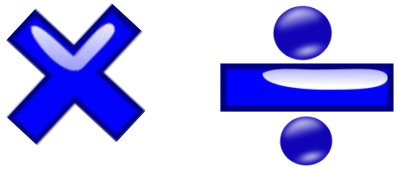
St Andrew's C. E. Primary School

'Where young minds grow and young hearts learn to care'

Peterborough Diocese Education Trust
ACHIEVING MORE TOGETHER

Calculation Policy



Multiplication and Division

Aims

This policy is designed to give children a smooth progression of skills from the early years to year 6. Each method leads into the next so that previous learning is built upon and children learn consistent strategies that will enable them to master skills. Children should be taught according to their ability and not their age as it is vital that each stage is embedded and children develop a secure understanding of methods without any misconceptions. Visual examples are given and key vocabulary/references to important notes are highlighted in red so that the layout of calculations and the vocabulary we teach remains consistent throughout the school. Children should have opportunities to explore concrete, pictorial and abstract representations of calculation at all stages. This will ensure that they develop a secure understanding of multiplication and division. Mastery examples are given for each stage as a reminder that all children must have opportunities to master their skills by solving problems and reasoning in a variety of contexts before moving on to the next stage.

Multiplication and Division EYFS- KS1

Early Years

Mental strategies:
Double numbers to 10
Halve even numbers to 10

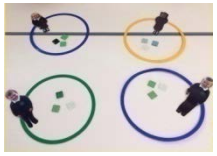
Early Learning Goal EYFS

Mathematics Numbers: Solve problems involving halving and doubling

Principles of counting

- 1-1 correspondence
- Counting objects in any order (left to right or right to left)
- Reciting number words in order
- Understanding that anything can be counted
- Knowing that the final number name represents how many objects have been counted

-Share, halve and double practically in real life contexts. e.g. food, toys, coins.



- Teach children to recognising the link between halving and doubling i.e. half of 4 is 2 so double 2 is 4.

- Unitising 10- Children need to understand how to regroup when they have 10.

-Encourage organising, reorganising and sorting objects in to lines, dice dots and arrays so that children can count efficiently and recognise amounts instantly without counting (subitising).

Mastery Example NCETM

I can double any number but only halve some numbers. Do you agree? Explain your reasoning.

All maths should be practical in EYFS. Unless children show evidence of mastery and are working at greater depth, they should not formally record.

Stage 1

Mental strategies:
Count in 2s to 24, 5s to 60 and 10s to 120
Double numbers to 20
Halve even numbers to 20

National Curriculum Expectations Year 1

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

-Arrays- provide rich variety such as; printing, real life objects, pictures, peg boards and children's own pictorial representations.

-Develop unitising by encouraging children to regroup for 2, 5 and 10 and count in steps.

- Halving -strengthen and develop from EYFS using a range of practical resources. Discuss 'what happens when you halve an odd number?'

- Provide opportunities for children to share objects practically and using drawings.

'Sharing' should become 'grouping' as children move from year 1 into year 2. The term 'sharing' should only be used in EYFS/Year 1.

-Double numbers to 10 with a range of resources to develop instant recall.

Mastery Example NCETM

If I start at 0 and count on in fives will I say the number 55? If I start on 4 and count on in 2s will I say the number 17? If I start at 10 and count on in 10s will I say 100? Explain your reasoning.

Children should not be moved on to working with numbers above 20 unless there is evidence of mastery and they are working at greater depth.

Stage 2

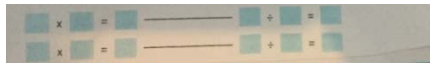
Mental strategies:
Double any multiple of 10 to 100
Halve multiples of 10 to 100
Identify odd and even numbers to 100
Count in steps of 2, 3, 5 and 10 forward and backward

National Curriculum Expectations Year 2

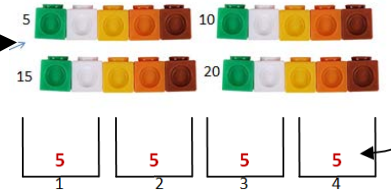
- *Recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables, including recognising odd and even numbers*
- *Calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs*
- *Show that multiplication of two numbers can be done in any order (commutative) and division of one number by another cannot*
- *Solve problems involving multiplication and division, using materials, arrays, repeated addition, mental methods, and multiplication and division facts, including problems in context*

-Arrays to be used as with year one but alongside calculation.

- X ÷ should be taught together so that children understand how they relate. Encourage children to find families of multiplication and division facts.

