Calculation Policy KS1/2

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Introduction

The following calculation policy has been devised to meet the requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a consistent and smooth progression of learning in calculations and ensure that children master the curriculum across the Key Stage 1 and 2 phases. Please note that early learning in number and calculation in Reception follows the 'Development Matters' EYFS document and separate calculation policy. This policy is designed to build on progressively from the content and methods established in the Early Years Foundation Stage.

Age stage expectations The calculation policy is organised according to age stage expectations as set out in the National Curriculum 2014 and the expectation is that the majority of pupils will move through the programmes of study at broadly the same pace. However, decisions about when to progress should always be based on the security of pupils' understanding and their readiness to progress to the next stage. **Pupils who grasp concepts rapidly should be challenged through being offered rich and sophisticated problems before any acceleration through new content.** Those who are not sufficiently fluent with earlier material should consolidate their understanding, including through additional practice and intervention, before moving on.

Providing a context for calculation and ensuring mastery: It is important that any type of calculation is given a real life context or problem solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods when faced with problems. This must be a priority within calculation lessons. Mastery challenges should be incorporated into each lesson.

Choosing a calculation method: Children need to be taught and encouraged to use the following processes in deciding what approach they will take to a calculation, to ensure they select the most appropriate method for the numbers involved, whether it is using mental methods, jottings, drawings or more formal written methods.

Teacher's questions: Questioning must be used to develop mathematical reasoning. This can be done simply by asking children to explain how they worked out a calculation or solved a problem, and to compare and contrast different methods that are described. Examples of rich questions include: 'What's the same, what's different?', 'Which one is the odd one out?', 'Here's the answer. What could the question have been?', 'True or false?', 'Identify the correct question', 'Greater than, less than or equal to?'

Estimation

Pupils are expected to use their developing number sense from Year 1 to make predictions about the answers to their calculations. As their range of mental strategies increases, these predictions and, later, estimates should become increasingly sophisticated and accurate. All teaching of calculation should emphasise the importance of making and using these estimates to check, first, the sense and, later, the accuracy of their calculations.

Mental calculation and rapid recall of known facts

Children should be taught to recall addition & subtraction facts and multiplication facts rapidly through a range of strategies and should reach different targets based on their ages, outlined in this policy. CLIC maths will be used to teach these and also to consolidate basic skills, there will be a weekly 'Big Maths' tests to track progress and to encourage children to beat their scores. Children will remain on the same test each half term to allow them to master all of the necessary skills rapidly. In KS2 and in the Spring & Summer term of Ks1 'Minute Maths' tests will also be set at homework to improve children's mental calculation strategies with a weekly test to track progress.

Mathematical language

It is essential that teaching using the strategies outlined in this policy are accompanied by the use of appropriate mathematical vocabulary. New vocabulary should be introduced in a suitable context (for example, with relevant real objects, apparatus, pictures or diagrams) and explained carefully. High expectations of the mathematical language used are essential, with teachers only accepting what is correct. The correct mathematical language should always be evident in books and displays.

✓	**X**
ones	units
is equal to	equals
zero	oh (the letter O)

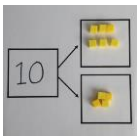
Addition Year 1

- Understand '+' & '='. - Identify 1 more - Know number bonds to 20 - Add 1-digit and 2-digit numbers to 20, including 0. - Solve 1-step problems involving Addition using concrete objects and pictures. - Solve missing number problems

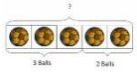
+ and = signs Children need to be taught the concept of equality before using the = sign. Calculations should be written either side of the = sign so that it is not just understood as 'the answer' (e.g. 3 = 2 + 1, 2 + 1 = 3)

Combining two parts to make a whole: part- whole model. *Use cubes to add two numbers together as a group or in a bar.* Combing two sets of objects (aggregation) which will progress onto adding a set

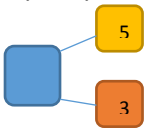




Use pictures to add two numbers together as a group or in a bar.



