Calculation Policy

Tacolneston & Morley CE VA Primary Schools Federation

May 2017

Background

At the Tacolneston & Morley CE VA Primary Schools Federation, we firmly believe in the importance of maths for our children, both as a key to future learning and as a vital tool for use throughout their everyday lives. We aim to provide a positive, stimulating environment where children feel confident to explore maths and develop their skills. The 2014 Primary National Curriculum for mathematics gives end of Key Stage expectations broken into suggested goals for each year. While our teachers have the autonomy to introduce content earlier or later, there is an emphasis on developing depth of knowledge before breadth, with an overarching goal for children to develop their fluency, reasoning and problem solving skills while developing an enthusiasm for maths.

Maths Mastery

We are working with the National College for Excellence in Teaching Mathematics to implement a mastery approach to maths at our schools. At the centre of the mastery approach is the belief that all children have the potential to succeed. Pupils have access to the same curriculum content and are given the opportunity to deepen their conceptual understanding by tackling engaging, challenging and varied problems. Within our calculation strategies, children must not simply rote learn procedures but be guided to develop and demonstrate their increasing fluency through the use of concrete materials and pictorial representations. When planning, teachers identify ways to reinforce children's understanding and learning by challenging their understanding of concepts and exploring and discussing common misconceptions. While there is an expectation that Upper Key Stage 2 children will confidently use formal methods of calculation, this is coupled with the explicit requirement for children to use concrete materials and create pictorial representations to aid their calculations – a key component of the mastery approach. This policy outlines the different calculation strategies that should be taught and used in Year 1 to Year 6 in line with the requirements of the 2014 Primary National Curriculum.

What maths looks like at our schools.

We are currently developing and implementing our approach to develop mastery. Initially focus is on Morley School, and, once established, this approach will be embedded at Tacolneston. The mastery model we are building incorporates these main points -

- All pupils are encouraged with the belief that by working hard they can succeed.
- Staff will use their maths skills, knowledge of common misconceptions and of their pupils to plan and deliver carefully sequenced lessons that use back and forth interactions to enable children to master the same content at the same time.
- Some children will have interventions to help build fluency and number sense or to reinforce concepts so that they are able to move forward with the whole class.
- Supported by high quality text books, teachers will use procedural and conceptual variation to deepen learning.
- Fluency will be taught and developed in discrete daily lessons.
- Children will use carefully chosen equipment to represent problems that expose mathematical structures.
- Children will support each other's learning, talking about and explaining their mathematics.

Planning and Schemes of Work

We are currently in the process of adapting the White Rose Maths Hub Schemes of work and planning documents for use across the school. As teachers implement the schemes of work from the White Rose Maths Hub, they base their planning around their year group modules, focussing on building fluency, reasoning and problem solving skills. These modules use the Singapore maths methods and are affiliated to the workings of the 2014 Primary National Curriculum (2014 PNC).

Resources

It is important that structured models are used across the school to help children reason about mathematical relationships. The resources in use across the school are currently under review. Further guidance on texts and concrete materials will follow.

Mathematical Language

The quality and variety of language that pupils hear and speak are key factors in developing their mathematical vocabulary and the use of the correct mathematical language is a central part of children's learning, facilitating reasoning, convincing and conjecture. In certain year groups, the 2014 PNC non-statutory guidance highlights the requirement for children to extend their language around certain concepts; it is therefore essential that teaching is accompanied by the use of appropriate and precise mathematical vocabulary. New vocabulary is introduced in a suitable context (for example, with relevant real objects, apparatus, pictures or diagrams) and explained carefully. Teachers plan and introduce sentence stems that express key concepts and enable children to communicate their ideas with precision and clarity; repetition of these help embed this knowledge. There is a strong and consistent focus on questioning that encourages and develops mathematical reasoning by, for example, asking children to explain how they solved a problem or worked out a calculation while considering and comparing different methods and their efficiency. High expectations of the mathematical language used are essential, with teachers only accepting what is correct. The agreed list of terminology is included within this policy.

Fluency

Mathematical fluency is dependent on accurate and rapid recall of basic number facts. There is a structured approach to teaching number facts and, as soon as possible, children are encouraged to calculate rather than count and to look for patterns and make conceptual connections by considering 'What is the same, what is different?' Lessons are planned to ensure that children are given opportunity to experience concrete, pictorial and abstract representations, enabling children to connect abstract symbols with familiar concepts. Early focus is also given to children's understanding of the = symbol, equality and, by extension, inequality. Classes are developing a daily fluency session of approximately 15 minutes designed to develop conceptual understanding. Children will become fluent in place value, addition and subtraction facts and times tables knowledge, which will in turn enable them to become confident in formal written methods.

