Calculation Guidance

2019-2022

Mental and Written Calculations

This policy outlines both the **mental** and **written** methods that should be taught from Pre School to Year 6.

The policy has been written according to the National Curriculum 2014 and the written calculations for all four operations are as outlined on the appendices of the Programme of Study.

The document builds on the interconnectedness of mathematics and outlines the progression for addition, subtraction, multiplication and division. It is our intention that addition and subtraction should be taught in succession or in some cases at the same time to ensure children are able to see the clear links between the operations and the inverse nature of them along with multiplication and division.

Children should secure mental strategies. They are taught the strategy of counting forwards and backwards in ones and tens first and then 'Special Strategies' are introduced. Children are taught to look carefully at the calculation and decide, which strategy they should use. Children should explain and reason as to why they have chosen a strategy and whether it is the most efficient.

The formal written methods should be introduced with caution. Calculations that require a written method should be presented to the children and models and images, such as dienes apparatus, place value counters, etc. should be used to ensure children have a conceptual understanding of the written method and that it is not a process that the children use for every type of calculation regardless of whether it can be completed mentally or mentally with jotting i.e. the number line.

The policy outlines the **mental strategies** that children should be encouraged to use:

A mental strategy that they can always rely on **E.g. counting in tens and ones, forwards and backwards E.g.** 56 – 25 (count back in 10s 56, 46, 36 and back in ones 36, 35, 34, 33, 32, 31)

A special strategy they can select from a small range of strategies if they can see something special about the numbers they are being asked to calculate with E.g. 46 – 24 (I can use near doubles to support my calculation E.g. 46 – 23 – 1)

The policy outlines the **written methods** as suggested on the appendices of the Curriculum 2014 and suggests that children:

- Look at a calculation and decide whether it can be done mentally, mentally with a jotting or whether it needs a written method.
- **Should always be shown written methods with place value apparatus to ensure children are clear about the value of the numbers that they are calculating with and the numbers do not just become digits.**
- Estimate, calculate and check to ensure that the answer they generate has some meaning.

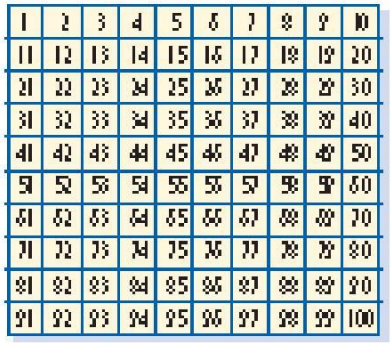
For the purpose of developing understanding there may be occasions when examples that can be completed mentally may be shown as a written method purely to develop understanding of the method. This needs to be made very clear to children and when they are practising the methods, appropriate calculations should be used.

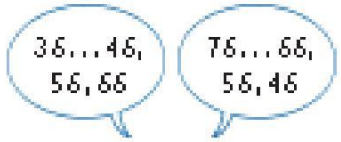
Bar Models (see appendix) will be used to form a link between calculations and solving word problems to ensure that children have a deep understanding of what is being asked of them. Bar Models will take the form or concrete and pictorial representations with the abstract alongside so children can see the connection.

There is also a section on calculating with fractions; the expectations from Y1—Y6 and examples with the models and images that should be used in order to ensure children develop a conceptual understanding when calculating with fractions.

Addition and Subtraction

Key representations to support conceptual understanding of addition and subtraction.



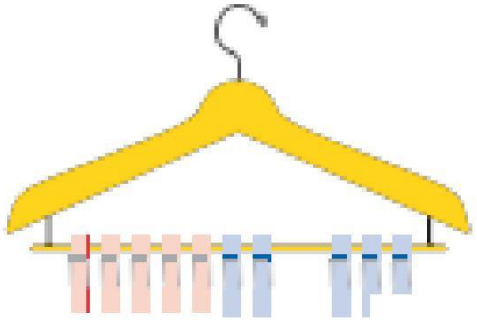


6 + 10 = 16
16 + 10 = 26
26 + 10 = 36
36 + 10 = 46

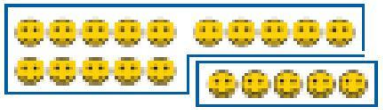
36 + 20 = 56

96 − 10 = 86
86 − 10 = 76
76 − 10 = 66
etc.

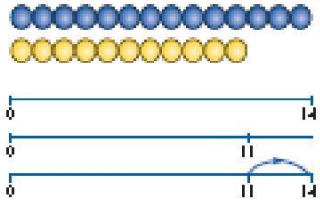
76 − 30 = 46



8 + ? = 10



15 + 5 = 20

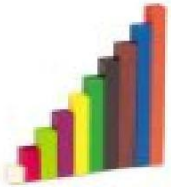


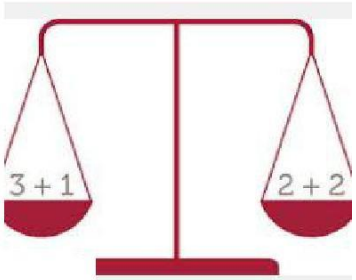
10 = 7 + 3

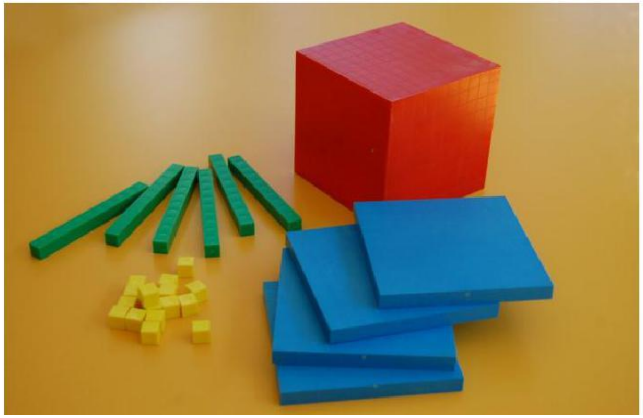
The difference between 11 and 14 is 3.

14 − 11 = 3

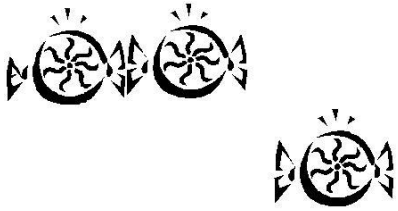
11 + □ = 14







DEVELOPING UNDERSTANDING OF ADDITION AND SUBTRACTION

Pre School	Reception
Objectives **2 year old provision** • Notice changes in number of objects/images or sounds in groups of up to 3 • Select a small number of objects from a group when asked (eg. please give me two) **2 year + provision** • Select a small number of objects from a group when asked • They recite some number names in sequence • Crete and experiment with symbols and marks representing ideas of number • Use some language of quantities, such as more, and, a lot, and they know that a group of things changes in quantity when something is added or taken away	**Objectives** **Children:** • Count reliably with numbers from 1 to 20, • Place numbers 1-20 in order and say which number is one more or one less than a given number. • Use quantities and objects, to add and subtract two single-digit numbers and count on or back to find the answer. • They solve problems, including doubling, halving and sharing.
I've got 2 sweets and I am given one more. How many have I got now?  Strategy: combining two groups and counting to establish total Recording: teacher demonstration of pictorial recording where appropriate. Vocabulary: more, and, plus, make, sum, total, altogether Equipment: everydaay objects, counters, fingers etc	Jane had 3 bears. She was given 2 more. How many does she have now?  3 + 2 = 5 Strategy: combining two or more groups and counting to establish total; 'counting on' from one number Recording: teacher demonstration of calculation to match pictorial recording using number lines and use of standard notation of + and = Children begin using number lines and standard notation when appropriate e.g. Summer term Vocabulary: add, more, plus, and, make, sum, total, altogether Equipment: every day objects number lines, counters, fingers etc

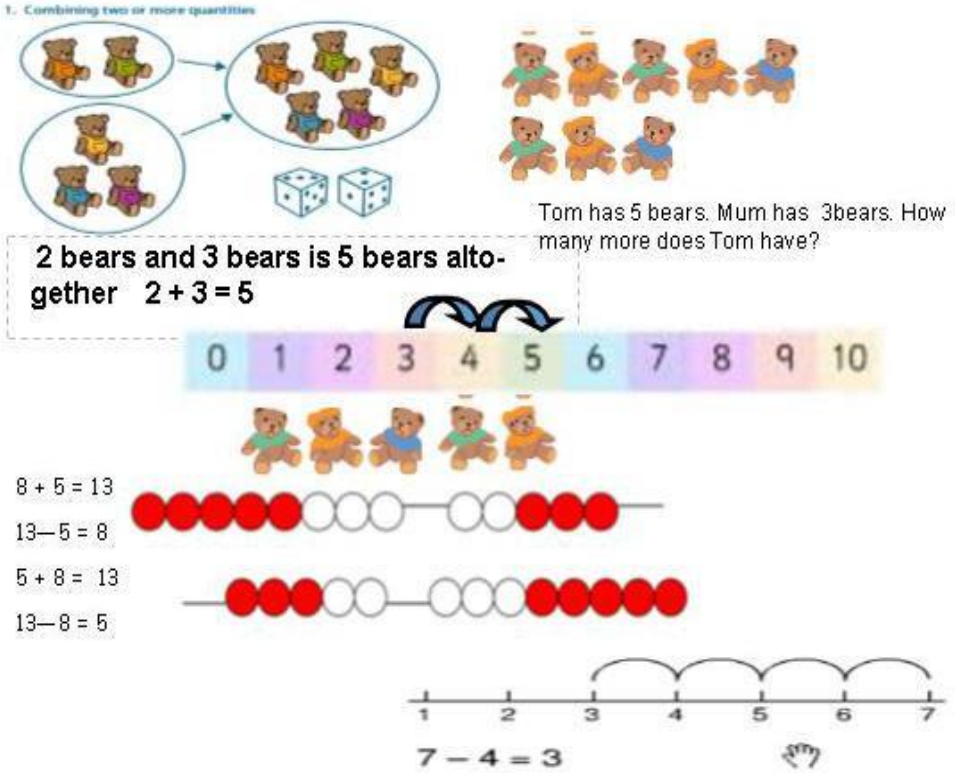
Year 1

Objectives	Recall of Facts
read, write and interpret mathematical statements involving addition (+), subtraction (-) and equals (=) signs **represent** and **use** number bonds and related subtraction facts within 20 add and subtract one-digit and two-digit numbers to 20, including zero	 If we know 4 + 5 = 9 We also know: , 5 + 4 = 9 9 - 5 = 4 9 - 4 = 5 14 + 5 = 19 19 - 14 = 5, etc Work with all numbers up to 20.

