All Faiths Children's Academy Calculation Policy

February 2021 (to be reviewed February 2024)

All Faiths Children's Academy Maths calculation policy

Rationale

We teach the mastery approach in Mathematics at All Faiths, with White Rose Maths at the heart of our teaching and learning. We embed Mathematical thinking and talk into our curriculum to ensure that the children can be their best selves and experience success and achievement in Maths. Our children deepen their conceptual understanding by tackling challenging and varied problems. The children are given opportunities to think interdependently when they are reasoning and problem solving. This encourages our pupils to challenge one another's methods and perspectives.

Our children work hard to master a variety of calculation strategies, which allow them to solve the four operations effectively and efficiently. Our pupils do not learn by wrote and are expected to demonstrate their understanding of the four operations with concrete materials and pictorial representations. Our children complete a daily arithmetic starter to build their fluency and recall of operations and number facts. By the end of Year 6, our children are equipped with mental and written methods that they understand and can use correctly.

The Concrete Pictorial Abstract (CPA) Approach

The concrete pictorial abstract (CPA) approach is an inclusive, effective way of teaching maths, by building on the children's pre-existing knowledge and skills in a concrete and tangible way. The children have access to concrete manipulatives to help them to understand what they are doing. Pictorial representations often link the concrete element to the abstract element, which supports them in making connections. When children have a secure understanding of a topic, they are able to understand and use abstract calculations with greater fluency. However, concrete, pictorial and abstract elements do not have to be used sequentially and can be used to differentiate and enhance the learning experience of the children.

Why are All Faiths using the White Rose (CPA) approach?

The 2014 Mathematics programme of study places a greater emphasis on all children becoming fluent in the fundamentals of Mathematics, with opportunities to make rich connections across topics to build fluency. White Rose Maths provides pupils who grasp concepts rapidly with rich and sophisticated challenges and problems, rather than accelerating through new content. Those who are not sufficiently fluent with earlier material should consolidate their understanding, including through additional practice, before moving on. White Rose Maths ensures that children can explore, consolidate and master new concepts through the CPA approach, enabling all children to access and achieve. Moreover, White Rose's coherent approach builds in opportunities to recap and deepen prior learning, before introducing new learning, which aids the children's fluency and metacognition.

Mathematical Language:

The 2014 National Curriculum is explicit in articulating the importance of pupils using the correct mathematical language as a central part of their learning. It is essential that teaching strategies outlined in this policy are accompanied by the use of appropriate mathematical vocabulary which should be introduced and debugged in a suitable context (e.g. with relevant real objects, apparatus, pictures or diagrams) and explained carefully. The children should then use this vocabulary within their lessons and answer verbally in full sentences. High expectations of the mathematical language used is essential, with teachers only accepting what is correct.

Correct	Incorrect
Ones	Units
Is equal to	Equals

Purpose of the policy:

The purpose of this policy is to support teachers in identifying appropriate abstract, pictorial representations and concrete materials to help develop understanding. The policy only details the strategies; teachers must plan opportunities for pupils to apply these in accordance with White Rose Maths or Power Maths.

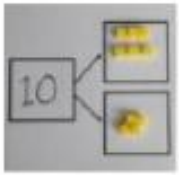
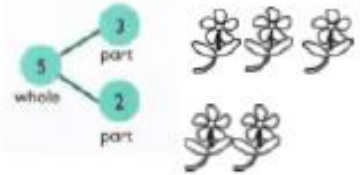
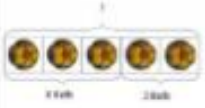
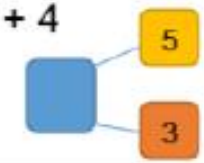
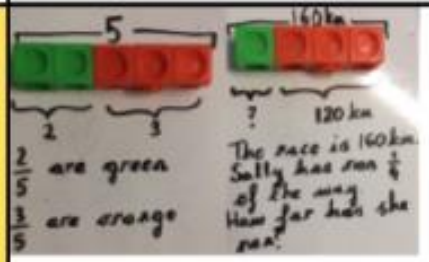
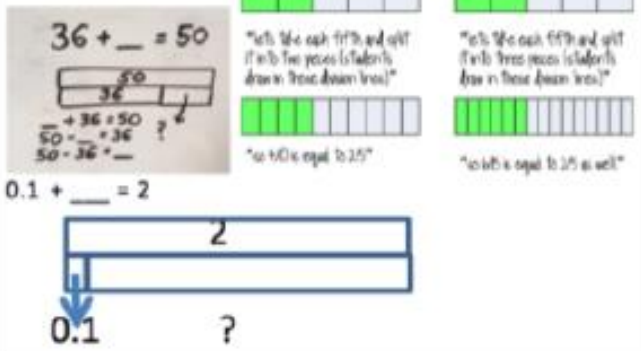
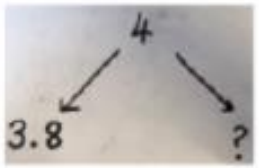
Key Maths Vocabulary