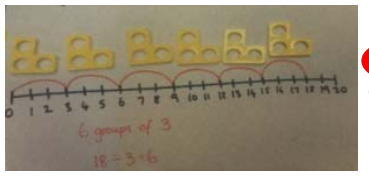


- Grouping- practical, pictorial and abstract methods to reinforce times tables knowledge when dividing. e.g. 20 ÷ 5 = 'How many groups of 5 can you make with 20?



'Sweet and bag' method

- Multiplication and division should be taught on a number line alongside practical strategies and resources.



When teaching division on a number line, use additive links as this leaves less room for error and reinforces times tables.

Mastery Example NCETM

True or false?

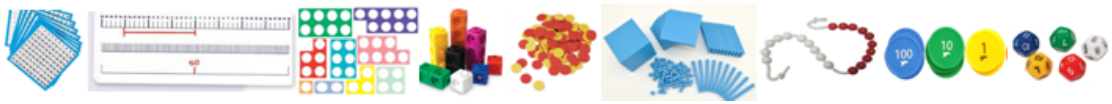
5x4=4x5 **5x4=10x2** **5x4=2x10**

Explain your reasoning. What do you notice?

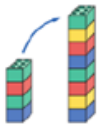
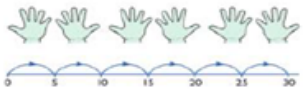
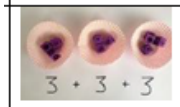
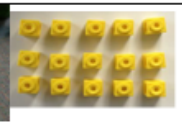
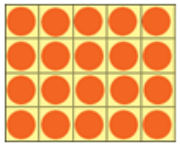
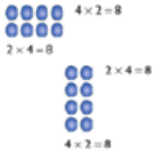
Children should not move beyond 2, 3, 5 and 10 times tables unless there is evidence of mastery and they are working at greater depth.

Possible resources

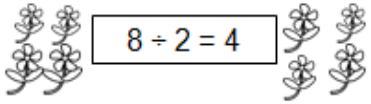
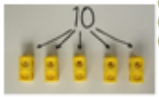
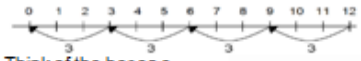
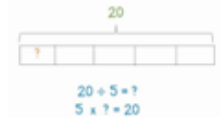
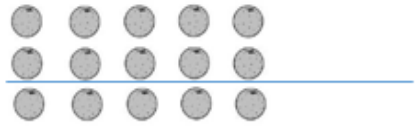
Numicon, Dienes, multi-link, counters, number lines, hundred squares, multiplication grids, counting beads, abacus, place value counters, cars, dice, real world objects e.g. conkers, leaves, socks, gloves.



Multiplication

Concrete	Pictorial	Abstract
Use practical activities to show how to double a number. 	Double 4 is 8  Draw pictures to show how to double a number.	 Partition a number and then double each part before recombining it back together.
 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
   Use different objects to add equal groups.	 2 add 2 add 2 equals 6 5 + 5 + 5 = 15	Write addition sentences to describe objects and pictures.  2 + 2 + 2 + 2 + 2 = 10
  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.  4 × 2 = 8 2 × 4 = 8	Use an array to write multiplication sentences and reinforce repeated addition.  5 + 5 + 5 = 15 3 + 3 + 3 + 3 + 3 = 15 3 x 5 = 15 5 x 3 = 15

Division

Concrete	Pictorial	Abstract
 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
 Divide quantities into equal groups. Use cubes, counters, objects or place 	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?
 Link division to multiplication by creating an array and thinking about the number sentences that can be crested. 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

Vocabulary

Groups of, lots of, share, regroup, double, halve, multiple, repeated addition, array, regroup, factor, product, multiple, multiply, divide, method, strategy, remainder, calculation, symbol

Multiplication and Division LKS2

Stage 3

Mental strategies
Recall 3, 4 and 8 times table
Count in steps of 4, 8, 50 and 100
Use place value to times and divide by 10, 100 and 1000

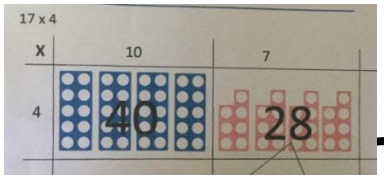
National Curriculum Expectations Year 3

- *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*
- *solve problems, including missing number problems, involving multiplication and division, including positive integer scaling problems and correspondence problems* in which n objects are connected to m objects.

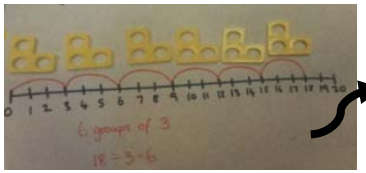
- Introduce grid method for multiplication alongside resources to aid children's understanding.

