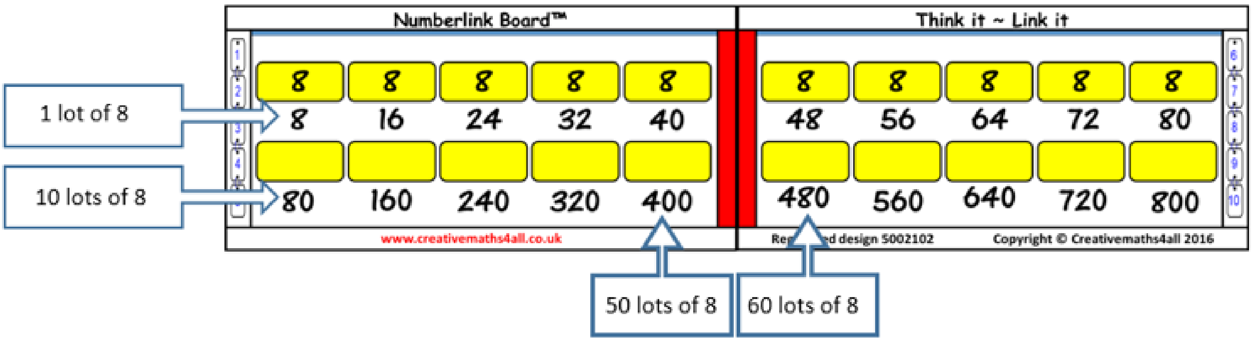
- The children should have a good idea of what the quotient should be before using compact division method 'bus stop'. They should use estimation and number sense so they can spot an error if it occurs.
- Make sure children know what each number in the calculation represents.

Y5/Y6

Y5: Up to 4dn ÷ 1dn; short division method 'bus stop'; interpret the remainder
Y6: Up to 4dn ÷ 1dn; short division or long division when appropriate; interpret the remainder

Focus on a particular divisor when working on the algorithm initially. For example if using 8 as the divisor build the Numberlink Board up as shown below. The children can then find the dividend on the board and estimate what the quotient will be.

Estimate how many 8s there are in 475.



475 is between 400 and 480 so the quotient will be between 50 and 60.

Y5/Y6

$$\begin{array}{r|l} & 2\ 6\ 4\ r3 \\ \hline 6 & 1\ 5^{3}8^{2}7 \end{array}$$

$$\begin{array}{r|l} & 2\ 8\ .\ 8 \\ \hline 15 & 4\ 3\ 2\ .\ 0 \\ & -3\ 0 \\ & 1\ 3\ 2 \\ & -1\ 2\ 0 \\ & 1\ 2\ 0 \\ & -1\ 2\ 0 \end{array}$$

150

75

15

Deepening understanding of division

53 apples are put into bags of 4. How many bags are filled? (13)

What happens to a group of 53 children if they are put into teams of 4?
(They make 13 teams with 1 child left over: 13r1)

A roll of fabric is 53m long and is cut into 4 equal lengths. How long is each piece? ($13\frac{1}{4}$m).

£53 is shared equally between 4 friends. How much do they get each?
(£13.25)