	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Addition	Number, numeral, add, plus, altogether, partition, biggest, more than, number bond, 'how many?'	Part – whole model, bar model, tens frame, number bonds, number line, count on, equal to, more than, fact family, tens, ones. Add, plus, number sentence, sum.	Part – whole model, tens frame, partition, related facts, base 10, inverse, add, plus, altogether, total, number sentence, column addition, regrouping, tens, ones.	Column addition, Carrying, addition, tens column, hundred, tens and ones, inverse, calculation, estimate.	Column addition, thousands, hundred, tens and ones. Rounding, estimation, inverse, negative integers	Decimal, tenth, hundredth, powers of 10, rounding. Column addition, thousands, hundred, tens and ones, inverse.	Estimation, Thousandth, order of operations, numbers to ten million, integers.
Subtraction	Less than, take away, subtract, smallest, 'how many?'	Least, subtract, minus, find the difference backwards, number line, fact family, smallest.	Commutative, fewer, difference, least, inverse, base ten, column subtraction, exchanging, bridging.	Column expanded, exchange, hundreds, tens and ones, bridging, calculation.	Column expanded, borrow, thousands, hundreds, tens and ones, bridging, partitioning	Decimal, tenth hundredth, inverse.	Hundreth, thousandth, integers.
Multiplication	Groups of, lots of, double.	Odd, even, count in steps of two, five and ten. Forwards, backwards, jumps of, lots of, groups of, array, times.	Multiply, commutative, inverse, jumps of, groups of, lots of, array, times table, multiple, ones column, pattern.	Arrays, multiples of three, four, eight, fifty and one hundred, scale up. Inverse, commutative, grid method, short written method	Place value, short method, expanded method, product, multiples of six, nine, seven, eleven, twelve, fifty and one hundred, scale up, remainders.	Arrays, short written method, long method, composite numbers, prime number, prime factors, square number, cubed numbers. remainders	Formal written method, order of operations, common factors, common multiples, remainders.
Division	Half, share equally.	Arrays, column, row, counters, share equally.	Grouping and sharing equally, arrays, column, rows, inverse, jumps of, scaling.	Place value counters, whole part model, short division.	Place value grid, written short division, Divisor (dividing number), dividend (number being divided), quotient (answer)	Place value grid, partitioning, short division, divisor, dividend and quotient	Written short division, written long division, divisor, dividend, quotient

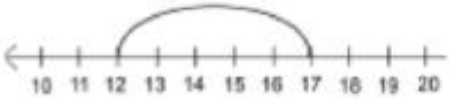
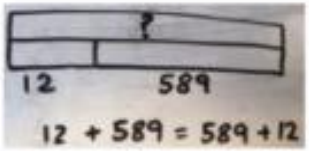
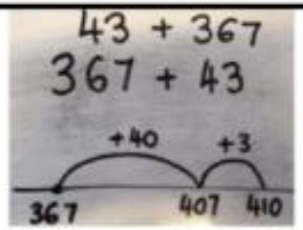
Year group calculation types

	Reception	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Addition	- Counting forwards in ones to 20 and beyond. - Finding the total in a group -Number bonds to 5 &10 -Subitising	-Combining two parts to make a whole: (part whole model) -Starting at the biggest number and counting on. -Number bonds to 10.	-Adding three single digits (using number bonds) -Number bonds 10,20 and 100. - Base 10 column method (no regrouping) -Column method with regrouping	-Column method with regrouping (up to 3 digits)	- Column method with regrouping (up to 4 digits)	-Column method with regrouping (with more than 4 digits) -Adding decimals with the same number of decimal places	-Column method with regrouping (with more than 4 digits) -Adding decimals with the same number of decimal places
Subtraction	- Counting backwards in ones. - Taking a way from a group of objects.	-Taking away ones -Counting back -Find the difference Part whole model (Make 10)	-Counting back -Find the difference - Base 10 column subtraction -Column method- with exchanging	-Column method with regrouping (up to 3 digits)	-Column method with regrouping (up to 4 digits)	-Column method regrouping (with more than 4 digits) -Subtracting decimals with the same number of decimal places.	-Column method with regrouping -Subtracting decimals with the same number of decimal places
Multiplication	- Odd and even numbers. - Doubling (concrete)	-Doubling - Repeated addition -Counting in multiples of 2, 5 and 10. -Arrays (with support)	-Doubling -Counting in Multiples of 2, 3, 5 and 10 (on fingers). -Repeated addition -Arrays showing commutivity.	-Counting in Multiples (3,4,8 times tables) -Repeated addition -Arrays -Grid method - Expanded column 2d x 1 d)	- Place value grids x 10, x 100 -Column multiplication (2 and 3-digit multiplied by 1 digit) - 6,9,7,11,12 times tables.	-Column multiplication (up to 4-digit numbers multiplied by 1 or 2 digits)	-Column multiplication (multi-digit up to 4 digits by a 2 digit number)
Division	- Halving - Sharing (concrete)	-Make equal groups (sharing) - Make equal groups (grouping)	-Division as grouping -Division as sharing -Division within arrays	-Division with place value counters -Short division (2-digits by 1-digit concrete and pictorial) -Division with a Remainder	-Place value grids dividing by 10 & 100. -Short division (3-digits by 1-digit concrete and pictorial) -Division with a remainder	-Grouping -Short division (up to 4 digits by a 1-digit number and interpret remainders appropriately)	-Short division (divide multi digits by 2 digits) -Long division (divide multi digits by 2 digits)