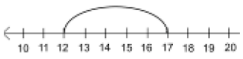

Use the part-part whole diagram as shown to move into the abstract.



5 + 3 = 8
8 = 5 + 3

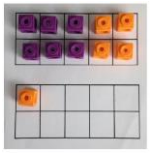
Starting at the bigger number and counting on *Start with the larger number on the bead string and then count on to the smaller number 1 by 1 to find the answer.*

Start at the larger number on the number line or number track and count on in ones or in one jump to find the answer. 12 + 5 = 17



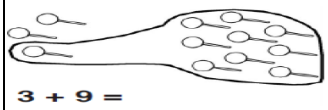
Place the larger number in your head and count on the smaller number to find your answer.

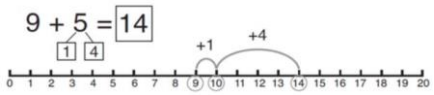
Regrouping to make 10



Start with the bigger number and use the smaller number to make 10.

Partitioning and bridging through 10, use pictures or a number line. Regroup or partition the smaller number to make 10.





Mentally calculate e.g. 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 1, 2, 3 more - focus on using language, use bead strings '*1 more than 5 is equal to 6.'*

Adding three single digits (make 10 first), *make 10 with 2 of the digits (if possible) then add on the third digit 4 + 7 + 6= 17 Put 4 and 6 together to make 10. Add on 7.*

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.

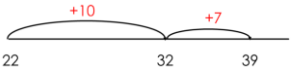
Missing number problems Use empty boxes to solve missing number problems which need to be placed in all possible places (supported by models and images)

Addition Year 2

- Use place value and number facts to solve problems. - Recall and use addition and number facts to 20 fluently and derive and use related facts to 100 - Add numbers using concrete objects, pictures and mentally including: TO+O, TO+T, TO+TO, O+O+O. - Show that addition of 2 numbers can be done in any order (commutative) - Solve problems with Addition using concrete objects and pictures.
- Solve missing number problems. - Partition numbers in different ways e.g. 23=20+3 23=10+13

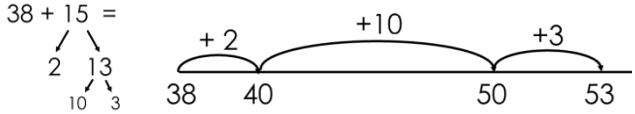
Continue to consolidate strategies from Year 1 and use a range of representations/ number lines to develop understanding of:

Partitioning one number, then adding tens and ones *Pupils can choose themselves which of the numbers they wish to partition. Pupils will begin to see when this method is more efficient than adding tens and taking away the extra ones, as shown. Using number lines or tracks to support.*



Adding multiples of ten *Using the vocabulary of 1 ten, 2 tens, 3 tens etc. alongside 10, 20, 30 is important, as pupils need to understand that it is a **ten** and not a one that is being added.*

Make ten strategy *How pupils choose to apply this strategy is up to them; focus on efficiency.*



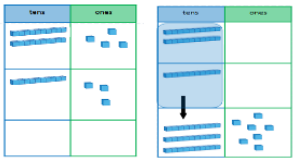
Adding 9 or 11 by adding 10 and adjusting by 1, rounding one number, then adding the tens and taking away extra ones

Using known facts *Dienes blocks should be used alongside pictorial and abstract representations when introducing this strategy. E.g 3 + 4 = 7, 30 + 40 = 70*

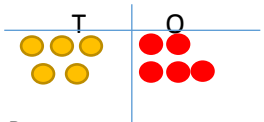
TOWARDS A WRITTEN METHOD:

Partitioning to add *Place value grids and Dienes blocks should be used as shown in the diagram before moving onto the pictorial representations. Dienes blocks should always be available, focus on place value.*

24 + 13

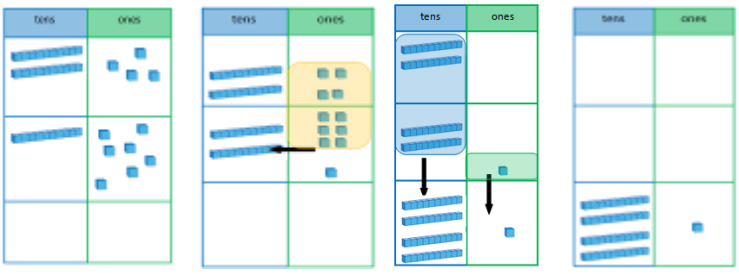


After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions.