Maths in the Early Years Foundation Stage (EYFS)

In the (EYFS), we relate the mathematical aspects of the children's work to the Development Matters statements and the Early Learning Goals (ELG), set out in the EYFS profile document as number (ELG 11) and shape, space and measures (ELG 12). Maths development involves providing children with opportunities to practise and improve their skills in counting numbers, calculating simple addition and subtraction problems and describing shapes, spaces, and measures. We continually observe and assess children against these areas using their age-related objectives, and plan the next steps through a topic-based curriculum. Whenever possible, children's interests are used as a vehicle for delivering the curriculum; for example, an interest in dinosaurs may give rise to sorting, counting and recording the number of dinosaurs in small world play. There are opportunities for mathematical thinking throughout the EYFS (both inside and outside) – in planned activities, self-initiated learning and we recognise that children are just as likely to access the mathematics curriculum through building in the construction area or exploring in the outdoor area as from the self-selection of easily accessible quality maths resources. Towards the end of Reception teachers aim to draw the elements of a daily maths lesson together, so that by the time children move into Year 1 they are familiar with a structured lesson / activity.

How to use this policy

This mathematics policy is a guide for all Tacolneston & Morley CE VA Primary Schools Federation staff and has been adapted from work by the NCETM and the White Rose Maths Hub. It is purposely set out as a progression of mathematical skills and not into year group phases to encourage a flexible approach to teaching and learning. It is expected that teachers will use their professional judgement to decide whether consolidation of existing skills is required or if pupils should move onto the next concept. However, our main focus must always remain on breadth and depth rather than accelerating through concepts. Children should not be extended with new learning before they are ready, but instead they should deepen their conceptual understanding by tackling challenging and varied problems. Teachers can use any teaching resources that they wish to use and the policy does not recommend one set of resources over another, rather that a variety of resources are used. For each of the four rules of number, different strategies are laid out, together with examples of what concrete materials can be used and how, along with suggested pictorial representations. The principle of the concrete-pictorial-abstract (CPA) approach [Make it, Draw it, Write it] is for children to have a true understanding of a mathematical concept; they will need to master all three phases within a year group's scheme of work.

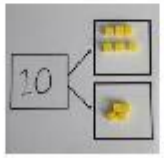
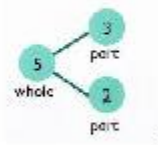
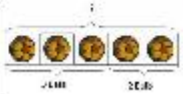
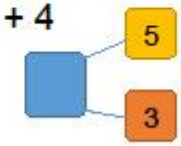
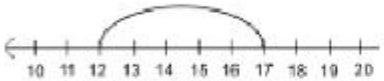
Index

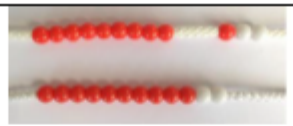
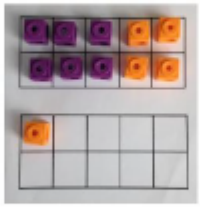
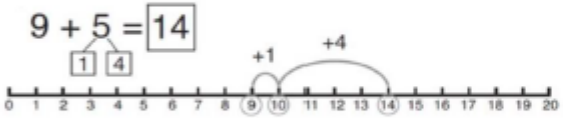
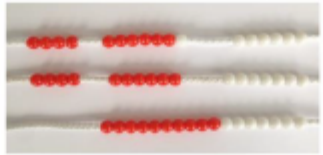
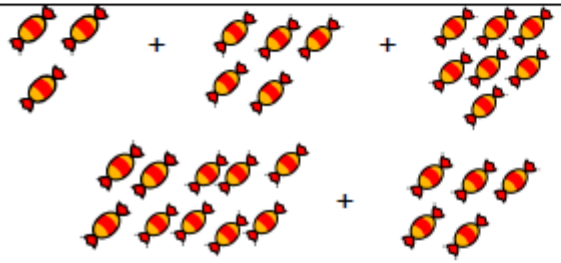
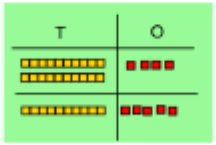
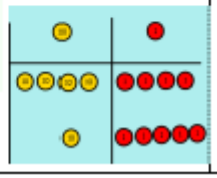
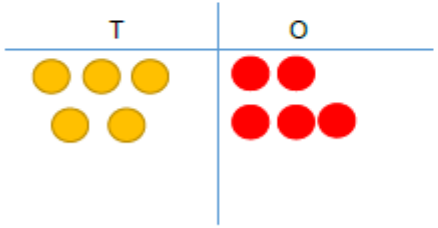
Calculation methods by year group