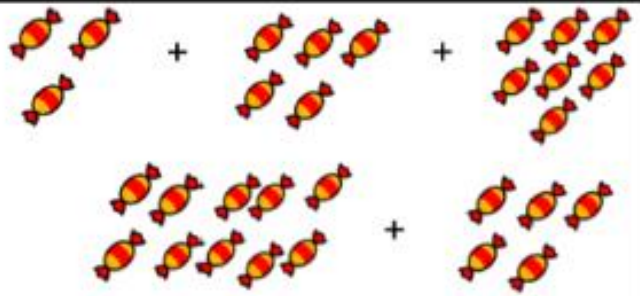
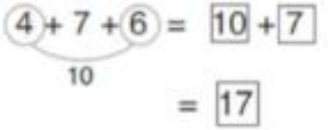
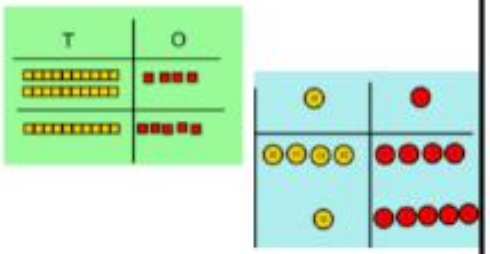
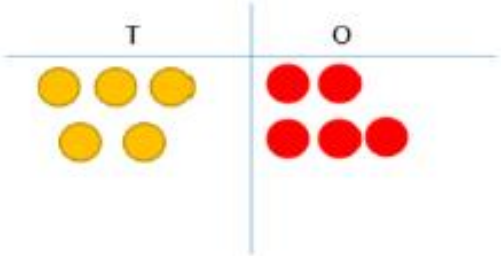
Addition

Objective & Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: **Part-whole model**	  Use cubes to add two numbers together as a group or in a bar. 	  Use pictures to add two numbers together as a group or in a bar. 	$4 + 3 = 7$ $10 = 6 + 4$  Use the part-part whole diagram as shown above to move into the abstract.
How to extend for other year groups for consolidation	 		$576 = \_\_\_ + 36$ I have 6 litres of water and I drink another ½ of a litre. How much water have I consumed? 

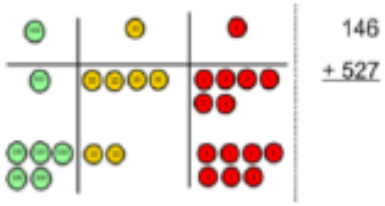
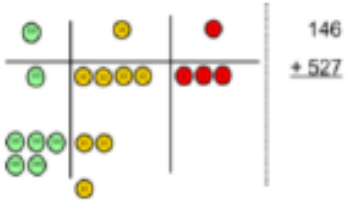
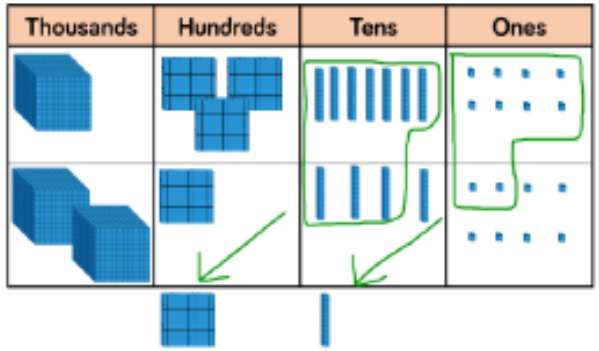
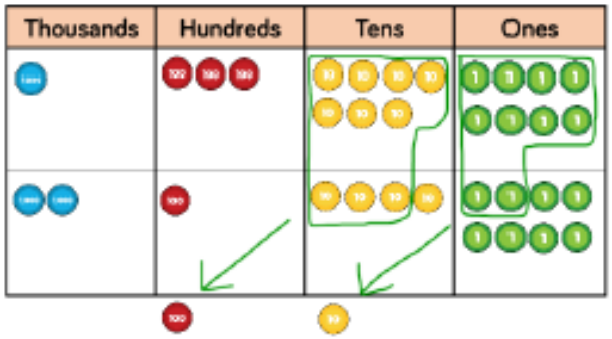
Addition