Progress on to regrouping, first add the ones, regroup 10 ones to 1 ten. Next add the tens.

24 + 17



Expanded written method:

20 + 4

\+ 10 + 7

30 + 11 = 41

Addition Year 3

- Add and subtract numbers mentally, including: a. a three-digit number and ones, a three-digit number and tens, a three-digit number and hundreds. - Add and numbers with up to three digits, using formal written methods of columnar addition - Estimate the answer to a calculation and use inverse operations to check answers. - Solve problems, including missing number problems, using number facts, place value, and more complex addition

Continue to consolidate strategies from year 2 where required, manipulatives with numbers appropriate to the unit pupils are working within

Children need to choose strategy to mentally complete calculations

Using known number facts, counting on, partitioning tens and ones, compensation and rounding, bar models etc. *It is important that pupils are given plenty of (scaffolded) practice at choosing their own strategies to complete calculations efficiently and accurately (use number lines, number tracks, hundred squares). Explicit links need to be made between familiar number facts and the calculations that they can be useful for and pupils need to be encouraged to aim for efficiency.*

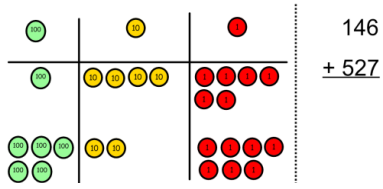
No regrouping	
345 + 30	274 - 50
1128 + 300	1312 - 300
326 + 342	856 - 724
945 + 1000	3892 – 1000

With some regrouping	
416 + 25	232 - 5
383 + 130	455 - 216
611 + 194	130 - 40
1482 + 900	2382 - 500

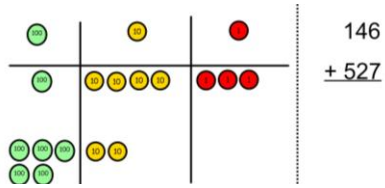
Column method- regrouping

As in Year 2, pupils should be given plenty of practice with calculations that require multiple separate instances of regrouping. In Year 3 they become more familiar with calculations that require 'regrouping to regroup'. Understanding must be secured through the considered use of manipulatives and images, combined with careful use of language. Pupils should be challenged as to whether this is the most efficient method, considering whether mental methods (such as counting on, using known number facts, compensation.) may be likelier to produce an accurate solution.

Make both numbers on a place value grid.



Add up the units and exchange 10 ones for one 10.



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.

Children can draw a pictoral representation of the columns and place value counters to further support their learning and understanding.

Some children may begin to use a formal columnar algroithm, initially introduced alongside the expanded formal method. The formal method should be seen as more streamlined version of the expanded method, not a new method.

$$\begin{array}{r} 536 \\ +\ 85 \\ \hline 621 \\ \hline 1\ 1 \end{array}$$

Addition Year 4

- Add numbers with up to 4 digits using the formal written methods of columnar addition where appropriate - Estimate and use inverse operations to check answers to a calculation - Solve addition two-step problems in contexts

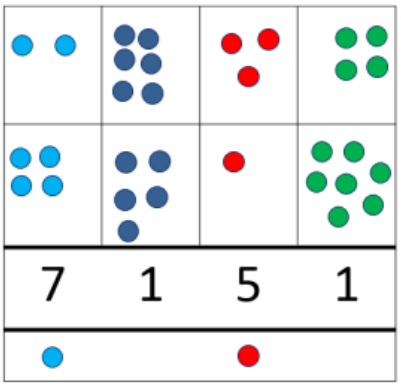
Add and subtract multiples of 10, 100 and 1000 mentally

By Year 4 pupils are confident in their place value knowledge and are calculating mentally both with calculations that do not require regrouping and with those that do. Initially they count on and back in steps of ten, one hundred and one thousand. These should be practised regularly, ensuring that boundaries where more than one digit changes are included. Pupils should extend this knowledge to mentally adding and subtracting multiples of 10, 100 and 1000. Counting in different multiples of 10, 100 and 1000 should be incorporated into transition activities and practised regularly.