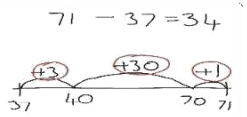
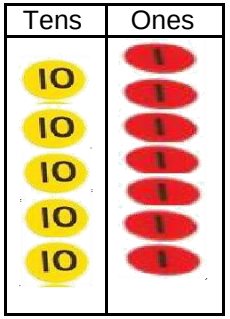
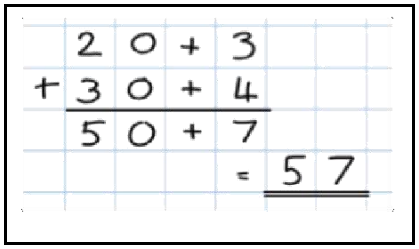
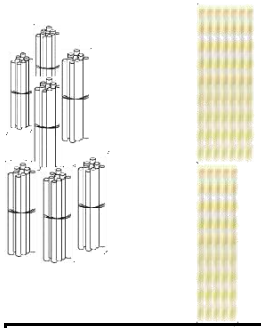
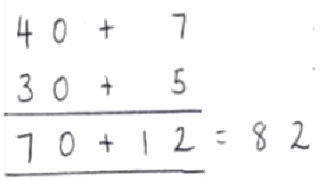
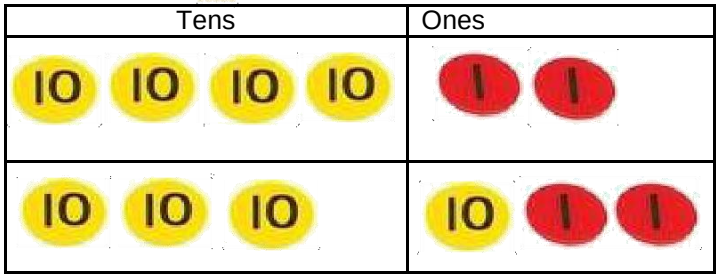
Children need to be secure with Using and Applying these skills in unfamiliar contexts before moving into the Year 2 objectives

Mental Jottings with representations

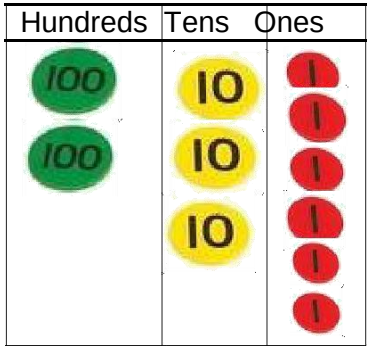
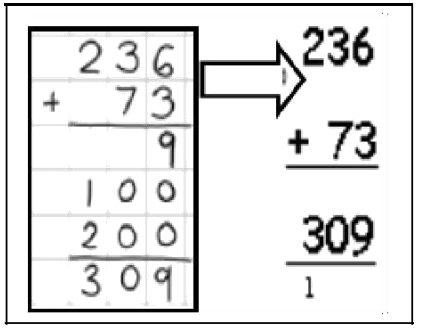
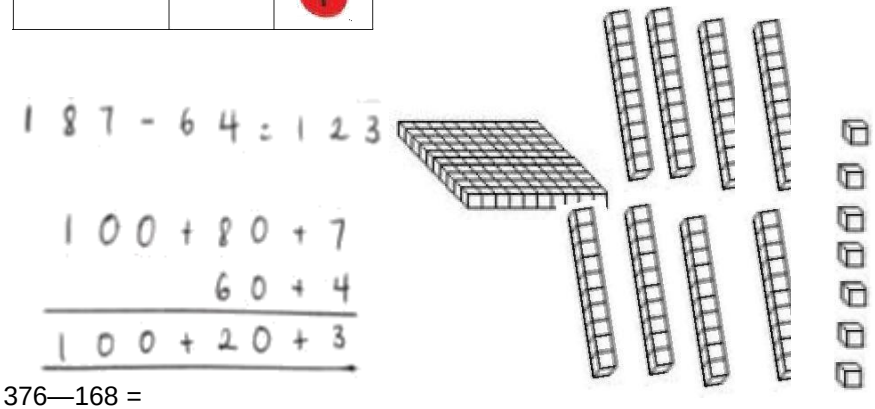
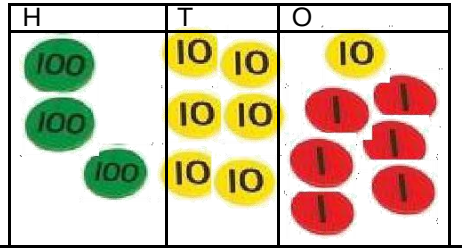
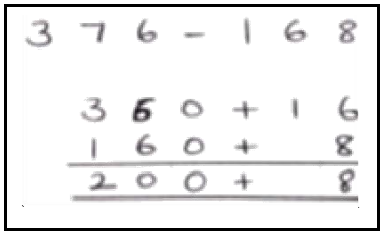
Immerse children in practical opportunities to develop understanding of addition and subtraction. Link practical representations on a number track on a beadstring to recording on a number line. By the end of Year 1 children should be able to recall and use facts within and to 20.

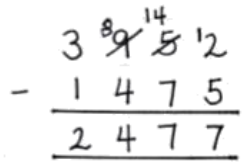
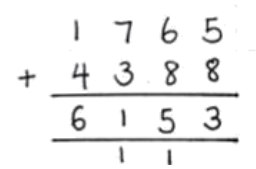


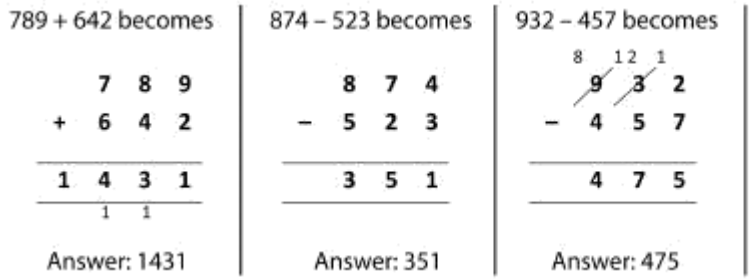
Year 2

Objectives:	**Mental Recall/Jottings:**	**Written Methods with representations**
Show that addition of two numbers can be done in any order and subtraction cannot. Recall and use addition and subtraction facts to 20 fluently and derive and use related facts up to 100. Add and subtract numbers using concrete objects, pictorial presentations and mentally including: 2 digit number and ones 2 digit number and tens Two 2 digit numbers Add three 1 digit numbers Solve problems with addition and subtraction: · using concrete objects and pictorial representations, including those involving numbers, quantities and measures · applying their increasing knowledge of mental and written methods	**Using known facts** If I know: 2+3 = 5 I also know: 3+2 = 5 20 + 30 = 50 30 + 20 = 50 50—30 = 20 50—20 = 30 **Bridge through 10** 26 + 7 = 26 + 4 + 3 26 + 4 = 30 30 + 3 = 33 **Counting on/back in10s** 26 + 20 = 67-20 **Partitioning** 23 + 34 = 46—25 **Special Strategy** **Rounding and adjusting** + 9—9 +11—11 **Bonds to 10** 2 + 7 + 8 = 8 + 2 + 7 **Finding the difference between two numbers. 71 – 37:**  **Partitioning numbers in different ways in preparation for subtracting using decomposition:** 90 + 2 80 + 12 (I have subtracted a ten and added it onto the ones) Continue to record mental jottings as outlined in Year 2 with increasingly larger numbers. Use suitable resources as required (See models and images page). Children that have not achieved the age related expectations for Year 2 should not move onto formal written methods until they are secure with mental recall/jottings.	Recording addition and subtraction in columns supports place value and prepares for formal written methods.      Encourage children to recognise this can be completed mentally: 42 -15 → 40 + 2 / 10 + 5 → 30 + 12 / 10 + 5 / 20 + 7 → 42 – 15 = 27

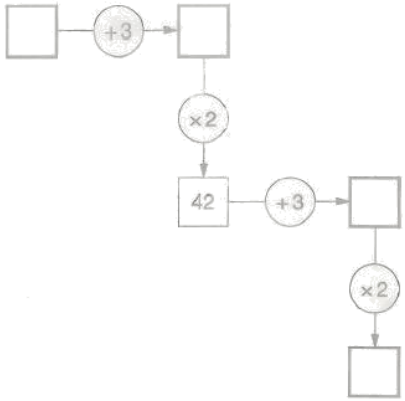
Year 3

Objectives:	**Mental Recall/Jottings:**	**Written Methods with representations**
Add and subtract numbers mentally A 3 digit number and 1s A 3 digit number and 10s A 3 digit number and 100s Add and subtract numbers with up to 3 digits using formal written methods of columnar addition and subtraction. **Estimate** **Calculate** **Check**	**Bridging to 10** 425 + 8 = 425 + 5 + 3 = 430 + 3 = 433 **Rounding and Adjusting** 425 + 90 = 425 + 100 = 525 - 10 = 515 146 – 9 = 146 – 10 + 1 = 136 + 1 = 137 146 – 50 = 146 – 40 – 10 = 106 – 10 = 96 **Counting forwards or backwards in 100s** 636 – 500 = 136	Pupils use their understanding of place value and partitioning, and practise using columnar addition and subtraction with incr easingly large numbers up to three digits to become fluent    376—168 = Using my knowledge of partitioning in different ways. 376 = 360 + 16.  

Year 4		
Objectives:	**Mental Recall/Jottings:**	**Written Methods:**
Continue to secure and extend mental methods from previous year groups. To select whether a calculation can be done mentally, with a jotting or using a formal written method. Add and subtract numbers with up to 4 digits using formal written methods of column addition and subtraction where appropriate.	Develop confidence at calculating mentally with larger numbers. Using the full range of strategies: · **Counting in 1s/10s** · **Bridging through multiples of 10** · **Partitioning** · **Rounding and Adjusting** · **Reordering** · **Near Doubles** · **Bridging through 60 when calculating with time.** **Can I do it mentally?** **Should I use a jotting?** **Should I use a written method?**	Add and subtract numbers up to four digits.   Revert to expanded methods if the children experience any difficulty. Use the written method with decimals in the context of money £ 32.50 + £ 21.75 = £54.25 £32.50 + £21.75 £54.25 1 £ 42.50 - £ 13.35 = £ 29.15 £ 3 1 4 1 2. 4 5 1 0 - £ 1 3. 3 5 £ 2 9. 1 5 Using number to ensure children understand the process before quickly moving into numbers that do require a written method.