Objective & Strategies	Concrete	Pictorial	Abstract
Starting at the bigger number and counting on	 Start with the larger number on the bead string and then count on to the smaller number 1 by 1 to find the answer.	12 + 5 = 17  Start at the larger number on the number line and count on in ones or in one jump to find the answer.	5 + 12 = 17 17 = 12 + ☐ Place the larger number in your head and count on the smaller number to find your answer.
How to extend for other year groups for consolidation	Use number beads to represent 10s, 100s, 1000s etc. 	 	15 + 49 = ___ 49 + 15 = ___ 17 + 397 = ___ 397 + 17 = ___

Addition

Objective & Strategies	Concrete	Pictorial	Abstract
Adding three single digits	4 + 7 + 6= 17 Put 4 and 6 together to make 10. Add on 7.  Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.	 Add together three groups of objects. Draw a picture to recombine the groups to make 10.	 Combine the two numbers that make 10 and then add on the remainder.
Column method - no regrouping	24 + 15= Add together the ones first then add the tens. Use the Base 10 blocks first before moving onto place value counters. 	After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions. 	Calculations 21 + 42 = 21 + 42

Addition

Objective & Strategies	Concrete	Pictorial	Abstract
Column method - regrouping	Make both numbers on your place value grid using your place value counters.  Add up your ones column and exchange ten ones for one lot of ten, in your tens column.  Add up the rest of the columns until they have all been added. This can also be done with Base 10 to help children clearly see that 10 ones are equal to 1 ten and 10 tens are equal to 1 hundred. As children move onto decimals, money and decimal place value, place value counters can be used to support learning.	Children can draw a pictoral representation of the columns and place value counters to further support their learning and understanding.   	Start by partitioning the numbers before moving on to clearly show the exchange below the addition. 20 + 5 40 + 8 60 + 13 = 73 As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here. 536 + 85 621 1 1 72.8 + 54.6 127.4 1 1 £ 2 3 . 5 9 + £ 7 . 5 5 £ 3 1 . 1 4 1 1 1 2 3 . 3 6 1 9 . 0 8 0 5 9 . 7 7 0 + 1 . 3 0 0 9 3 . 5 1 1 2 1 2

Addition

Column method - regrouping (continued)

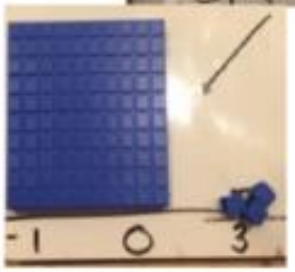
Gather resources to make both numbers being added.

Regroup and exchange 10 ones and 1 ten. Record ones in ones column.

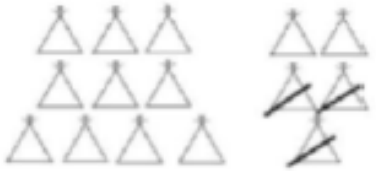
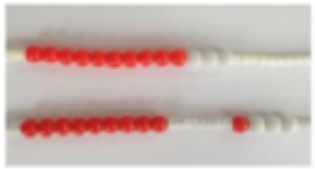
Move 1 ten to the tens column.

Regroup and exchange 10 tens as 1 hundred. Record tens in tens column.