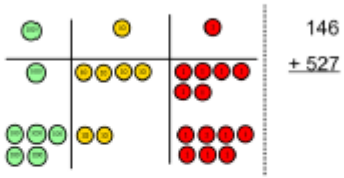
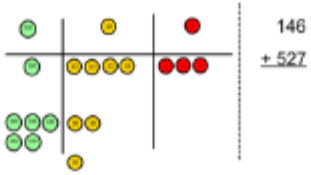
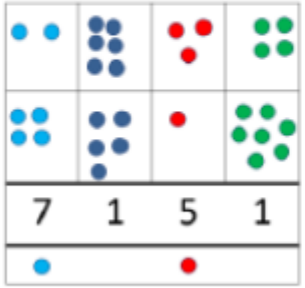
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Addition	Combining two parts to make a whole: part whole model. Starting at the bigger number and counting on. Regrouping to make 10.	Adding three single digits. Column method – no regrouping.	Column method- regrouping. (up to 3 digits)	Column method- regrouping. (up to 4 digits)	Column method- regrouping. (with more than 4 digits) (Decimals- with the same amount of decimal places)	Column method- regrouping. (Decimals- with different amounts of decimal places)
Subtraction	Taking away ones Counting back Find the difference Part whole model Make 10	Counting back Find the difference Part whole model Make 10 Column method- no 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) (Decimals- with the same amount of decimal places)	Column method with regrouping. (Decimals- with different amounts of decimal places)
Multiplication	Doubling Counting in multiples Arrays (with support)	Doubling Counting in multiples Repeated addition Arrays- showing commutative multiplication	Counting in multiples Repeated addition Arrays- showing commutative multiplication Grid method	Column multiplication (2 and 3 digit multiplied by 1 digit)	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	Sharing objects into groups Division as grouping	Division as grouping Division within arrays	Division within arrays Division with a remainder Short division (2 digits by 1 digit- concrete and pictorial)	Division within arrays Division with a remainder Short division (up to 3 digits by 1 digit- concrete and pictorial)	Short division (up to 4 digits by a 1 digit number interpret remainders appropriately for the context)	Short division Long division (up to 4 digits by a 2 digit number- interpret remainders as whole numbers, fractions or round)

Progression in Calculations

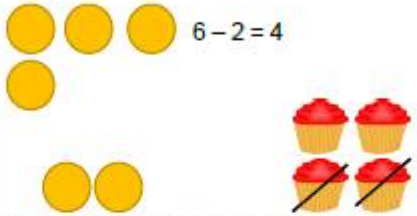
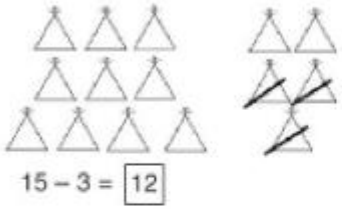
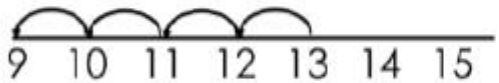
Addition

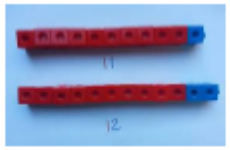
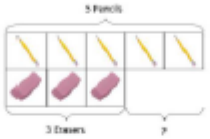
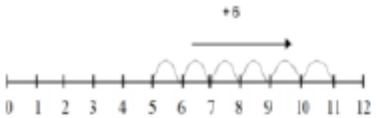
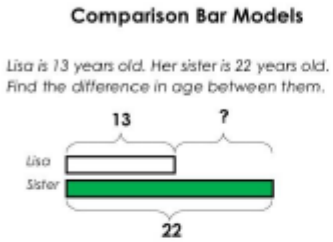
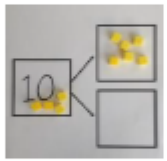
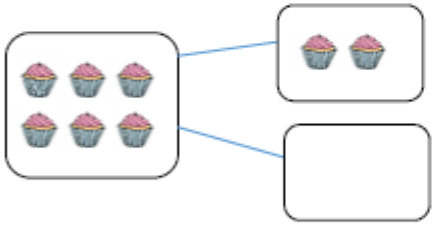
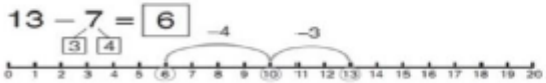
Objective and Strategies	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part-whole model	   Use cubes to add two numbers together as a group or in a bar. 	   Use pictures to add two numbers together as a group or in a bar. 	4 + 3 = 7 10= 6 + 4  Use the part-part whole diagram as shown above to move into the abstract.
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 Place the larger number in your head and count on the smaller number to find your answer.