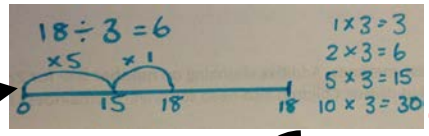
1 — 1 digit by 2 digit

2 — 1 digit by 3 digit2 digit



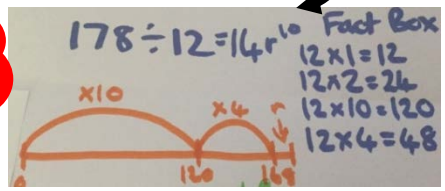
- Division on number line- teach as additive as this leads to less errors and reinforces times tables. Fact boxes should be recorded alongside number line using layout shown below.





Use 1x, 2x, 5x and 10 times the divisor for initial fact boxes as this enables children to find most other related facts.

Children can use resources or jottings to support their mental calculations if needed.



Teach children how to use multiplication sqaure as a resources to support their calculations.

Mastery Example NCETM

Sam is planting onions in his vegetable garden. He arranges the onions in to rows of 4 and has 2 left over. He then arranges them in to rows of 3 and has none left over. How many onions might he have had? Explain your reasoning.

Children should use a range of resources to support calculations. They should be able to apply these methods in a range of contexts in order to demonstrate mastery.

Stage 4

Mental strategies
Develop quick recall of all times tables facts
Begin to recall related division facts
Use knowledge of place value to multiply and divide any single digit number by a multiple of 10, 100 or 1000
Count in steps of 6, 7, 9, 25 and 100
Recognise and use factor pairs

National Curriculum Expectations Year 4

- *Recall multiplication and division facts for multiplication tables up to 12 × 12*
- *Use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers*
- *Recognise and use factor pairs and commutativity in mental calculations*
- *Multiply two-digit and three-digit numbers by a one-digit number using formal written layout*
- *Solve problems involving multiplying and adding, including using the distributive law to multiply two digit numbers by one digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects.*

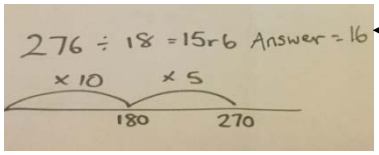
- Children to develop use of grid method.

3 — 2 digit by 2 digit

X	20	3	
10	200	30	=230
5	100	15	=115
			345

Teach children when to use grid method and when to use times tables knowledge. Encourage mental methods for calculations that involve known multiplication facts.

- Develop use of number lines for division. Children should explore calculations with remainders and round up and down in the contexts of problems.



rounded up

- Teach expanded short division (bus stop method) for calculations with single digit divisors. Number lines should be used for 2/3 digit divisors.

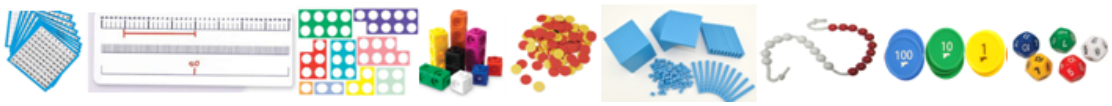
Mastery Example NCETM

Multiply a number by itself and then make one factor one more and the other one less. What happened to the product.
E.g. 4 x 4 6 x 6
5 x 3 7 x 5
What do you notice? Will this always happen?

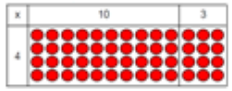
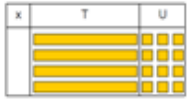
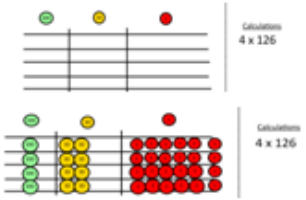
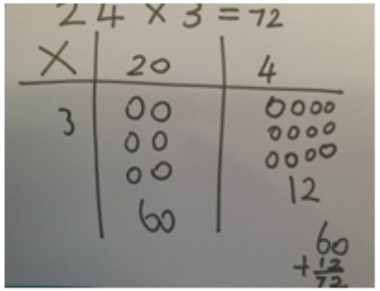
Children should be presented with problems in a range of contexts to deepen their understanding and evidence mastery.