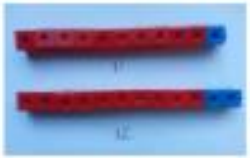
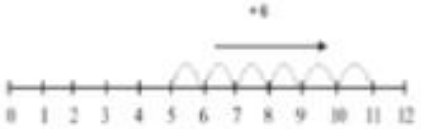
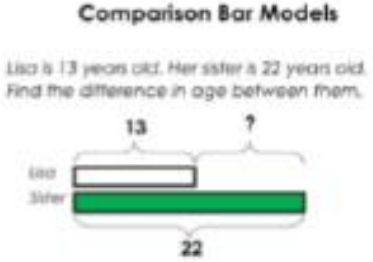
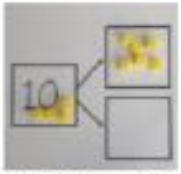
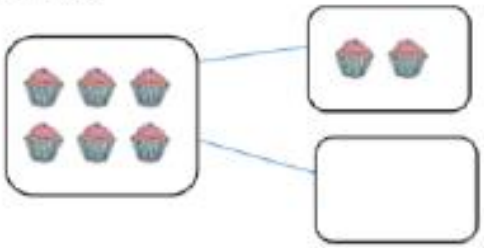
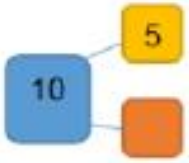
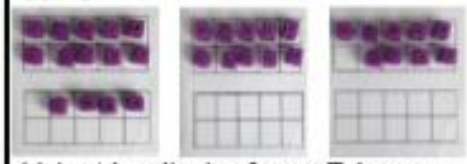
Collect all final resources to the bottom, reading off final answer as 103.



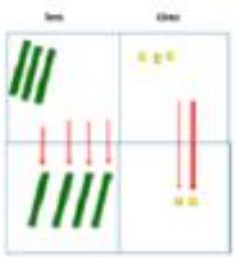
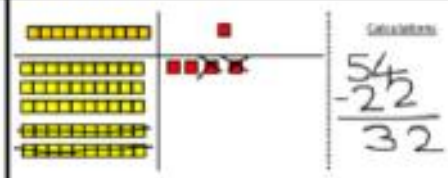
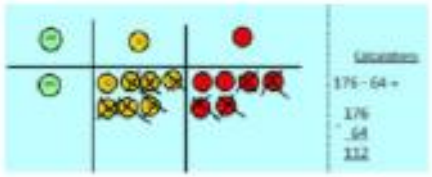
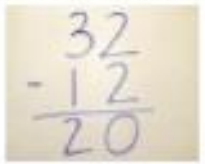
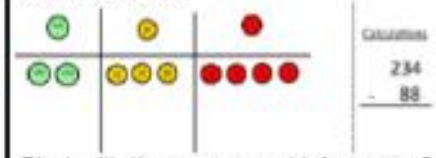
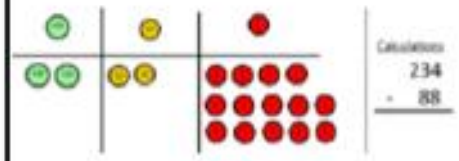
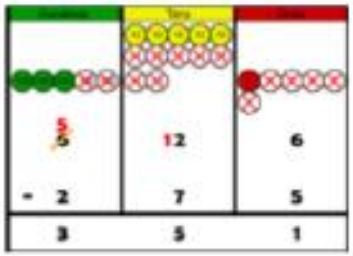
Subtraction

Objective & Strategies	Concrete	Pictorial	Abstract
Taking away ones	Use physical objects, counters, cubes etc to show how objects can be taken away.  6 – 2 = 4  	Cross out drawn objects to show what has been taken away.  15 – 3 = 12	18 -3= 15 8 – 2 = 6
Counting back	Make the larger number in your subtraction. Move the beads along your bead string as you count backwards in ones.  13 – 4 Use counters and move them away from the group as you take them away counting backwards as you go. 	Count back on a number line or number track  9 10 11 12 13 14 15 Start at the bigger number and count back the smaller number showing the jumps on the number line.  -1 -1 -1 -10 -10 34 35 36 37 47 57 This can progress all the way to counting back using two 2 digit numbers.	Put 13 in your head, count back 4. What number are you at? Use your fingers to help.

Subtraction

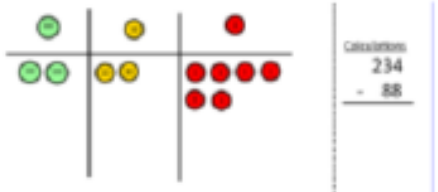
Objective & Strategies	Concrete	Pictorial	Abstract
Find the difference	Compare amounts and objects to find the difference.  Use cubes to build towers or make bars to find the difference  Use basic bar models with items to find the difference	 Count on to find the difference. Draw bars to find the difference between 2 numbers. 	Hannah has 23 sandwiches, Helen has 15 sandwiches. Find the difference between the number of sandwiches.
Part Part Whole Model	 Link to addition- use the part whole model to help explain the inverse between addition and subtraction. If 10 is the whole and 6 is one of the parts. What is the other part? 10 - 6 =	Use a pictorial representation of objects to show the part part whole model. 	 Move to using numbers within the part whole model.
Make 10	14 – 9 =  Make 14 on the ten frame. Take away the four first to make 10 and then takeaway one more so you have taken away 5. You are left with the answer of 9.	 Start at 13. Take away 3 to reach 10. Then take away the remaining 4 so you have taken away 7 altogether. You have reached your answer.	16 – 8= How many do we take off to reach the next 10? How many do we have left to take off?