Year 5		
Objectives:	**Mental Recall/Jottings:**	**Written Methods:**
Add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction) Add and subtract numbers mentally with increasingly large numbers Use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why.	12 462 – 2300 Use knowledge of place value to calculate mentally with increasingly larger numbers. Employ a range of special strategies to develop confidence in calculating mentally. E.g. **2364 + 1999 =** 2364 + 2000 = 4364 4364—1 = 4363 **13484 + 2400 =** 13000 + 2000 = 15000 484 + 400 = 884 15000 + 884 = 15884 4 = 2001—1997  1997 2000 2001 13486—5000 13486—3000 = 10486 10486—2000 = 8486	**Estimate:** 800 + 640 = 1440 900 – 500 = 400 900 – 500 = 400  **Check:** **Is your estimate close to the answer you have calculated?** 25.356 + 346.28 becomes: Estimate: 25 + 350 = 375 25.356 +346.28 371.636 1 1 9.076 – 3.142 becomes: Estimate: 9 – 3 = 6 8 1 9. 076 3. 142 5. 934

Year 6

Objectives:	**Mental Recall/Jottings:**	**Written Methods:**
Perform mental calculations, including with mixed operations and large numbers Use their knowledge of the order of operations to carry out calculations involving the four operations Solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why	**Ensure children use a wide range of mental strategies when calculating including decimals and increasingly larger numbers.** **What is 2 minus 0.005?** **What is 5.7 added to 8.3?**  **57 +** ☐ **= 125** **911 – 47 =** ☐ **149 + 137 + 158 =** ☐ **(** ☐ **+** ☐ **) x** ☐ **= 10**	12 462 + 8456 Estimate: 21 000 = 12 500 + 8 500 12 462 + 8 456 20 918 1 1 3906 = 12 462 – 8556 Estimate: 4000 = 12 500 – 8 500 $^{11}\not{1}\not{2}\ ^{1}4^{5}\not{6}^{1}2$ - 8 5 5 6 3 9 0 6 Add and subtract numbers with a different number of decimal places. 12.4 – 3.56 = Estimate: 12 – 4 = 8 (my answer should be between 8 and 9) $1^{1}\not{2}.^{13}\not{4}0$ - 3. 5 6 8. 8 4

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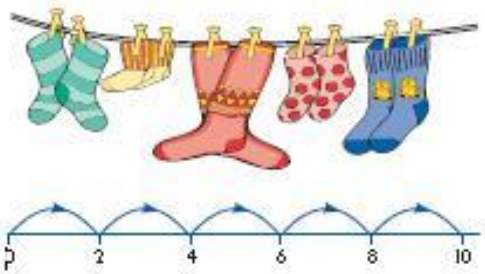
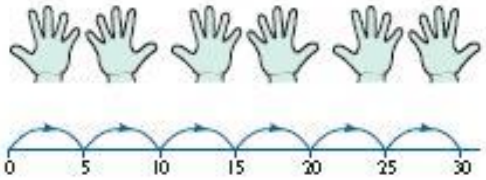
Multiplication and Division

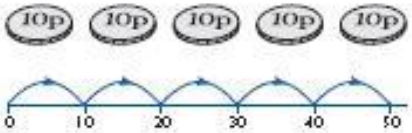
Key representations to support conceptual understanding of multiplication and division



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



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



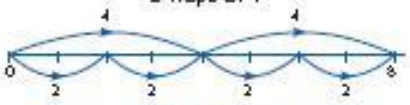
$10p + 10p + 10p + 10p + 10p = 50p$
$10p \times 5 = 50p$
5 hops of 10

$4 \times 2 = 8$
$2 \times 4 = 8$

$5 \times 2 = 10$
$2 \times 5 = 10$

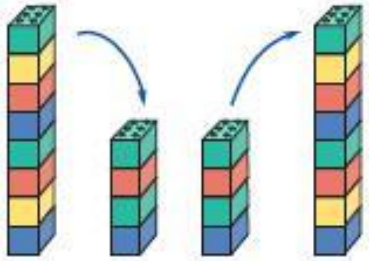
$2 \times 4 = 8$
$4 \times 2 = 8$

$2 \times 5 = 10$
$5 \times 2 = 10$

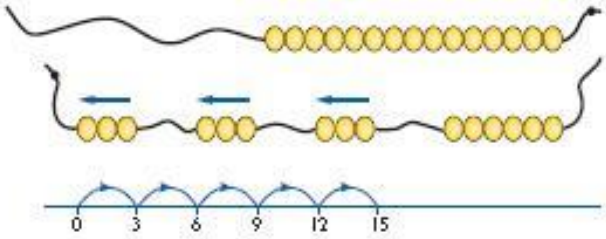


2 hops of 4
4 hops of 2

2 hops of 5
5 hops of 2



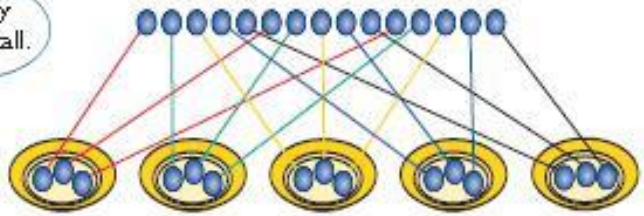
half of 8 is 4
$8 \div 2 = 4$
double 4 is 8
$4 \times 2 = 8$

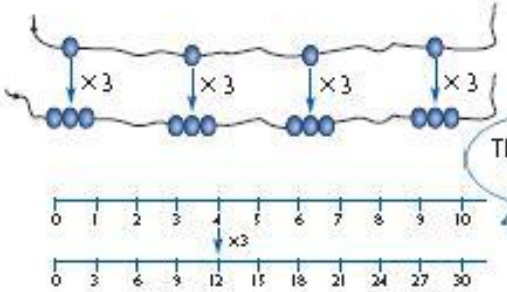


How many 3s in 15?

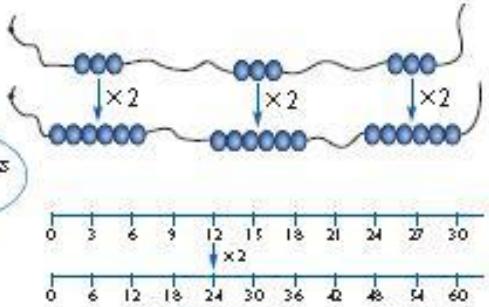
$15 \div 3 = 5$

5 hops in 15. How big is each hop?
$15 \div 5 = 3$
15 shared between 5

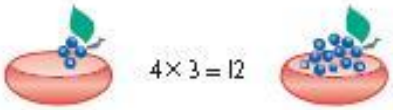




Three times as many



$12 \times 2 = 24$
Twice as many

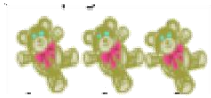
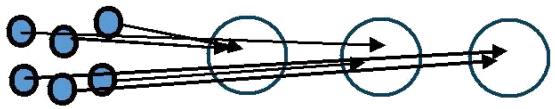
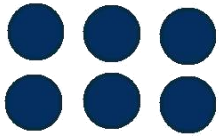
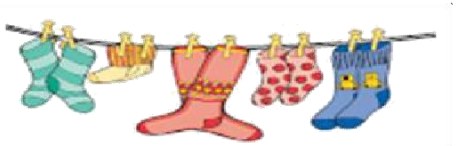
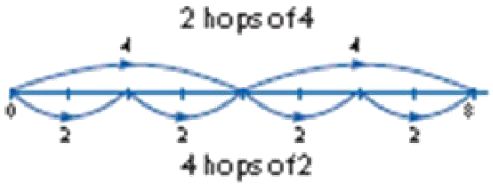
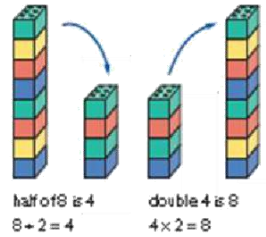


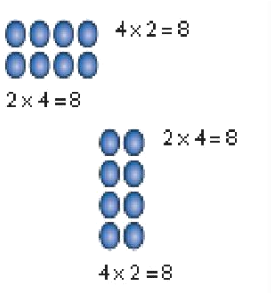
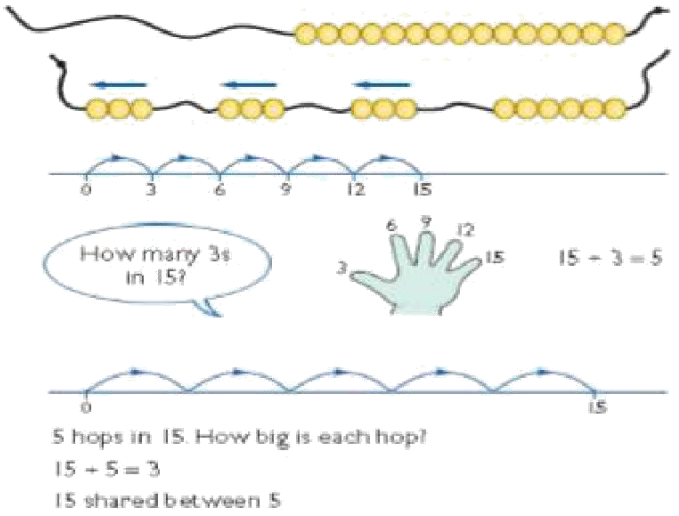
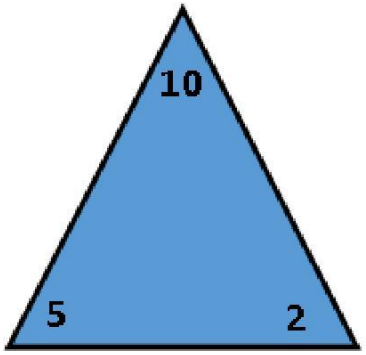
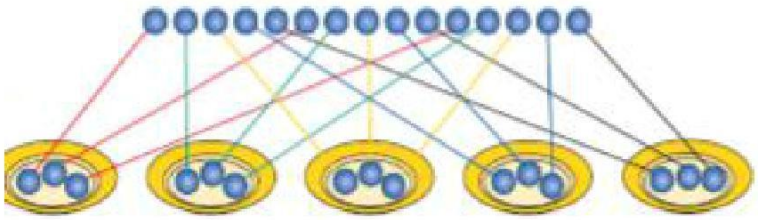
$4 \times 3 = 12$