Mental Methods

Pupils should continue to develop, supported by a range of models and images, including the number line. The bar model should continue to be used to help with problem solving.

Written methods (progressing to 4 – digits)



$$\begin{array}{r} 2634 \\ +4517 \\ \hline 7151 \\ \hline {\scriptstyle 1\quad 1} \end{array}$$

Children should be able to make the choice of reverting to expanded methods if experiencing any difficulty.

As the children move on, introduce decimals with the same number of decimal places and different. Money can be used here.

$$\begin{array}{r} 72.8 \\ +\,54.6 \\ \hline 127.4 \\ \hline {\scriptstyle 1\ 1} \end{array}$$

$$\begin{array}{rr} & £23.59 \\ + & £\ 7.55 \\ \hline & £31.14 \\ & {\scriptstyle 1\ \ 1\ \ \ 1} \end{array}$$

Subtraction Year 1

- Identify 1 less.- Know number bonds and related subtraction facts to 20 e.g. 9+7=16; 16-7=9. - Subtract 1-digit and 2-digit numbers to 20, including 0. - Solve 1-step problems involving subtraction using concrete objects and pictures. - Solve missing number problems e.g. 7 = ☐ - 9

Understand subtraction as taking away, take away ones *use physical objects, counters, cubes etc to show how objects can be taken away.*

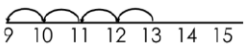
Counting back

Subtracting 1, 2, or 3 by counting back

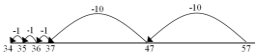
Make the larger number in your subtraction. Move the beads along your bead string as you count backwards in ones.

Use counters, 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



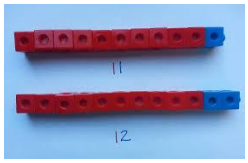
Start at the bigger number and count back the smaller number showing the jumps on the number line.



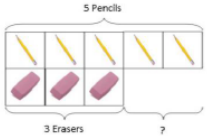
Put 13 in your head, count back 4. What number are you at? Use your fingers to help.

Understand subtraction as finding the difference

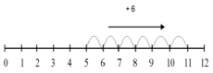
Use cubes to build towers or make bars to find the difference



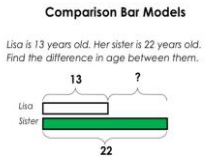
Use basic bar models with items to find the difference



Count on to find the difference.

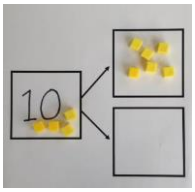


Draw bars to find the difference between 2 numbers.

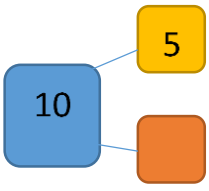


Part whole model

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?



Move to using numbers within the part whole model

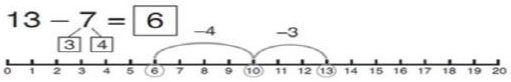
Subtraction Year 1 Continued

Make 10

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.

14 – 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?

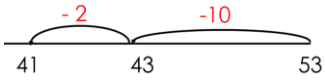
How many do we have left to take off?

Subtraction Year 2

- Use place value and number facts to solve problems. - Subtract numbers using concrete objects, pictures and mentally – Understand that subtraction is not commutative - Solve problems with Subtraction using concrete objects and pictures. - Recognise and use the inverse relationship between Addition/Subtraction and use to check calculations and solve missing number problems. - Partition numbers in different ways.