Subtraction

Objective & Strategies	Concrete	Pictorial	Abstract
Column method without regrouping	 Use Base 10 to make the bigger number then take the smaller number away. Show how you partition numbers to subtract. Again make the larger number first. 	 Draw the Base 10 or place value counters alongside the written calculation to help to show working. 	$47-24=23$ $40+7$ $-\ 20+4$ $20+3$ This will lead to a clear written column subtraction. 
Column method with regrouping	Use Base 10 to start with before moving on to place value counters. Start with one exchange before moving onto subtractions with 2 exchanges. Make the larger number with the place value counters  Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones. 	 Draw the counters onto a place value grid and show what you have taken away by crossing the counters out as well as clearly showing the exchanges you make.  When confident, children can find their own way to record the exchange/regrouping. Just writing the numbers as shown here shows that the child understands the method and knows when to exchange/regroup.	 Children can start their formal written method by partitioning the number into clear place value columns.  Moving forward the children use a more compact method.

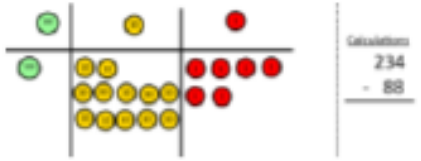
Column method with regrouping (continued)

Now I can subtract my ones.



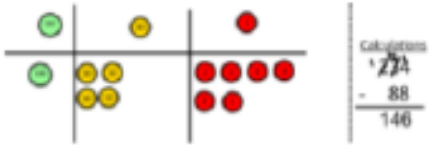
Calculations
234
- 88

Now look at the tens, can I take away 8 tens easily? I need to exchange one hundred for ten tens.



Calculations
234
- 88

Now I can take away eight tens and complete my subtraction



Calculations
~~2~~ 1~~3~~4
- 88
146

Show children how the concrete method links to the written method alongside your working. Cross out the numbers when exchanging and show where we write our new amount.

This will lead to an understanding of subtracting any number including decimals.

$$\begin{array}{r} \ 5\ \ 12\ \ \ 1 \\ 2\ \not{6}\ \not{3}\ .\ 0 \\ -\ \ \ 2\ \ 6\ .\ 5 \\ \hline 2\ \ 3\ \ 6\ .\ 5 \end{array}$$

Subtraction

Subtraction

Column method with regrouping (continued)

1) Gather resources and layout as right, showing both numbers in the calculation.

2) Establish we cannot subtract 8 from 7, therefore exchange for a ten.

3) Exchange that 1 ten for 10 ones. 7 now becomes 17.

4) 17-8=9. Leave 8 ones in the ones column.

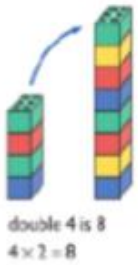
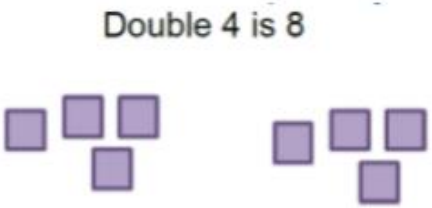
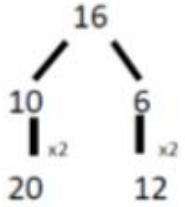
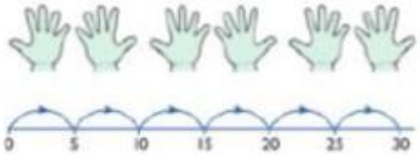
5) Establish we cannot subtract 60 from 30, therefore exchange for a hundred.

6) Exchange 1 hundred for 10 tens. 30 now is 130.

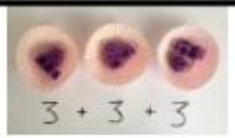
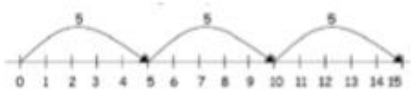
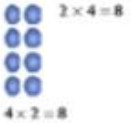
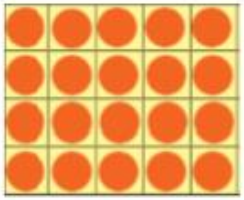
7) 130-60=70. Leave 7 tens in the tens answer column

8) 1 hnd-0 hnd = 1 hundred. Pull down into the answer column.