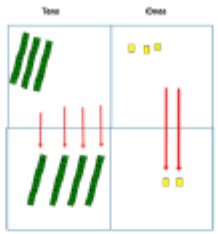
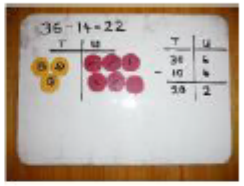
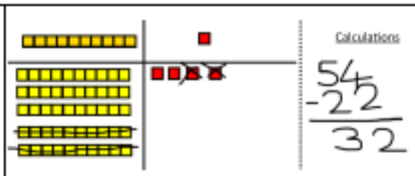
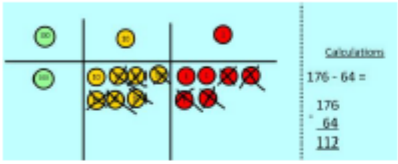
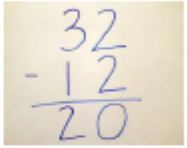
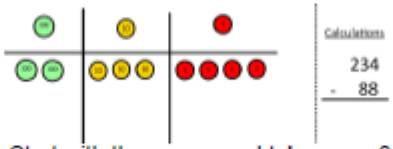
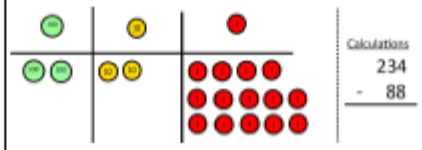
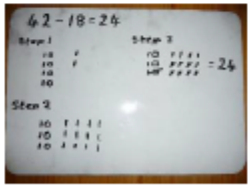
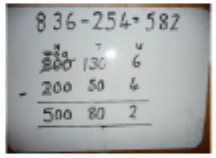
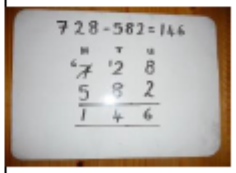
Regrouping to make 10.	 6 + 5 = 11  Start with the bigger number and use the smaller number to make 10.	 Use pictures or a number line. Regroup or partition the smaller number to make 10.  	7 + 4= 11 If I am at seven, how many more do I need to make 10. How many more do I add on now?
Adding three single 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.	4 + 7 + 6 = 10 + 7 10 = 17 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

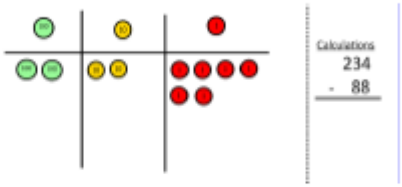
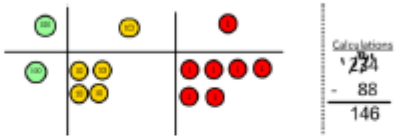
Column method- regrouping	Make both numbers on a place value grid.  146 + 527 Add up the units and exchange 10 ones for one 10.  146 + 527 Add up the rest of the columns, exchanging the 10 counters from one column for the next place value column until every column has been added. This can also be done with Base 10 to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100. As children move on to decimals, money and decimal 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

Subtraction

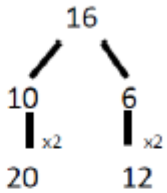
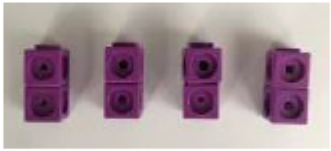
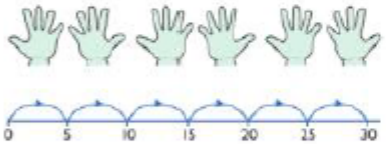
Objective and Strategies	Concrete	Pictorial	Abstract
Taking away ones	Use physical objects, counters, cubes etc to show how objects can be taken away.  6 – 2 = 4	Cross out drawn objects to show what has been taken away.  15 – 3 = 12	18 -3= 15 8 – 2 = 6
Counting back	Make the larger number in your subtraction. 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  Start at the bigger number and count back the smaller number showing the jumps on the number line.  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.