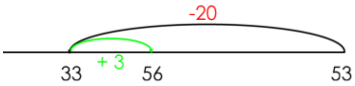
Continue to use a range of representations, use number lines to model take-away and difference, the bar model should continue to be used

Subtracting tens and ones

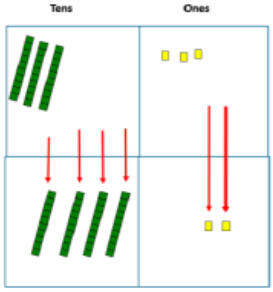


53 – 12 = 41

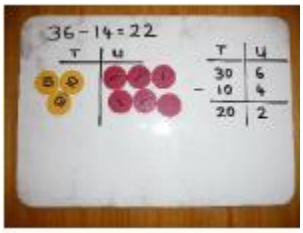
Subtracting tens and adding extra ones *Pupils must be taught to round the number that is being subtracted.*



Towards written methods *Record subtraction in expanded columns, support understanding of place value and prepare for efficient written methods with larger numbers, use dienes apparatus.*



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.

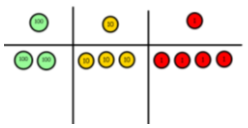
Subtraction Year 3

- Subtract numbers mentally, including: a three-digit number and ones, a three-digit number and tens, a three-digit number and hundreds. - Subtract numbers with up to three digits, using formal written methods of subtraction. Estimate the answer to a calculation and use inverse operations to check answers. - Solve problems, including missing number problems, using number facts, place value, and more complex addition and subtraction.

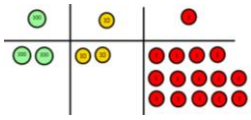
Mental Methods *pupils should continue to develop, supported by a range of models and images, including the number line and bar model. Children should make choices about whether to use complementary addition, counting on or back etc.*

Written methods (progressing to 3 – digits)

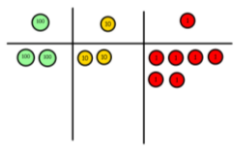
Use Base 10 to start with before moving on to place value counters. Start with one exchange before moving onto subtractions with 2 exchanges. Make the larger number with the place value counters



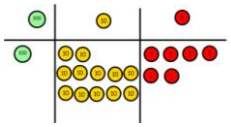
Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones.



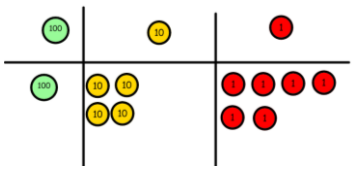
Now I can subtract my ones.



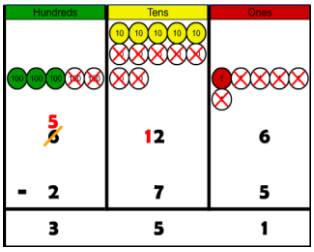
Now look at the tens, can I take away 8 tens easily? I need to exchange one hundred for ten tens.



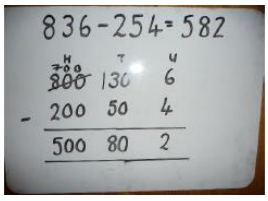
Now I can take away eight tens and complete my subtraction



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.



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.



Children can start their formal written method by partitioning the number into clear place value columns.

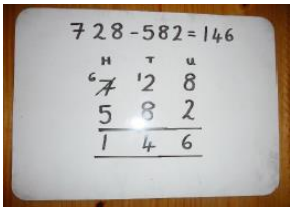
Subtraction Year 4

- Subtract numbers with up to 4 digits using the formal written methods of columnar subtraction where appropriate - Estimate and use inverse operations to check answers to a calculation - Solve addition and subtraction two-step problems in contexts, deciding which operations and methods to use and why.