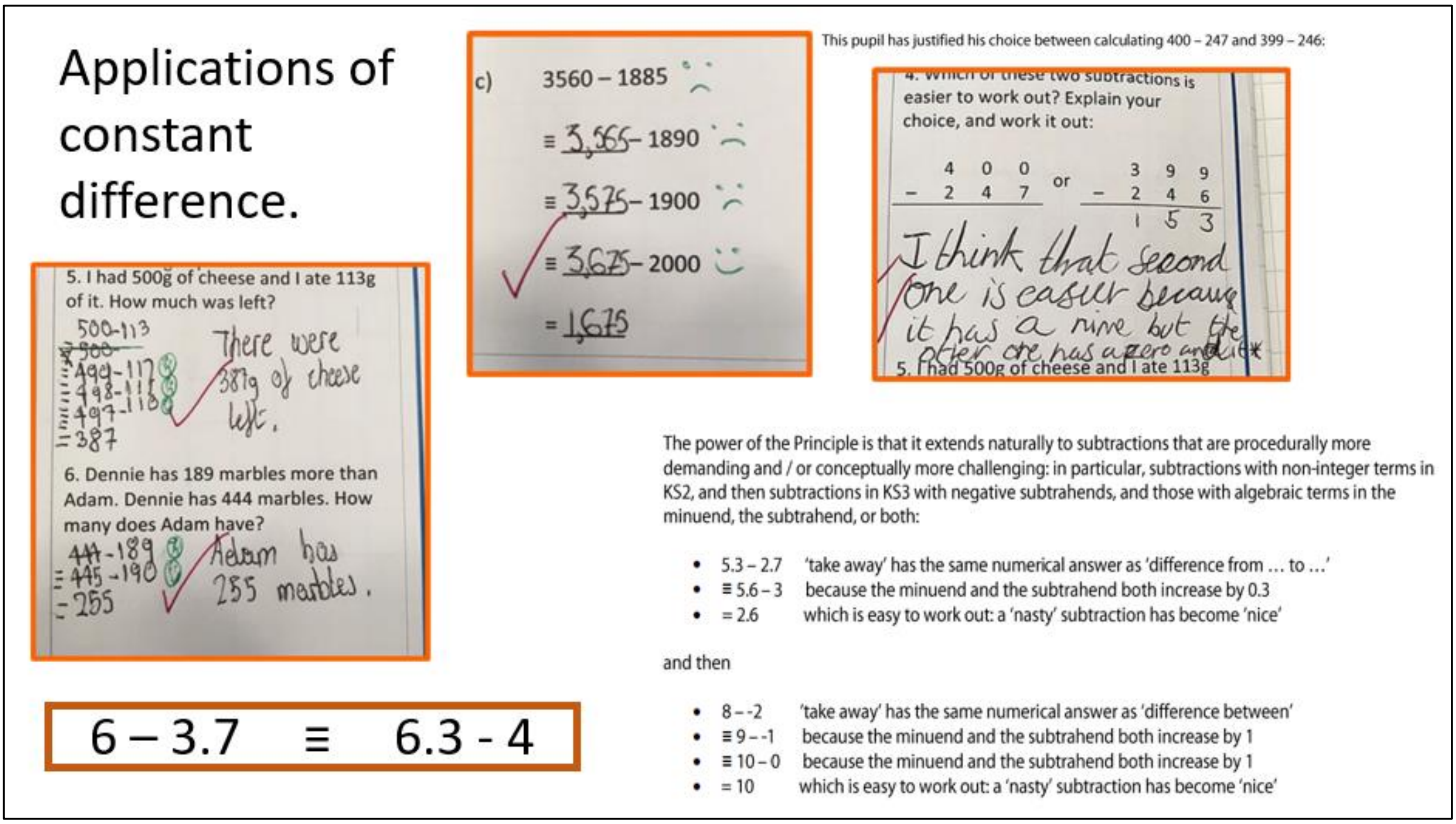
A taxi can hold 4 people. 53 people need a taxi, how many taxis will be needed? (14)

The principle of Constant Difference

The Principle of Constant Difference – If you change the minuend and the subtrahend by the same amount, the difference will remain the same.

53 – 19 = 54 – 20

This subtraction principle is taught from **Yr3/4** at FBPS. Children will need lots of practical experience to understand the principle and then be given chance to recognise equations where the strategy is particularly effective.



Teaching the Principle of Constant Difference

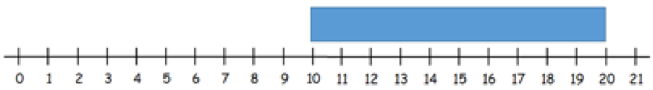
21 – 18 = 3

The difference between 21 and 18 is 3.

This picture shows a difference strip of 3. You could use Cuisenaire rods if you have them. Find other numbers which have a difference of 3. Can you explain what is happening to the minuend and the subtrahend to keep the difference the same?

20 – 10 = 10

The difference between 20 and 10 is 10.



This picture shows a difference strip of 10. The Dienes rod can be used as a difference strip of 10. Slide it along your ruler to see which numbers have a difference of 10.

These have a difference of 10 …

Can you describe and explain the pattern using the words minuend, subtrahend and difference?

30 – 20 = 10	**20 – 10 = 10**
29 – 19 = 10	21 – 11 = 10
28 – 18 = 10	22 – 12 = 10
27 – 17= 10	23 – 13 = 10
26 – 16 = 10	24 – 14 = 10

Suggest how to change these numbers to make the calculation easier but keeping the answer the same.

Y4

74 – 19	142 – 29	146 – 38
82 – 19	152 – 39	174 – 58

Y5 / Y6

134 - 198	5 – 1.9	15.1 – 7.8
4000 - 2759	30000 - 18759	