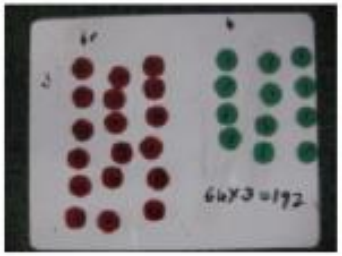
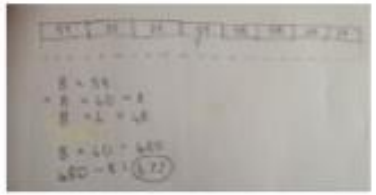
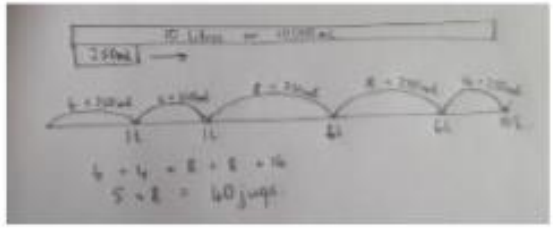
Multiplication

Objective & Strategies	Concrete	Pictorial	Abstract
Doubling	Use practical activities to show how to double a number.  	Draw pictures to show how to double a number.  	 Partition a number and then double each part before recombining it back together.
Counting in multiples	  Count in multiples supported by concrete objects in equal groups.	 Use a number line or pictures to continue support in counting in multiples.	Count in multiples of a number aloud. Write sequences with multiples of numbers. 2, 4, 6, 8, 10 5, 10, 15, 20, 25 , 30

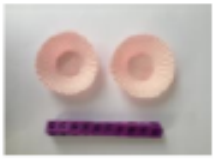
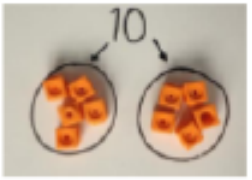
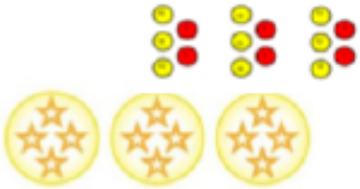
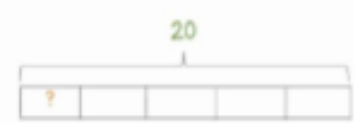
Multiplication

Objective & Strategies	Concrete	Pictorial	Abstract
Repeated addition	   Use different objects to add equal groups.	There are 3 plates. Each plate has 2 star biscuits on. How many biscuits are there?  2 add 2 add 2 equals 6  5 + 5 + 5 = 15	Write addition sentences to describe objects and pictures. 
Arrays - showing commutative multiplication	Create arrays using counters/ cubes to show multiplication sentences.  	Draw arrays in different rotations to find **commutative** multiplication sentences.    Link arrays to area of rectangles.	Use an array to write multiplication sentences and reinforce repeated addition.  5 + 5 + 5 = 15 3 + 3 + 3 + 3 + 3 = 15 5 x 3 = 15 3 x 5 = 15

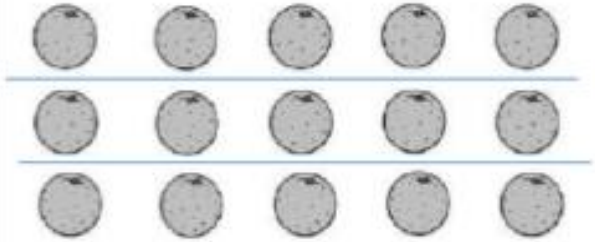
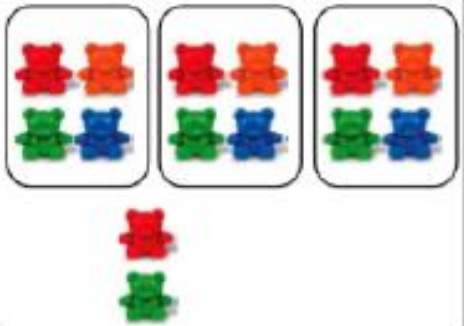
Multiplication

Objective & Strategies	Concrete	Pictorial	Abstract
Column multiplication	Children can continue to be supported by place value counters at the stage of multiplication.  It is important at this stage that they always multiply the ones first and note down their answer followed by the tens which they note below.	Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods.  	Start with long multiplication, reminding the children about lining up their numbers clearly in columns. If it helps, children can write out what they are solving next to their answer. 32 x 24 8 (4 x 2) 120 (4 x 30) 40 (20 x 2) 600 (20 x 30) 768  This moves to the more compact method. 1342 x 18 13420 10736 24156