DEVELOPING UNDERSTANDING OF MULTIPLICATION AND DIVISION

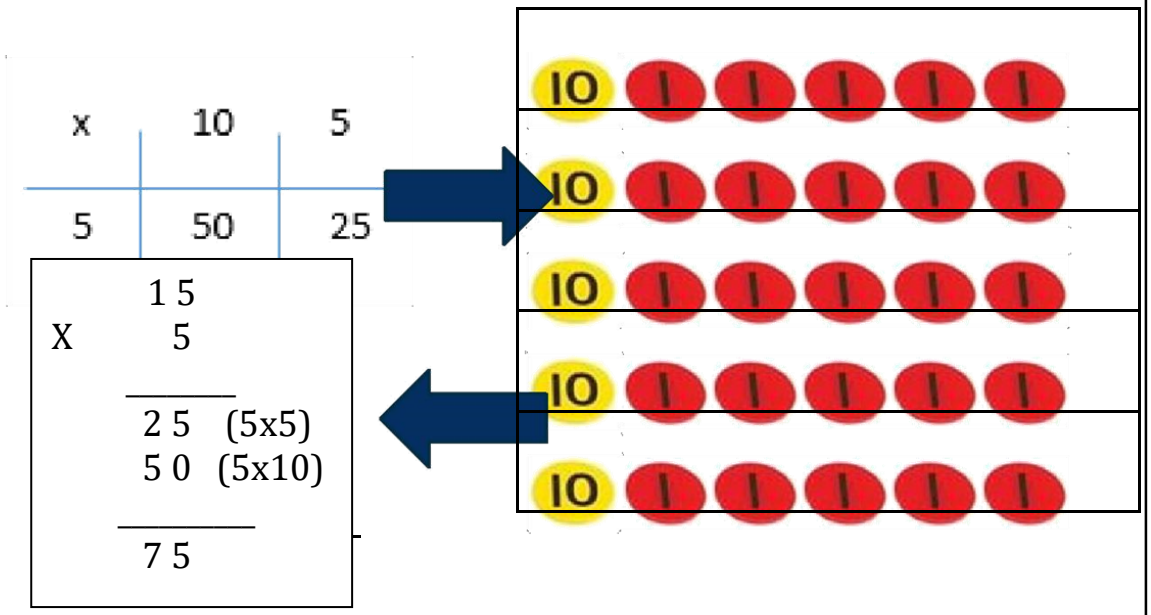
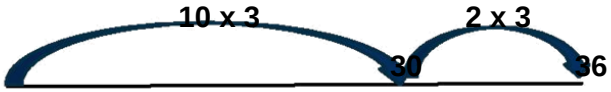
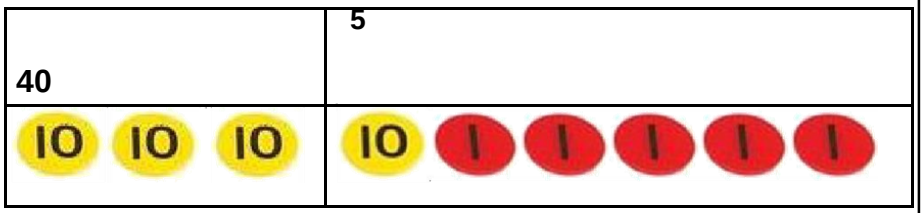
Pre School	Reception
Objectives **2 year old provision** • I am beginning to organise and categorise objects (eg. putting all the teddy bears together or teddies and cars in separate piles) **2 year + provision** • I can sort objects using simple criteria • I can say when two small groups have the same number of objects	**Objectives** **Children:** • Compare two groups of objects, saying when they have the same number • They show an interest in number problems and separate a group of three or four objects in different ways, beginning to recognise that the total is still the same

Year 1

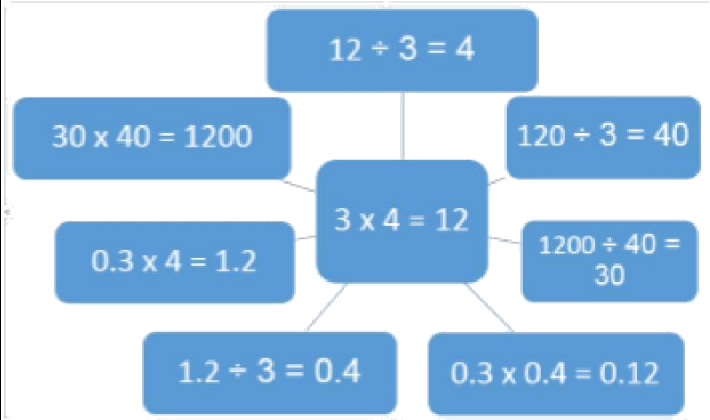
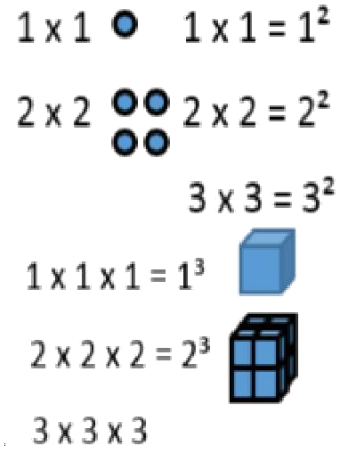
Objective	Examples	Representations
count, read and write numbers to 100 in numerals; count in multiples of twos, fives and tens Double numbers to 20	Use of visual models to support counting in 2, 5, 10 Ensure children begin to see the patterns of counting in 2, 5, 10. Double/halve numbers up to: 10 + 10 = 10 x 2 20 – 10 = 20 ÷ 2 Children do not need to record number sentences using the symbols. Develop the vocabulary by encouraging children to explain what they are doing.	Grouping and sharing   How many legs will 3 teddies have?  **Arrays**      Using coins to count in 2s, 5s and 10s 

Year 2		
Objective	**Examples**	**Models and Images**
count in steps of 2, 3, and 5 from 0, and in tens from any number, forward or backward (copied from Number and Place Value) recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot Written calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs	2 x 5 = 10 5 x 2 = 10 10 ÷ 2 = 5 10 ÷ 5 = 2 Use knowledge of doubling: 2 x 10 = 20 10 x 2 = 20 20 ÷ 2 = 10 20 ÷ 10 = 2	    3 x 5 = 15 15 ÷ 5 = 3

Year 3

Objective	Mental Recall Examples	Progressing from Mental to Written Methods with representations
count from 0 in multiples of 4, 8, 50 and 100 (copied from Number and Place Value) recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods (appears also in Written Methods)	If the children know 2/5/10 facts they now need to learn: 3 x 3 4 x 4 6 x 8 4 x 3 6 x 4 7 x 8 6 x 3 7 x 4 8 x 8 7 x 3 8 x 4 9 x 8 8 x 3 9 x 4 11 x 8 9 x 3 11 x 4 12 x 8 11 x 3 12 x 4 12 x 3 With corresponding division facts. Recall facts along with counting in steps sizes.  **4 x 3 = 3 x 4** **12 ÷ 3 = 4** **12 ÷ 4 = 3** To make 6 fairy cakes you need... How much will you need for 12?	 **36 ÷ 3 =**  **36 ÷ 3 = 1 2** 12 3)36  **Short multiplication and division rely on mental methods – children should be given short multiplication and division involving 2/3/4/5/6/10 times tables**

Year 4		
Objectives	**Mental methods**	**written methods with representations**
Count in multiples of 6,7, 9, 25 and 100		**Short multiplication** 24 × 6 becomes 2 4 × 6 1 4 4 2 Answer: 144 342 × 7 becomes 3 4 2 × 7 2 3 9 4 2 1 Answer: 2394
Recall multiplication and division facts for multiplication tables up to 12 x 12	If the children know multiplication and division facts for 2, 5, 10, 3, 4 and 8 they now need to learn: 6,7,9,11 and 12s.	
Use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; multiplying together three numbers.	Explore what happens when we divide by 1 and 0.	**Short division** 98 ÷ 7 becomes 1 4 7 | 9 (2) 8 Answer: 14 432 ÷ 5 becomes 8 6 r 2 5 | 4 3 (3) 2 Answer: 86 remainder 2
Recognise and use factor pairs and commutativity in mental calculations	Use known factor pairs; eg. 8 x 3 x 3 in measuring and scaling contexts, and correspondence problems in which m objects are connected to n objects (eg. 3 hats and 4 coats, how many different outfits; 12 sweets shared equally between 4 children)	(Above are taken from the Maths Appendix of the National Curriculum 2014)
Multiply two- digit and three digit-numbers by a one-digit number using formal written layout.		

Year 5	
Objective	**Mental Methods**
count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000 multiply and divide numbers mentally drawing upon known facts multiply and divide whole numbers and those involving decimals by 10, 100 and 1000 identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers. know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers establish whether a number up to 100 is prime and recall prime numbers up to 19 recognise and use square numbers and cube numbers, and the notation for squared (2) and cubed (3)	  **Multiplying and dividing whole numbers and decimals by 10, 100 and 1000.** **Thousands** | **Hundreds** | **Tens** | **Ones** | **/10 (tenths)** | **/100 (Hundredths)** | | | | | |

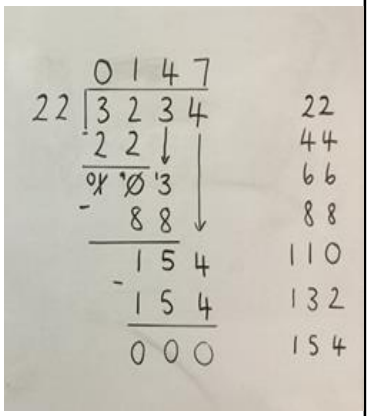
Year 5 Continued.