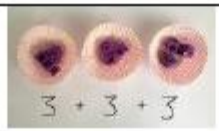
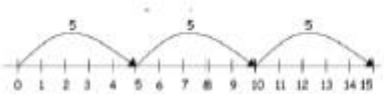
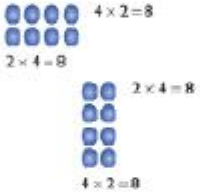
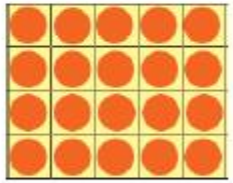
Find the difference	Compare amounts and objects to find the difference.  Use cubes to build towers or make bars to find the difference  Use basic bar models with items to find the difference	 Count on to find the difference. Draw bars to find the difference between 2 numbers.  	Hannah has 23 sandwiches, 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?

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.

	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 234 - 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. 5 12 1 2 ~~6~~ ~~3~~ . 0 - 2 6 . 5 2 3 6 . 5

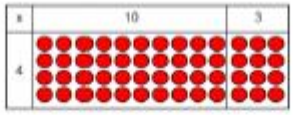
Multiplication

Objective and Strategies	Concrete	Pictorial	Abstract
Doubling	Use practical activities to show how to double a number.  	Draw pictures to show how to double a number. Double 4 is 8 	 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

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

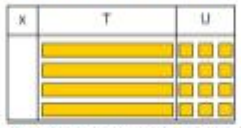
Grid Method

Show the link with arrays to first introduce the grid method.



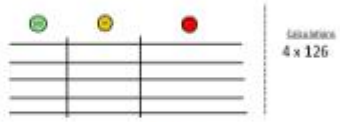
4 rows of 10
4 rows of 3

Move on to using Base 10 to move towards a more compact method.

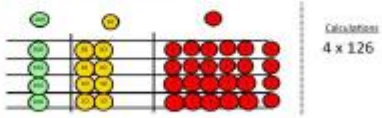


4 rows of 13

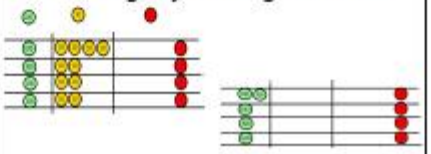
Move on to place value counters to show how we are finding groups of a number.We are multiplying by 4 so we need 4 rows.



Fill each row with 126.



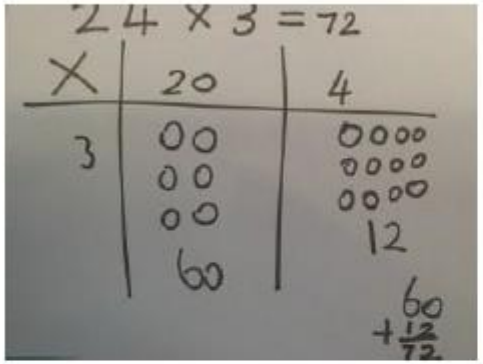
Add up each column, starting with the ones making any exchanges needed.



Then you have your answer.

Children can represent the work they have done with 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.

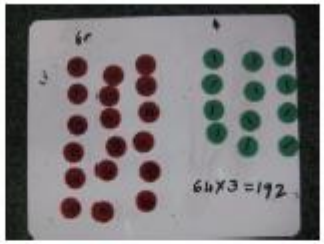
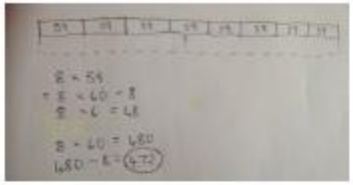
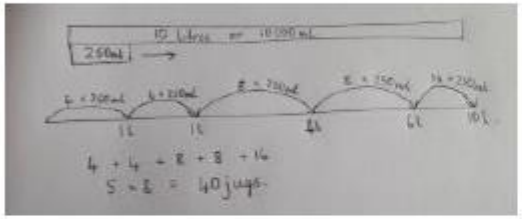
×	30	5
7	210	35

210 + 35 = 245

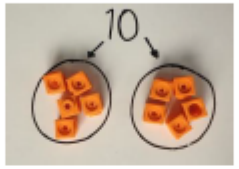
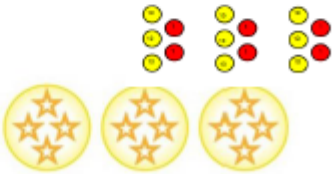
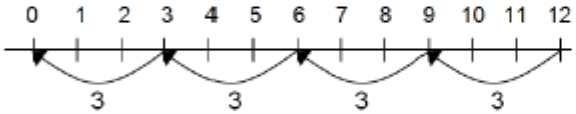
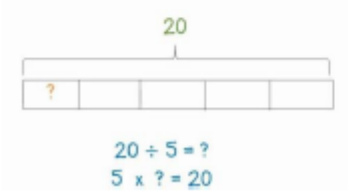
Moving forward, multiply by a 2 digit number showing the different rows within the grid method.