Add and subtract multiples of 10, 100 and 1000 mentally, mental methods

Continue strategies from year supported by a range of models, children continue to develop efficiency in chosen methods

Formal compact method



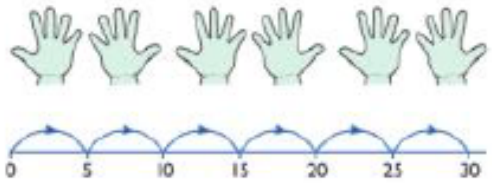
This will lead to an understanding of subtracting any number including decimals.

$$\begin{array}{rrrcr} & 5 & 12 & & 1 \\ & 2 & \cancel{6} & \cancel{3} & . \quad \mathbf{0} \\ - & & 2 & 6 & . \quad 5 \\ \hline & 2 & 3 & 6 & . \quad 5 \end{array}$$

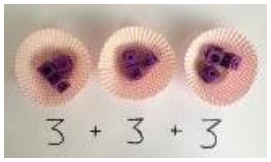
Multiplication Year 1

- Solve 1-step problems involving multiplication using objects, pictures and arrays with support.

Count 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.*



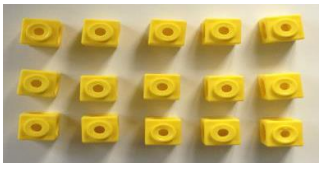
Repeated Addition *Use different objects to add equal groups*



There are 3 plates. Each plate has 2 star biscuits on. How many biscuits are there?

2 add 2 add 2 equals 6

Arrays- showing commutative multiplication *Use arrays to understand multiplication can be done in any order, create arrays using counters/ cubes to show multiplication sentences, pick up five, 4 times etc.*



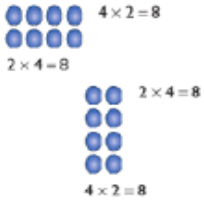
Multiplication Year 2

- x2, x5, x10 Recognise odd and even numbers. - Write numbers sentences for 2, 5 and 10 times tables and their related division facts. - Show that multiplication of 2 numbers can be done in any order but division cannot.- Solve problems involving x/÷ using materials, arrays, repeated addition, mental methods and x/÷ facts.

Skip counting in multiples of 2, 3, 4, 5, 10 from 0

Multiplication as repeated addition *Pupils apply skip counting to help find the totals of these repeated additions.*

Arrays *Draw arrays in different rotations to find* ***commutative*** *multiplication sentences.*



Use an array to write multiplication sentences and reinforce repeated addition.

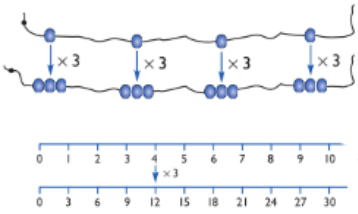
5 + 5 + 5 = 15

3 + 3 + 3 + 3 + 3 = 15

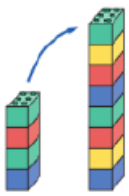
5 x 3 = 15

3 x 5 = 15

Scaling Begin to develop understanding of multiplication as scaling (3 times bigger/taller)

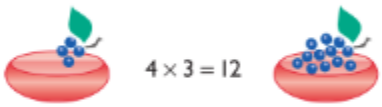


Doubling



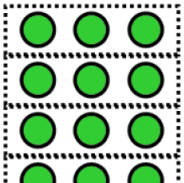
16

Use practical activities to show how to double a number.



Bar modelling *to represent the parts, the whole and the number of parts in multiplication wo problems*

There are 4 bags of sweets with 3 sweets in each bag.
How many sweets are there altogether?



Doubling numbers up to 10 + 10
Link with understanding scaling
Using known doubles to work out double 2d numbers
(double 15 = double 10 + double 5)

Multiplication Year 3

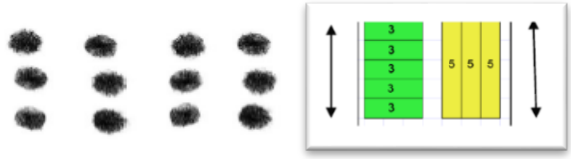
- Recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables. - Write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods. - Solve problems, including missing number problems, involving multiplication including positive integer scaling problems and correspondence problems in which n objects are connected to m objects.