Objective	**Written Methods**	
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 divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context	2307 x 8 = Estimate: 2000 x 8 = 16000 Calculate: (Short multiplication) 2 3 0 7 X 8 18 4 5 6 2 5 1431 x 23 = Estimate: 1431 x 20 = 28620 1 Calculate: (Long multiplication) 1 4 3 1 X 2 3 4 2 9 3 (1431 x 3) 2 8 6 2 0 (1431 x 20) 3 2 9 1 3 1 1 Examples with decimals: 4.65 x 9 =	432 ÷ 5 = Estimate: 400 ÷ 5 = 80 Calculate (short division) 432 ÷ 5 becomes 8 6 r 2 5 | 4 3 2 3 Answer: 86 remainder 2 432 ÷ 15 becomes 2 8 r 12 15 | 4 3 2 3 0 0 1 3 2 1 2 0 1 2 Examples with decimals: 37.2 ÷ 8 =

Challenge children to express remainders either as remainder, fraction or decimal, in preparation for year 6.
For example remainder 12 or 12/15 (4/5) or 0.8)

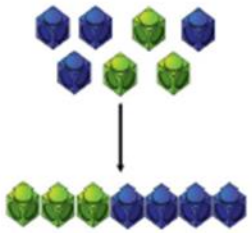
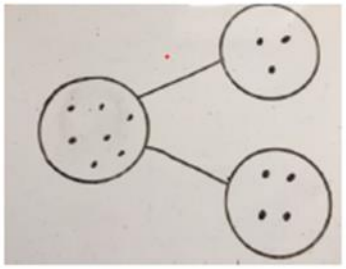
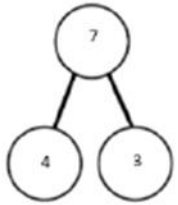
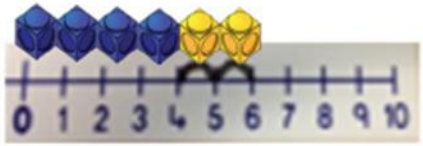
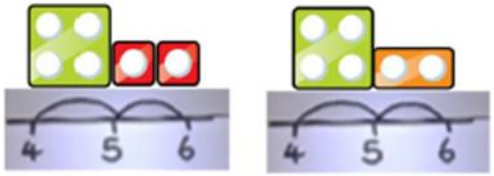
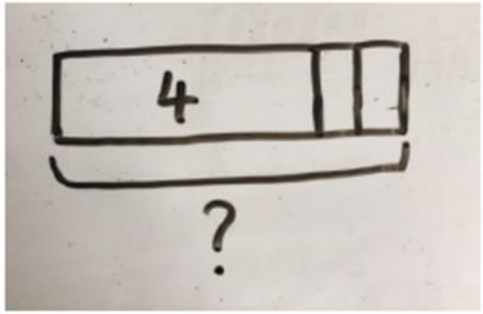
Year 6	
Objective	**Mental Methods**
perform mental calculations, including with mixed operations and large numbers	They undertake mental calculations with increasingly large numbers and more complex calculations. Pupils continue to use all the multiplication tables to calculate mathematical statements in order to maintain their fluency. Pupils round answers to a specified degree of accuracy, for example, to the nearest 10, 20, 50 etc., but not to a specified number of significant figures.
identify common factors, common multiples and prime numbers	Pupils explore the order of operations using brackets; for example, 2 + 1 x 3 = 5 and (2 + 1) x 3 = 9. Common factors can be related to finding equivalent fractions.
Use their knowledge of the order of operations to carry out calculations involving the four operations	Calculate 900 ÷ (45 × 4). A bag of four oranges costs thirty seven pence. How much do twelve oranges cost?

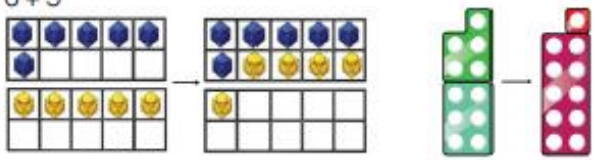
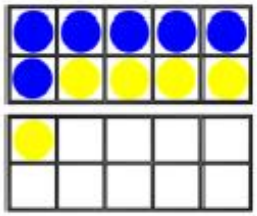
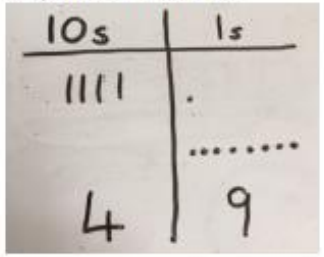
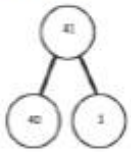
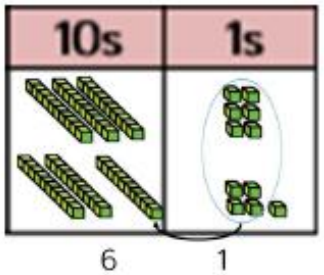
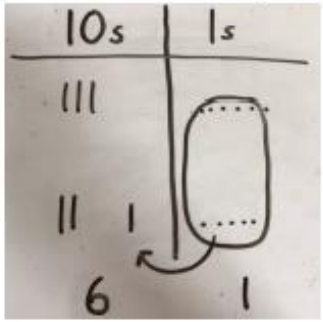
Year 6 Continued

Objective	Written Methods
multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication divide numbers up to 4-digits by a two-digit whole number using the formal written method of short division where appropriate for the context divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context	**Short division** 98 ÷ 7 becomes 1 4 7 | 9 8 (2) Answer: 14 432 ÷ 5 becomes 8 6 r 2 5 | 4 3 2 (3) Answer: 86 remainder 2 496 ÷ 11 becomes 4 5 r 1 1 1 | 4 9 6 (5) Answer: $45\frac{1}{11}$ **Long division** 432 ÷ 15 becomes 2 8 r 12 1 5 | 4 3 2 3 0 0 1 3 2 1 2 0 1 2 432 ÷ 15 becomes 2 8 1 5 | 4 3 2 3 0 0 15×20 1 3 2 1 2 0 15×8 1 2 $\frac{12}{15} = \frac{4}{5}$ 432 ÷ 15 becomes 2 8 · 8 1 5 | 4 3 2 · 0 3 0 1 3 2 1 2 0 1 2 0 1 2 0 0 

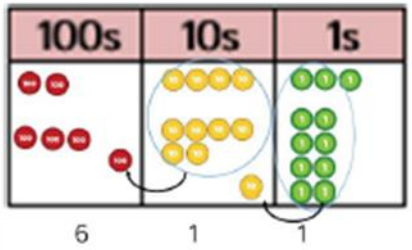
Calculation policy: Addition

Key language: sum, total, parts and wholes, plus, add, altogether, more, 'is equal to' 'is the same as'.

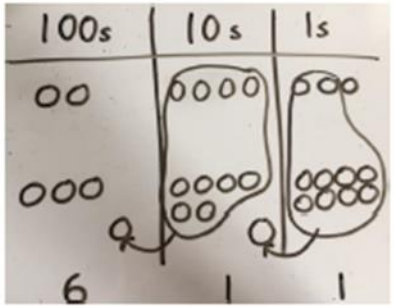
Concrete	Pictorial	Abstract
Combining two parts to make a whole (use other resources too e.g. eggs, shells, teddy bears, cars). 	Children to represent the cubes using dots or crosses. They could put each part on a part whole model too. 	4 + 3 = 7 Four is a part, 3 is a part and the whole is seven. 
Counting on using number lines using cubes or Numicon.  	A bar model which encourages the children to count on, rather than count all. 	The abstract number line: What is 2 more than 4? What is the sum of 2 and 4? What is the total of 4 and 2? 4 + 2 

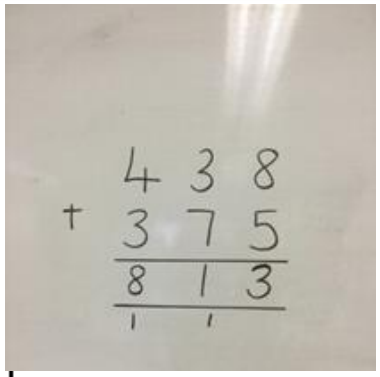
Regrouping to make 10; using ten frames and counters/cubes or using Numicon. 6 + 5 	Children to draw the ten frame and counters/cubes. 	Children to develop an understanding of equality e.g. $6 + \square = 11$ $6 + 5 = 5 + \square$ $6 + 5 = \square + 4$
TO + O using base 10. Continue to develop understanding of partitioning and place value. 41 + 8 	Children to represent the base 10 e.g. lines for tens and dot/crosses for ones. 	41 + 8  1 + 8 = 9 40 + 9 = 49 4 1 + 8 4 9
TO + TO using base 10. Continue to develop understanding of partitioning and place value. 36 + 25 	Chidlren to represent the base 10 in a place value chart. 	Looking for ways to make 10. 36 + 25 = 1 5 30 + 20 = 50 5 + 5 = 10 50 + 10 + 1 = 61 36 Formal method: +25 61 1

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.



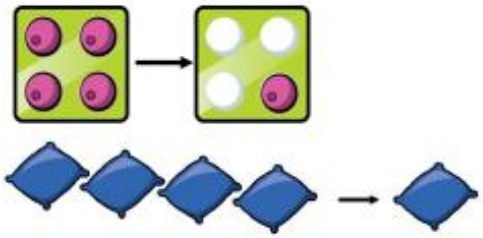
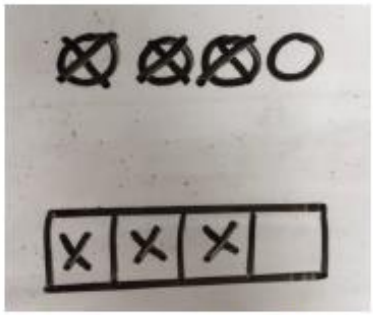
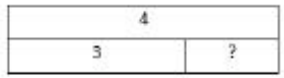
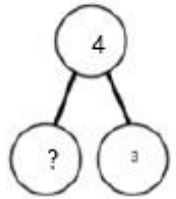
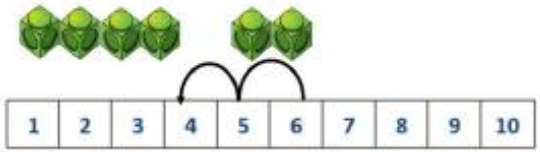
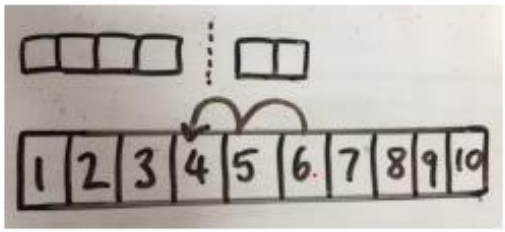
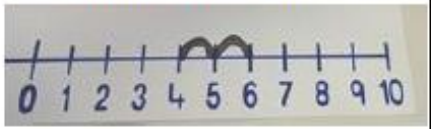
Chidren to represent the counters in a place value chart, circling when they make an exchange.