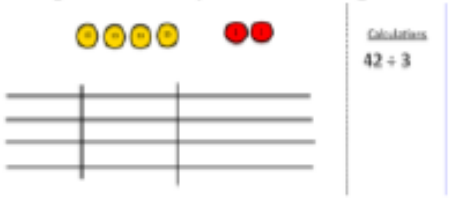
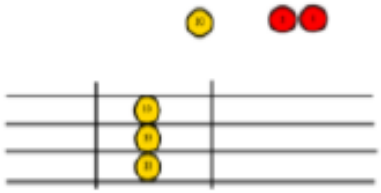
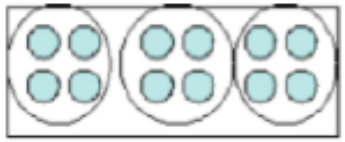
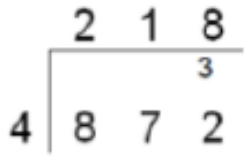
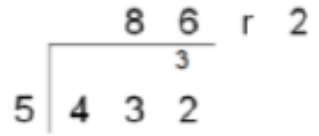
Division

Objective & Strategies	Concrete	Pictorial	Abstract
Sharing objects into groups	   I have 10 cubes, can you share them equally in 2 groups?	Children use pictures or shapes to share quantities.  8 ÷ 2 = 4	Share 9 buns between three people. 9 ÷ 3 = 3
Division as grouping	Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.   96 ÷ 3 = 32 	Use a number line to show jumps in groups. The number of jumps equals the number of groups.  Think of the bar as a whole. Split it into the number of groups you are dividing by and work out how many would be within each group.  20 ÷ 5 = ? 5 x ? = 20	28 ÷ 7 = 4 Divide 28 into 7 groups. How many are in each group?

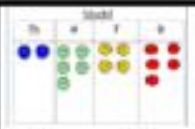
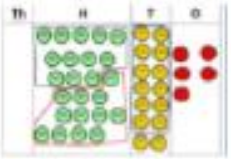
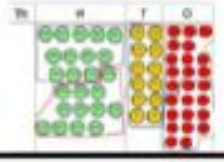
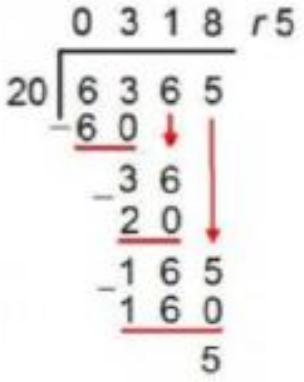
Division

Objective & Strategies	Concrete	Pictorial	Abstract
Division within arrays	 Link division to multiplication by creating an array and thinking about the number sentences that can be created. Eg 15 ÷ 3 = 5 5 x 3 = 15 15 ÷ 5 = 3 3 x 5 = 15	 Draw an array and use lines to split the array into groups to make multiplication and division sentences.	Find the inverse of multiplication and division sentences by creating four linking number sentences. 7 x 4 = 28 4 x 7 = 28 28 ÷ 7 = 4 28 ÷ 4 = 7
Division with a remainder	14 ÷ 3 = Divide objects between groups and see how much is left over 	Jump forward in equal jumps on a number line then see how many more you need to jump to find a remainder.  Draw dots and group them to divide an amount and clearly show a remainder. 	Complete written divisions and show the remainder using r. 

Division

Objective & Strategies	Concrete	Pictorial	Abstract
Short division	 Use place value counters to divide using the bus stop method alongside  42 ÷ 3= Start with the biggest place value, we are sharing 40 into three groups. We can put 1 ten in each group and we have 1 ten left over.  We exchange this ten for ten ones and then share the ones equally among the groups.  We look how much in 1 group so the answer is 14.	Students can continue to use drawn diagrams with dots or circles to help them divide numbers into equal groups.  Encourage them to move towards counting in multiples to divide more efficiently.	Begin with divisions that divide equally with no remainder.  Move onto divisions with a remainder.  Finally move into decimal places to divide the total accurately. 

Division

Objective & Strategies	Concrete	Pictorial	Abstract
Long division	 2544 – 12 How many groups of 12 thousands do we have? None Exchange 2 thousand for 20 hundreds.  How many groups of 12 are in 25 hundreds? 2 groups. Circle them. We have grouped 24 hundreds so can take them off and we are left with one.  Exchange the one hundred for ten tens so now we have 14 tens. How many groups of 12 are in 14? 1 remainder 2  Exchange the two tens for twenty ones so now we have 24 ones. How many groups of 12 are in 24? 2 	Instead of using physical counters, students can draw the counters and circle the groups on a whiteboard or in their books. Use this method to explain what is happening and as soon as they have understood what move on to the abstract method as this can be a time consuming process.	 0 3 1 8 r5 20 | 6 3 6 5 −6 0 3 6 −2 0 1 6 5 −1 6 0 5