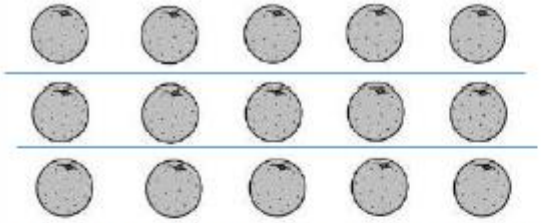
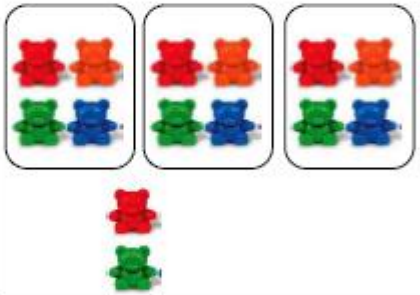
	10	8
10	100	80
3	30	24

X	1000	300	40	2
10	10000	3000	400	20
8	8000	2400	320	16

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 74 x 63 12 210 240 + 4200 4662 This moves to the more compact method. 1 3 1 1342 x 18 13420 10736 24156 1

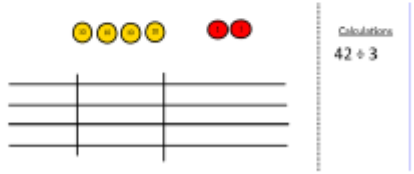
Division

Objective and 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. 	28 ÷ 7 = 4 Divide 28 into 7 groups. How many are in each group?

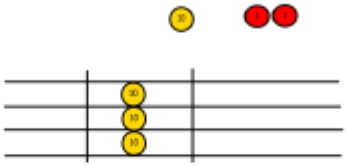
Division within arrays	 Link division to multiplication by creating an array and thinking about the number sentences that can be created. Eg 15 ÷ 3 = 5 5 x 3 = 15 15 ÷ 5 = 3 3 x 5 = 15	 Draw an array and use lines to split the array into groups to make multiplication and division sentences.	Find the 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. 29 ÷ 8 = 3 REMAINDER 5 ↑ ↑ ↑ ↑ dividend divisor quotient remainder

Short division

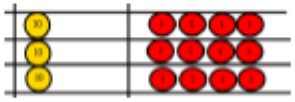
Use place value counters to divide using the bus stop method alongside



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.

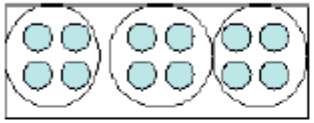


We exchange this ten for ten ones and then share the ones equally among the groups.



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.

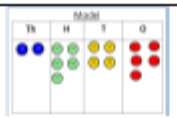
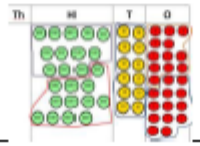
```
     2 1 8
     -----
4 | 8 7 2
      3
```

Move onto divisions with a remainder.

```
       8 6  r 2
       -----
5 | 4 3 2
      3
```

Finally move into decimal places to divide the total accurately.

```
         1 4 . 6
         -------
3 5 | 5 1 1 . 0
        16   21
```

Long division	 2544 ÷ 12 How many groups of 12 thousands do we have? None Exchange 2 thousand for 20 hundreds.  0 12 | 2544 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.  0 2 12 | 2544 24 1 Exchange the one hundred for ten tens so now we have 14 tens. How many groups of 12 are in 14? 1 remainder 2  0 2 1 12 | 2544 24 14 12 2 Exchange the two tens for twenty ones so now we have 24 ones. How many groups of 12 are in 24? 2  0 2 1 2 12 | 2544 24 14 12 24 24 0	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

Mathematical language

Preferred language	Incorrect
ones	
is equal to/is the same as	equals
zero	‘oh’ – the letter o
exchange/exchanging regrouping	borrowing stealing
calculation/equation number sentence (particularly for younger children)	sum
thinking blocks (although bar model/Singapore bar is acceptable, thinking blocks is our preferred term)	
known/unknown	
whole/part	