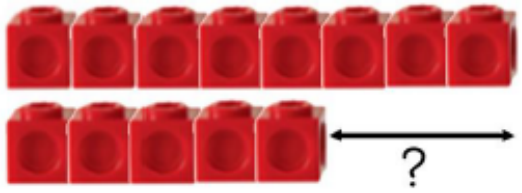
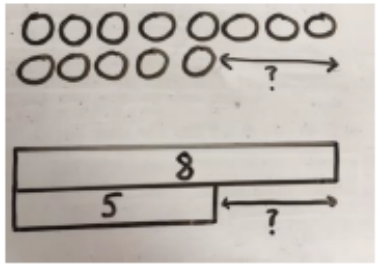
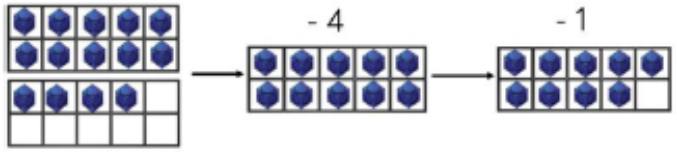
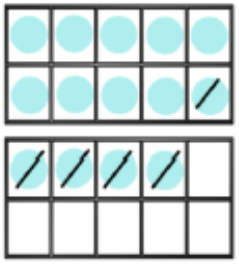
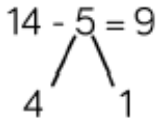
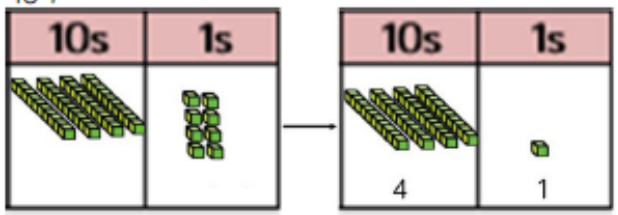
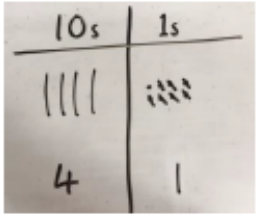
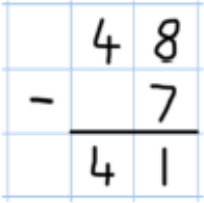


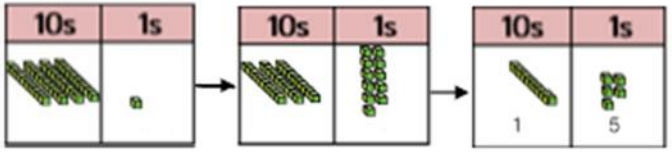
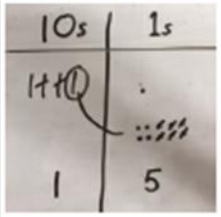
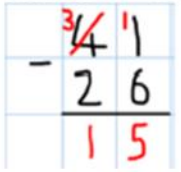
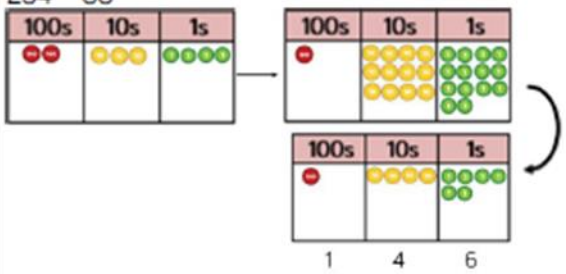
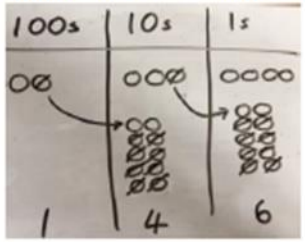
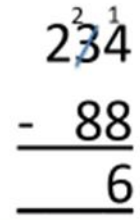


Calculation policy: Subtraction

Key language: take away, less than, the difference, subtract, minus, fewer, decrease.

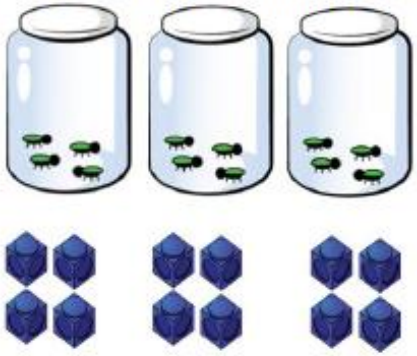
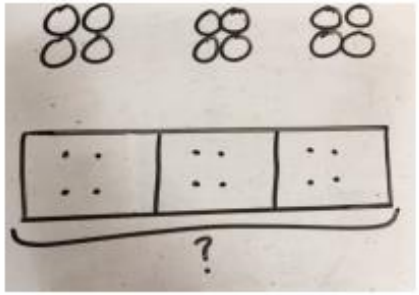
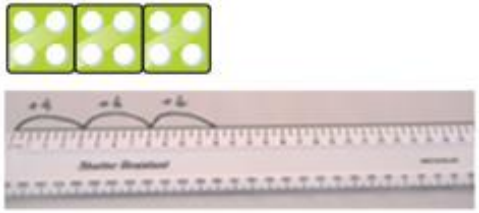
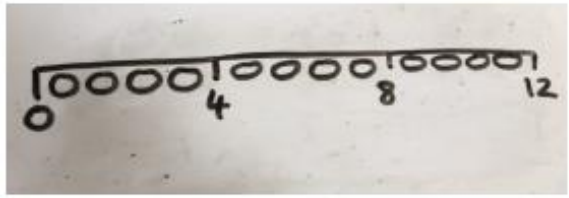
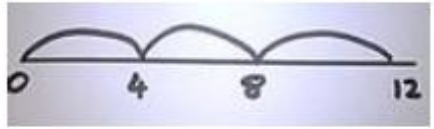
Concrete	Pictorial	Abstract
Physically taking away and removing objects from a whole (ten frames, Numicon, cubes and other items such as beanbags could be used). 4 - 3 = 1 	Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used. 	4- 3 = □ = 4 - 3  
Counting back (using number lines or number tracks) children start with 6 and count back 2. 6 - 2 = 4  	Children to represent what they see pictorially e.g.  	Children to represent the calculation on a number line or number track and show their jumps. Encourage children to use an empty number line  

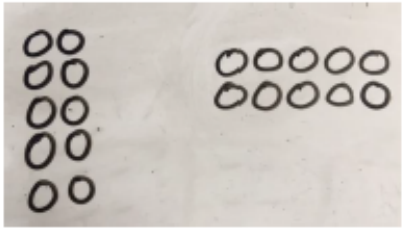
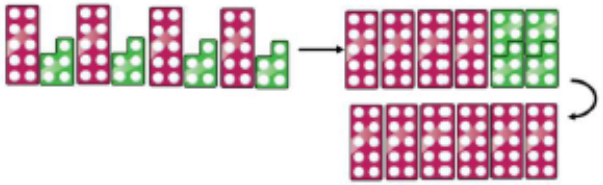
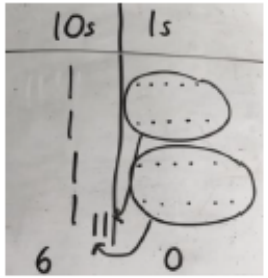
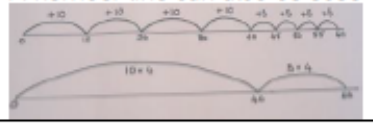
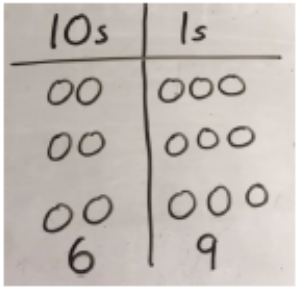
Finding the difference (using cubes, Numicon or Cuisenaire rods, other objects can also be used). Calculate the difference between 8 and 5. 	Children to draw the cubes/other concrete objects which they have used or use the bar model to illustrate what they need to calculate. 	Find the difference between 8 and 5. 8 – 5, the difference is ☐ Children to explore why 9 - 6 = 8 – 5 = 7 – 4 have the same difference.
Making 10 using ten frames. 14 – 5 	Children to present the ten frame pictorially and discuss what they did to make 10. 	Children to show how they can make 10 by partitioning the subtrahend.  14 – 4 = 10 10 – 1 = 9
Column method using base 10. 48-7 	Children to represent the base 10 pictorially. 	Column method or children could count back 7. 

Column method using base 10 and having to exchange. 41 – 26 	Represent the base 10 pictorially, remembering to show the exchange. 	Formal column method. Children must understand that when they have exchanged the 10 they still have 41 because 41 = 30 + 11. 
Column method using place value counters. 234 – 88 	Represent the place value counters pictorially; remembering to show what has been exchanged. 	Formal colum method. Children must understand what has happened when they have crossed out digits. 

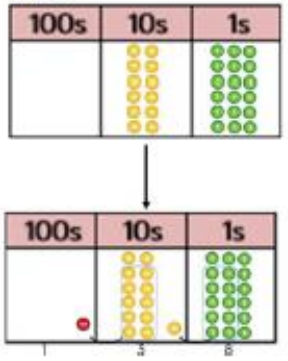
Calculation policy: Multiplication

Key language: double, times, multiplied by, the product of, groups of, lots of, equal groups.

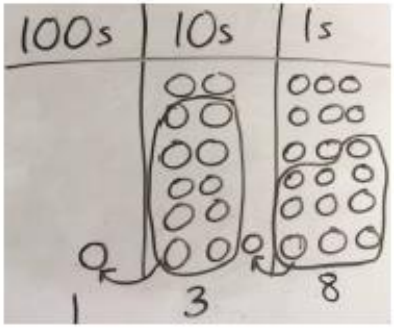
Concrete	Pictorial	Abstract
Repeated grouping/repeated addition 3 × 4 4 + 4 + 4 There are 3 equal groups, with 4 in each group. 	Children to represent the practical resources in a picture and use a bar model. 	3 × 4 = 12 4 + 4 + 4 = 12
Number lines to show repeated groups- 3 × 4  Cuisenaire rods can be used too.	Represent this pictorially alongside a number line e.g.: 	Abstract number line showing three jumps of four. 3 × 4 = 12 

Use arrays to illustrate commutativity counters and other objects can also be used. $2 \times 5 = 5 \times 2$  2 lots of 5 5 lots of 2	Children to represent the arrays pictorially. 	Children to be able to use an array to write a range of calculations e.g. $10 = 2 \times 5$ $5 \times 2 = 10$ $2 + 2 + 2 + 2 + 2 = 10$ $10 = 5 + 5$
Partition to multiply using Numicon, base 10 or Cuisenaire rods. 4×15 	Children to represent the concrete manipulatives pictorially. 	Children to be encouraged to show the steps they have taken. 4 x 15 10 5 10 x 4 = 40 5 x 4 = 20 40 + 20 = 60 A number line can also be used 
Formal column method with place value counters (base 10 can also be used.) 3×23 	Children to represent the counters pictorially. 	Children to record what it is they are doing to show understanding. 3×23 20 3 $3 \times 20 = 60$ $3 \times 3 = 9$ $60 + 9 = 69$ 23 × 3 69

Formal column method with place value counters.
6 x 23



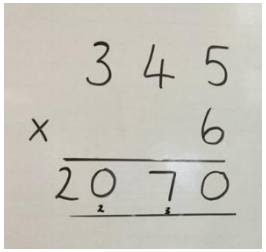
Children to represent the counters/base 10, pictorially e.g. the image below.