Doubling to derive new multiplication facts

Skip counting in multiples of 2, 3, 4, 5, 6, 8 and 10

Doubling 2 digit numbers using partitioning

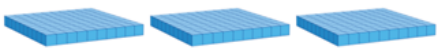
Use of part-part-whole model with arrays and bar models to establish commutativity and inverse relationship between multiplication and division



Ten times bigger

3 × 1 = 3

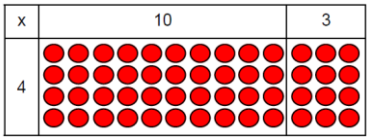
3 × 100 = 300



Using known facts, place value knowledge

7 × 3 = 21
7 × 30 = 210
70 × 3 = 210
70 × 30 = 2100
700 × 3 = 2100
7 × 300 = 2100

Grid method (partitioning, no regrouping)



×	10	2
3		

Grid method (partitioning, no regrouping)

Give children opportunities for children to explore this and deepen understanding using Dienes apparatus and place value counters

×	10	4
3	30	12

×	30	5
7	210	35

210 + 35 = 245

Multiplication 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.

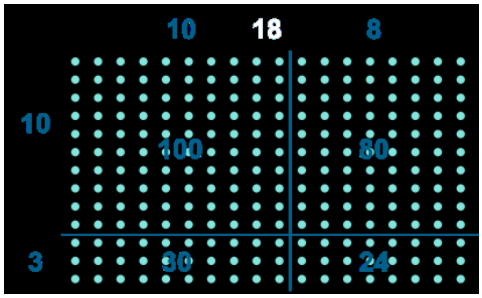
Mental methods *Counting in multiples of 6, 7, 9, 25, 100 and steps of 1/100*

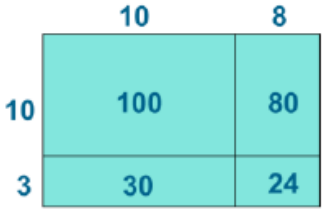
Mental multiplication of any 2-digit number by a 1-digit number, using distributive law

As well as partitioning into tens and ones (a familiar strategy), they begin to explore compensating strategies and factorisation to find the most efficient solution to a calculation.

Mental multiplication of 3 1-digit numbers, using the associative law, *choose the most efficient order to complete calculations*

Written methods *Embed and deepen their understanding of the grid method, ensure this is still linked back to their understanding of arrays and place value counters.*





Short multiplication of 3-digit number by 1-digit number

228 × 3 = ☐

200 × 3=

20 × 3 =

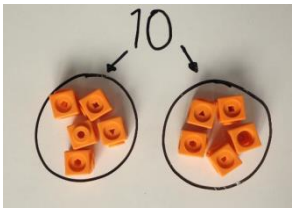
8 × 3 =

$$\begin{array}{r} 228 \\ \times \quad 3 \\ \hline \\ \hline \end{array}$$

Division Year 1

Sharing objects into groups

Pupils should become familiar with division equations through working practically.
The division symbol is not formally taught at this stage.

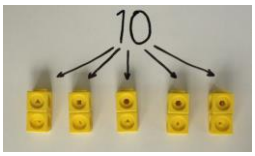


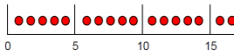
I have 10 cubes, can you share them equally in 2 groups?