Possible resources

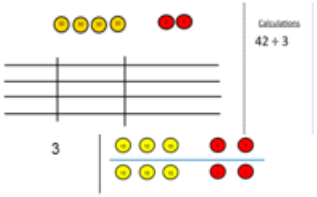
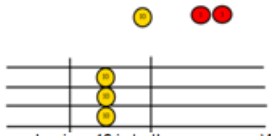
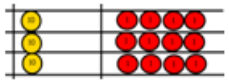
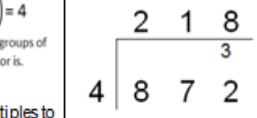
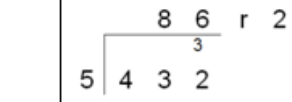
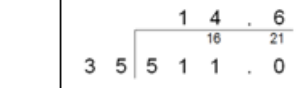
Numicon, Dienes, multi-link, counters, number lines, hundred squares, multiplication grids, counting beads, abacus, place value counters, cars, dice, real world objects e.g. conkers, leaves, socks, gloves.



Multiplication

Concrete	Pictorial	Abstract
Show the link with arrays to first introduce the grid method.  4 rows of 10 4 rows of 3 Move on to using Dienes to move towards a more compact method.  4 rows of 13 Move on to place value counters to show how we are finding groups of a number. We are multiplying by 4 so we need 4 rows.  Fill each row with 126. Add up each column, starting with the ones making any exchanges needed. 	Children can represent the work they have done with Dienes or place value counters in a way that they understand. They can draw the counters, using colours to show different amounts or just use circles in the different columns to show their thinking as shown below. 	Start with multiplying by one digit numbers and showing the clear addition alongside the grid. | × | 30 | 5 | | 7 | 210 | 35 | 210 + 35 = 245 Moving forward, multiply by a 2 digit number showing the different rows within the grid method. | | 10 | 8 | | 10 | 100 | 80 | | 3 | 30 | 24 | | X | 1000 | 300 | 40 | 2 | | 10 | 10000 | 3000 | 400 | 20 | | 8 | 8000 | 2400 | 320 | 16 |

Division

Concrete	Pictorial	Abstract
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 circles or other shapes to divide into equal groups but should count in multiples of the divisor and not in ones.  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. 

Vocabulary

factor, product, multiple, groups of, lots of, multiply, divide, quotient, array, method, strategy, remainder, short division, long division, round, estimate

Multiplication and Division UKS2

Stage 5

Mental strategies
Double and halve decimals to 1DP
Instantly recall multiplication and division facts up to 12 x 12
Know square numbers up to 12 x 12
Count forwards and backwards in powers of 10

National Curriculum Expectations Year 5

- *Identify multiples and factors, including finding all factor pairs of a number, and common factors of 2 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*
- *Multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers*
- *Multiply and divide numbers mentally, drawing upon known facts*
- *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*
- *Multiply and divide whole numbers and those involving decimals by 10, 100 and 1,000*
- *Recognise and use square numbers and cube numbers, and the notation for squared (²) and cubed (³)*
- *Solve problems involving multiplication and division, including using their knowledge of factors and multiples, squares and cubes*
- *Solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign*
- *Solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates*

-Consolidate children's use of grid method.

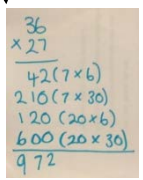
3 2 digit by 3 digit
4 2 digit by 4 digit
5 Decimal numbers

75 x 429 =

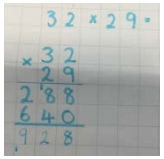
x	400	20	9
70	28,000	1400	630
5	2000	100	45

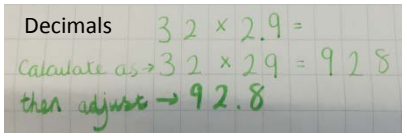
75 x 429 = 28,000 + 1400 + 630
75 x 429 = 32,175

Expanded vertical multiplication is optional. It is not necessary for all.

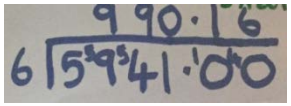


- Teach short multiplication for efficiency.





- Teach short division- (Single digit divisors). Children need to convert remainders to decimals/fractions in context of problems.



142 ÷ 4 =

035·5
4)142·0

= 35 2/4 = 35½ = 35.5

Fact Box
2 x 4 = 8
5 x 4 = 20
10 x 4 = 40

Teach children to develop efficient fact boxes.

- Consolidate additive chunking (2/3digit divisors).

Mastery Example NCETM

Factors come in pairs so all numbers have an even number of factors. Do you agree? Explain your reasoning.

Children should use a range of resources to support calculations. They should be able to apply these methods in a range of contexts in order to demonstrate mastery.