Formal written method

$$6 \times 23 =$$

$$\begin{array}{r} 23 \\ \times\ 6 \\ \hline 138 \\ \hline 1\ 1 \end{array}$$

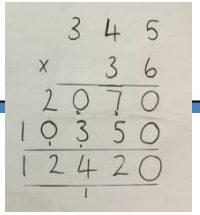


When children start to multiply 3d × 3d and 4d × 2d etc., they should be confident with the abstract:

To get 744 children have solved 6 × 124.
To get 2480 they have solved 20 × 124.

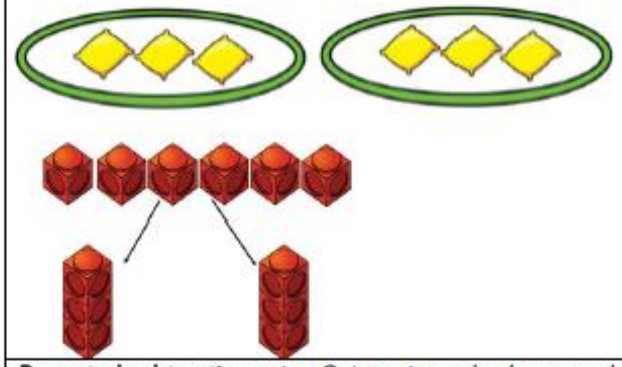
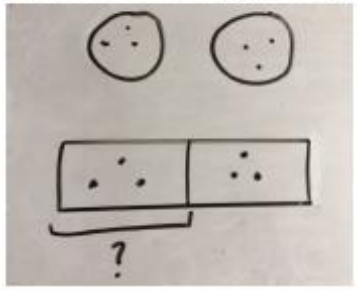
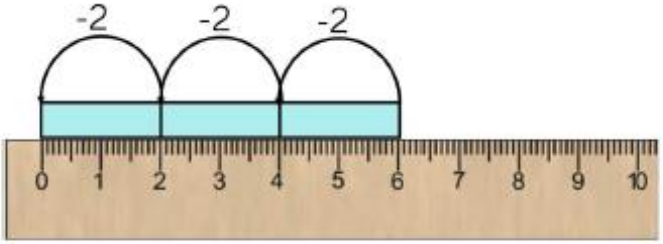
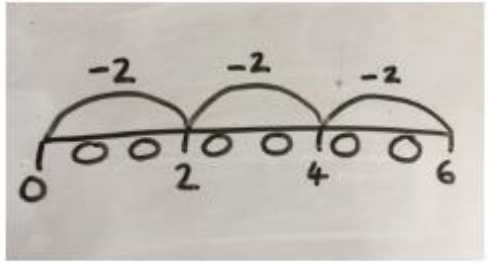
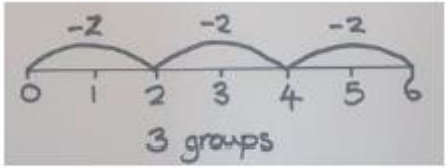
$$\begin{array}{r} 1\ 2\ 4 \\ \times\ \ 2\ 6 \\ \hline 7\ 4\ 4 \\ 2\ 4\ 8\ 0 \\ \hline 3\ 2\ 2\ 4 \\ \hline 1\ 1 \end{array}$$

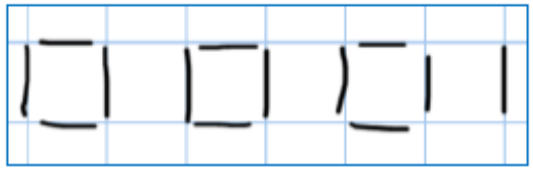
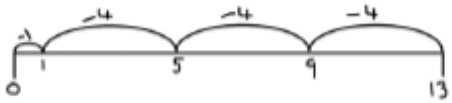
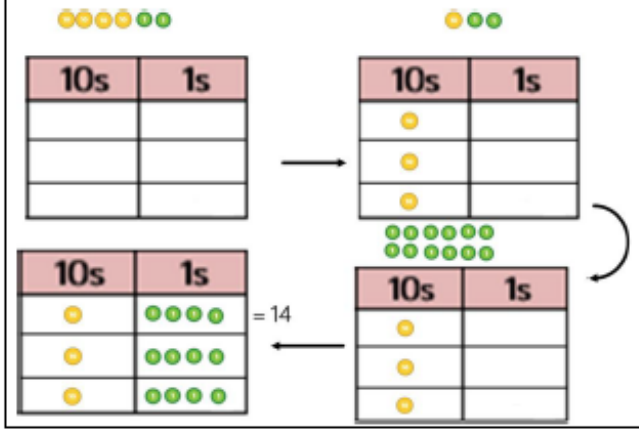
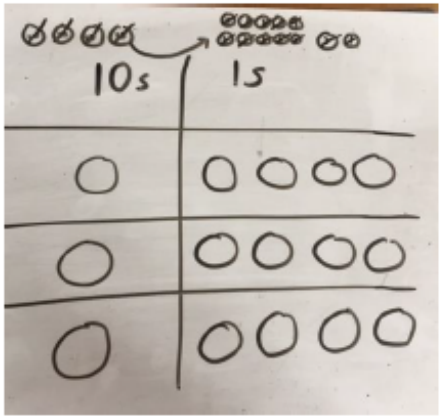
Answer: 3224

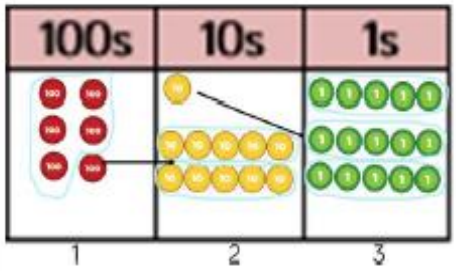
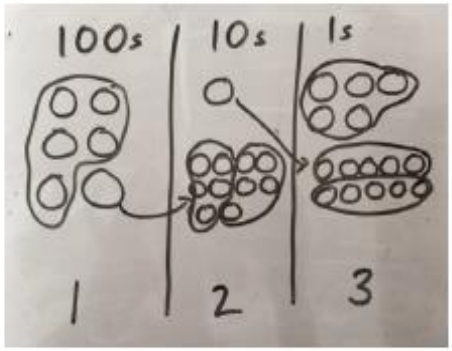
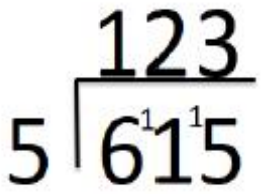


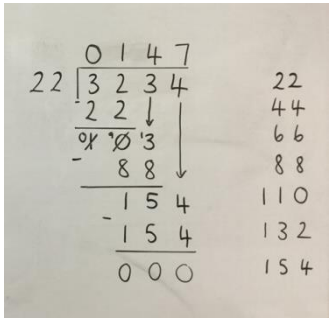
Calculation policy: Division

Key language: share, group, divide, divided by, half.

Concrete	Pictorial	Abstract
Sharing using a range of objects. 6 ÷ 2 	Represent the sharing pictorially. 	6 ÷ 2 = 3  Children should also be encouraged to use their 2 times tables facts.
Repeated subtraction using Cuisenaire rods above a ruler. 6 ÷ 2  3 groups of 2	Children to represent repeated subtraction pictorially. 	Abstract number line to represent the equal groups that have been subtracted. 

2d ÷ 1d with remainders using lollipop sticks. Cuisenaire rods, above a ruler can also be used. 13 ÷ 4 Use of lollipop sticks to form wholes- squares are made because we are dividing by 4.  There are 3 whole squares, with 1 left over.	Children to represent the lollipop sticks pictorially.  There are 3 whole squares, with 1 left over.	13 ÷ 4 = 3 remainder 1 Children should be encouraged to use their times table facts; they could also represent repeated addition on a number line. '3 groups of 4, with 1 left over' 
Sharing using place value counters. 42 ÷ 3 = 14 	Children to represent the place value counters pictorially. 	Children to be able to make sense of the place value counters and write calculations to show the process. 42 ÷ 3 42 = 30 + 12 30 ÷ 3 = 10 12 ÷ 3 = 4 10 + 4 = 14

Short division using place value counters to group. 615 ÷ 5  1. Make 615 with place value counters. 2. How many groups of 5 hundreds can you make with 6 hundred counters? 3. Exchange 1 hundred for 10 tens. 4. How many groups of 5 tens can you make with 11 ten counters? 5. Exchange 1 ten for 10 ones. 6. How many groups of 5 ones can you make with 15 ones?	Represent the place value counters pictorially.  	Children to the calculation using the short division scaffold. 

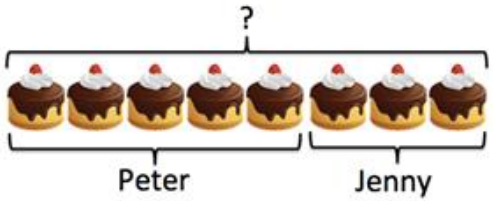

0 1 4 7
22 | 3 2 3 4
- 2 2
1 0 3
- 8 8
1 5 4
- 1 5 4
0 0 0
22
44
66
88
110
132
154

Appendix
Bar Models

Addition: One Bar

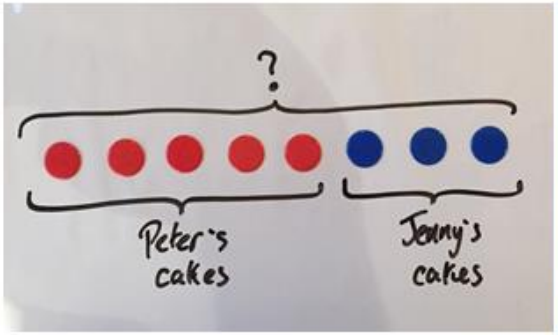
MathsHUBS White Rose

Model



Calculations

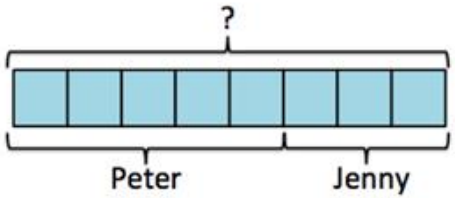
5 + 3 = ?



Calculations

5 + 3 = ?

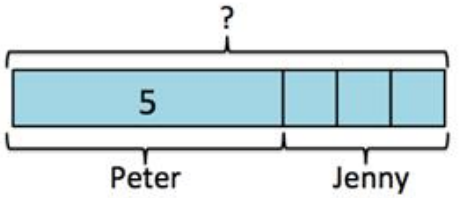
Model



Calculations

5 + 3 = ?