Division Year 2

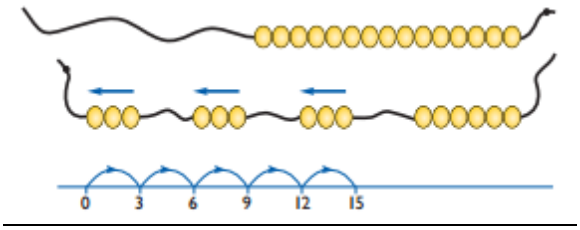
Know and understand sharing and grouping – introducing children to the ÷ sign

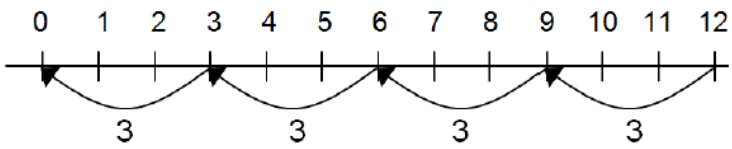
Division as grouping *Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.*



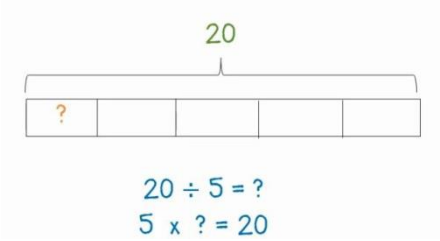


Grouping using a number line *Use a number line to show jumps in groups. The number of jumps equals the number of groups*

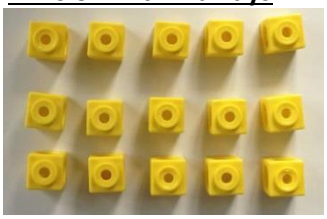




Think of the bar as a whole. Split it into the number of groups you are dividing by and work out how many would be within each group.



Division within arrays



Link division to multiplication by creating an array and thinking about the number sentences that can be created.

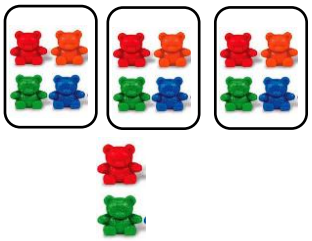
Eg 15 ÷ 3 = 5 5 x 3 = 15
15 ÷ 5 = 3 3 x 5 = 15

Division Year 3

Remainders

Divide objects between groups and see how much is left over

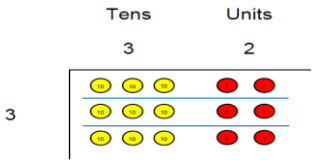
14 ÷ 3 =



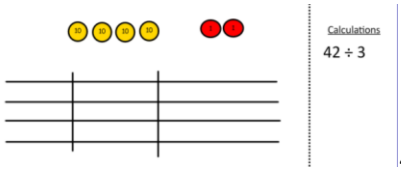
Jump forward in equal jumps on a number line then see how many more you need to jump to find a remainder.

Draw dots and group them to divide an amount and clearly show a remainder.

Short division



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

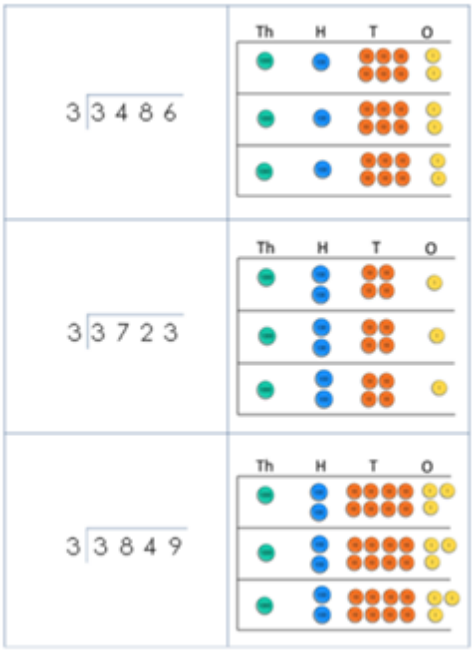


42 ÷ 3=

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.

Division Year 4

Short division – *Bus stop method, no remainders*



$$\begin{array}{r} 2\ 1\ 8 \\ 4\overline{)\,8\ 7\ 2} \\ \quad\ 3 \end{array}$$

Credit to and materials taken and compiled from Westerhope draft calculation policy, Mastery Mathematics Calculation Policy, Oakham Church of England Calculation policy and NCETM calculation guidance.