Stage 6

Mental strategies
Double and halve decimals to 2DP
Instantly recall multiplication and division facts to 12 x 12 and related multiples of 10/100/1000

National Curriculum Expectations Year 6

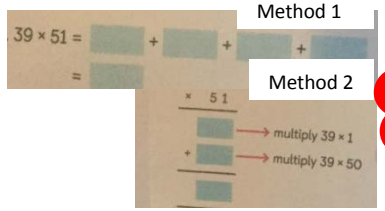
- *Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication*
- *Divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context*
- *Divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context*
- *Perform mental calculations, including with mixed operations and large numbers*
- *Identify common factors, common multiples and prime 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*
- *Solve problems involving addition, subtraction, multiplication and division*
- *Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.*

- Consolidate short multiplication methods.

5.9 x 3 =

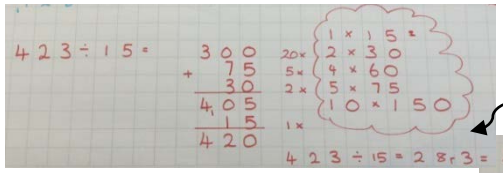
X	5	0.9
3	15	2.7

5.9 x 3 = 15 + 2.7
5.9 x 3 = 17.7

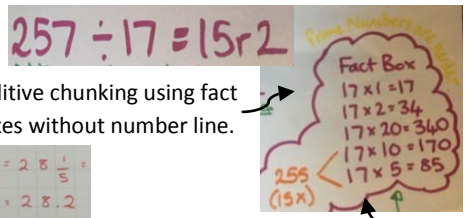


Comparing strategies with children strengthens their understanding.

- Consolidate short division (single digit divisor) and additive chunking (2/3 digit divisor).



Additive chunking using fact boxes without number line.



-Teach BIDMAS for calculations involving brackets.

- Children need to learn how to estimate the answers to calculations by rounding and using mental methods. They also need to use inverse operations to check answers are correct.

Children need to be presented with prime number problems.

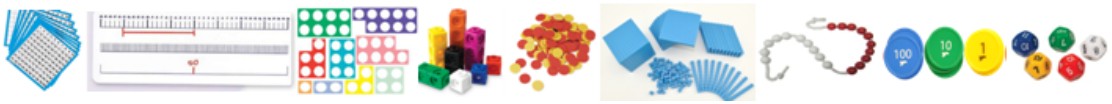
Mastery Example NCETM

Which calculation is the odd one out? Explain you reasoning.
753 x 1.8 /(75.3 x 3) x 6/ 753 +753 ÷ 5 x 4/ 7.53 x 1800/ 753 x 2 - 753 x 0.2/ 750 x 1.8 + 3 x 1.8

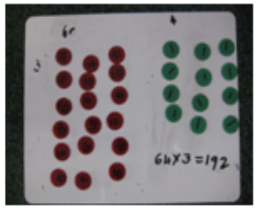
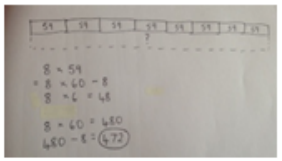
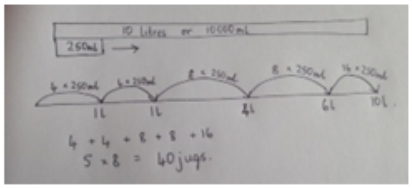
Children should be presented with problems in a range of contexts to deepen their understanding and develop mastery of skills.

Possible resources

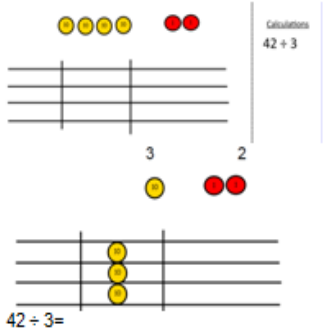
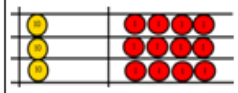
Numicon, Dienes, multi-link, counters, number lines, hundred squares, multiplication grids, counting beads, abacus, place value counters, cars, dice, real world objects e.g. conkers, leaves, socks, gloves.



Multiplication

Concrete	Pictorial	Abstract
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

Concrete	Pictorial	Abstract
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 circles or other shapes to divide into equal groups but should count in multiples of the divisor and not in ones.  Encourage them to move towards counting in multiples to divide more efficiently.	Begin with divisions that divide equally with no remainder. 2 1 8 4 8 7 2 Move onto divisions with a remainder. 8 6 r 2 5 4 3 2 Finally move into decimal places to divide the total accurately. 1 4 . 6 3 5 5 1 1 . 0

Vocabulary

factor, product, multiple, groups of, lots of, multiply, divide, quotient, array, method, strategy, remainder, short division, long division, round, convert, decimal, fraction, percentage