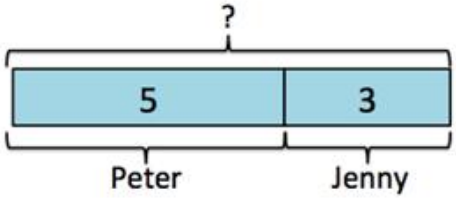
Model



Calculations

5 + 3 = ?

Model



Calculations

5 + 3 = ?

5 + 3 = ?

@wrmathshub

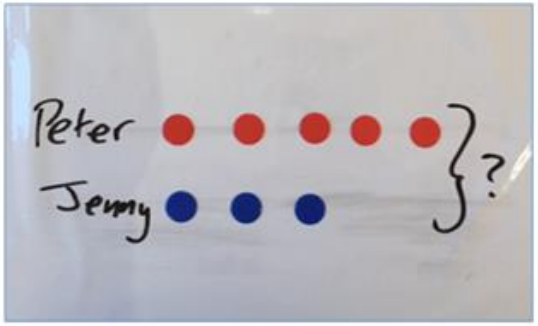
Addition: Two Bars

MathsHUBS White Rose

Model

Calculations

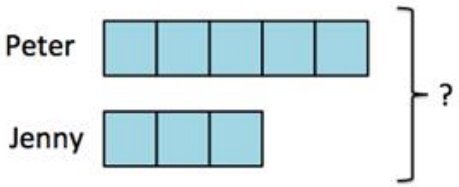
5 + 3 = ?



Calculations

5 + 3 = ?

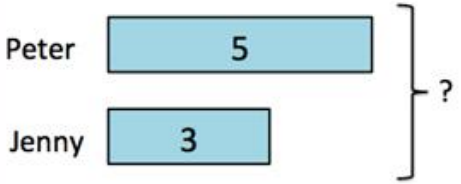
Model



Calculations

5 + 3 = ?

Model



Calculations

5 + 3 = ?

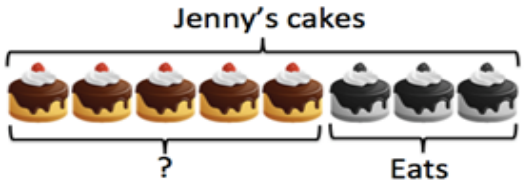
5 + 3 = ?

@wrmathshub

Subtraction: One Bar

MathsHUBS White Rose

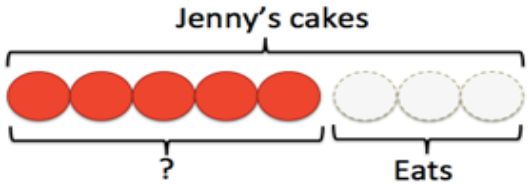
Model



Calculations

8 - 3 = ?

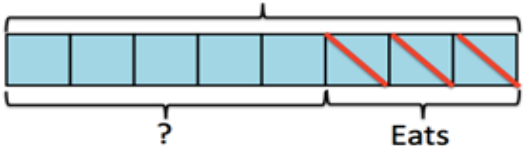
Model



Calculations

8 - 3 = ?

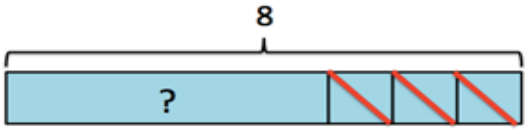
Model



Calculations

8 - 3 = ?

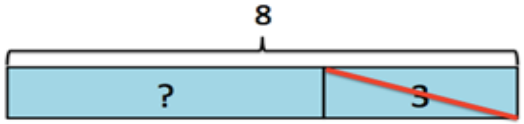
Model



Calculations

8 - 3 = ?

Model



Calculations

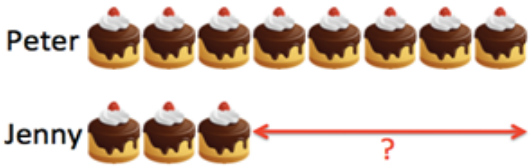
8 - 3 = ?

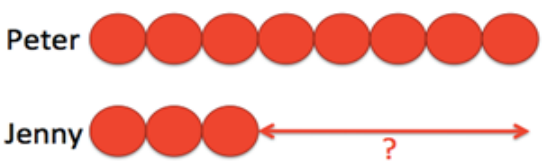
8 - 3 = ?

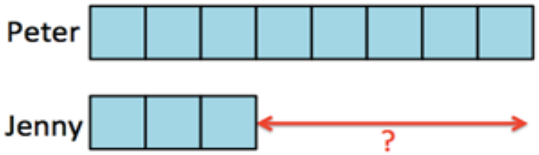
@wrmathshub

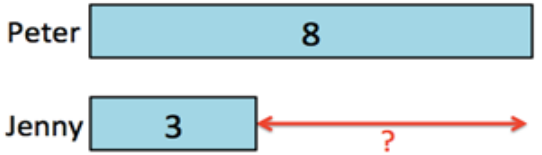
Subtraction: Two Bars

MathsHUBS White Rose

Model	Calculations
	8 - 3 = ?

Model	Calculations
	8 - 3 = ?

Model	Calculations
	8 - 3 = ?

Model	Calculations
	8 - 3 = ?

8 - 3 = ?

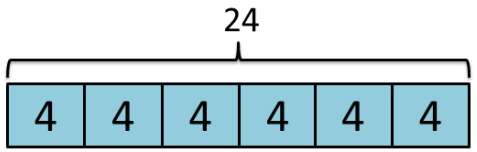
@wrmathshub

Multiplication: One Bar

MathsHUBS White Rose

Cakes come in boxes of 4. Peter buys 6 boxes of muffins.
How many muffins does Peter buy all altogether?

Model



Calculations

6 x 4 = 24

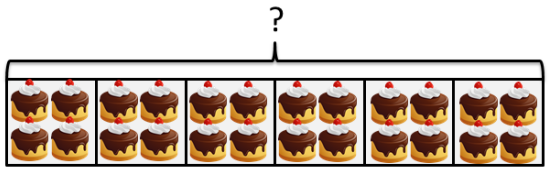
Represents multiplication as repeated addition @wrmathshub

Multiplication: One Bar

MathsHUBS White Rose

Cakes come in boxes of 4. Peter buys 6 boxes of muffins.
How many muffins does Peter buy all altogether?

Model



Calculations

6 x 4 = 24

Represents multiplication as repeated addition @wrmathshub

Multiplication: One Bar

MathsHUBS White Rose

Cakes come in boxes of 4. Peter buys 6 boxes of muffins.
How many muffins does Peter buy all altogether?

Model

Calculations

6 x 4 = 24

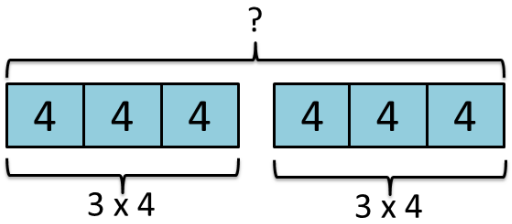
Represents multiplication as repeated addition @wrmathshub

Multiplication: One Bar

MathsHUBS White Rose

6 x 4 = ?

Model



Calculations

6 x 4

= 3 x 4 + 3 x 4

or

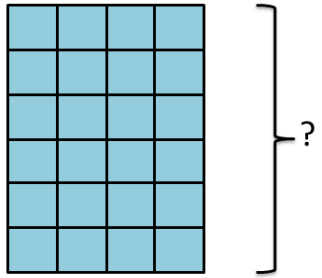
= 2 x 3 x 4

Promote reasoning with multiplication tables @wrmathshub

Multiplication: Array

Cakes come in boxes of 4. Peter buys 6 boxes of muffins.
How many muffins does Peter buy all altogether?

Model



Calculations

6 x 4

@wrmathshub

Using Arrays

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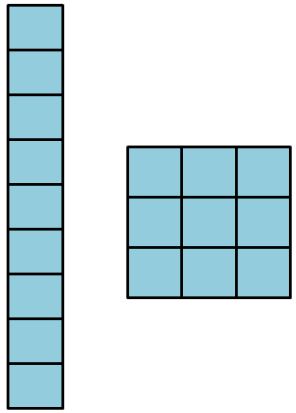

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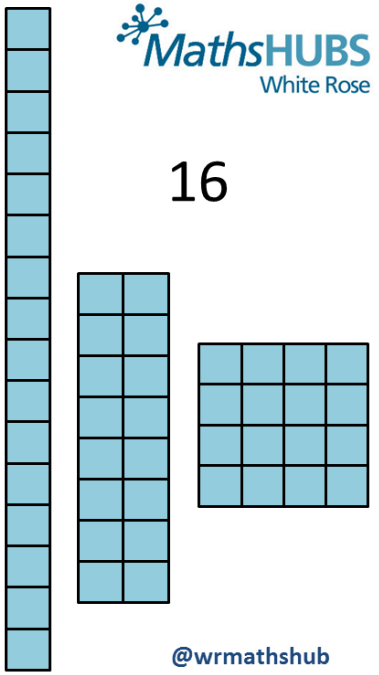
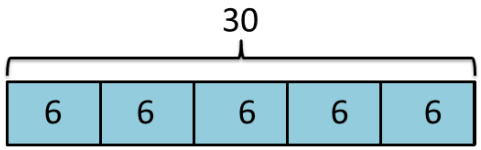


@wrmathshub

Division (Partitive)

Jane has 30 cakes. She wants to share them equally between five boxes. How many should go in each box?

Model



Number of cakes in each box = 6

Calculations

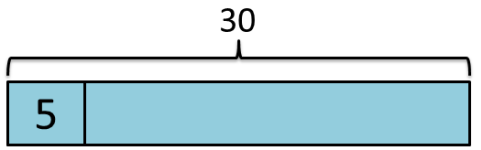
30 ÷ 5 = 6

In this version, we are splitting 30 into 5 equal groups.

Division (Quotitive)

Jenny has 30 cakes. She wants to pack them into boxes, with 5 cakes in each box. How many boxes will she need to pack all the cakes?

Model

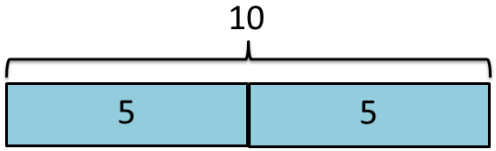


Number of boxes needed = ?

Calculations

30 ÷ 5

Linking Four Operations



5 + 5 = 10

10 - 5 = 5

2 x 5 = 10

10 ÷ 2 = 5 (sharing)

10 ÷ 5 = 2 (grouping)