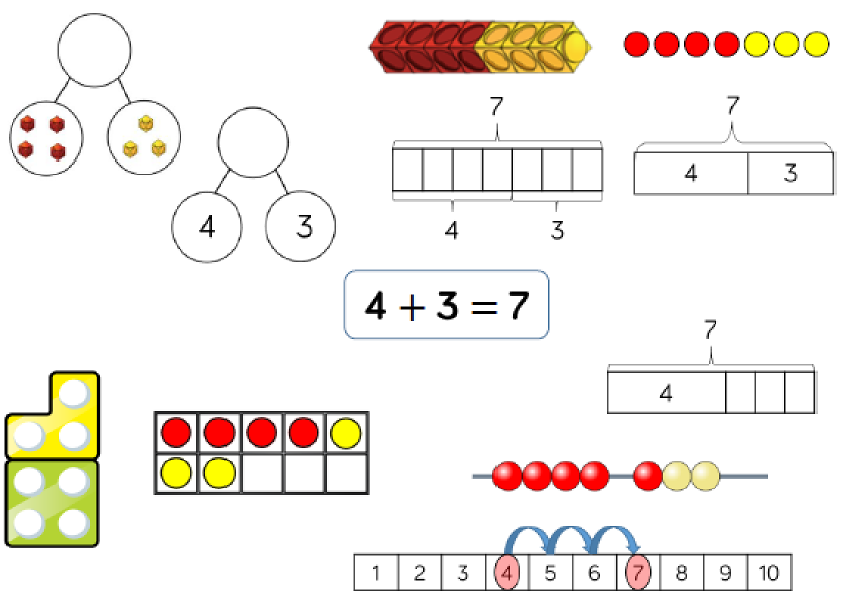
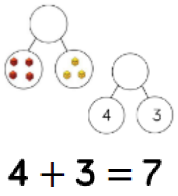
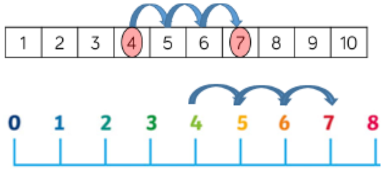
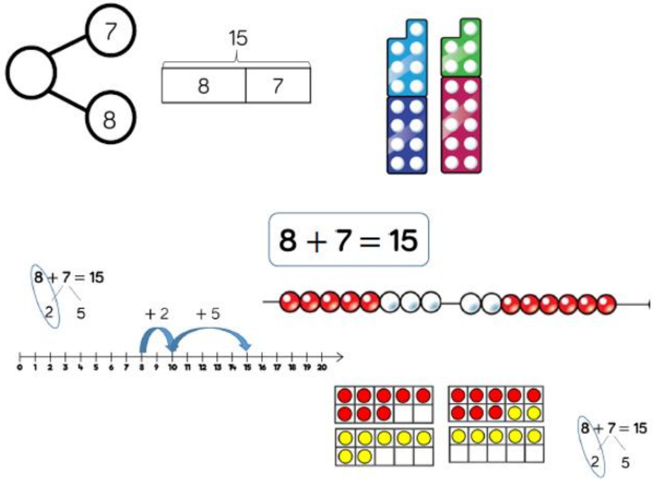
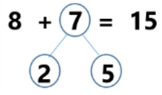
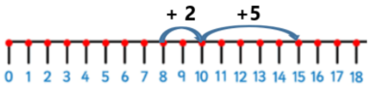
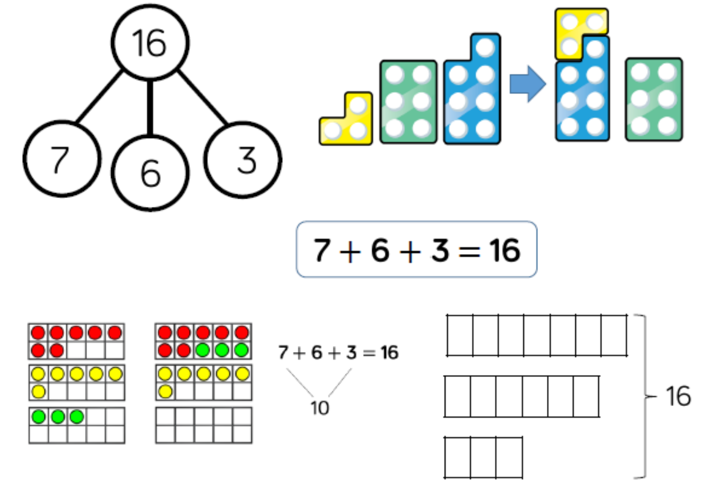
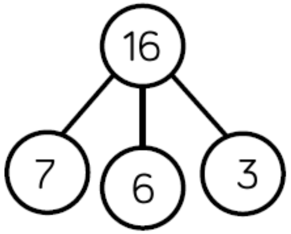
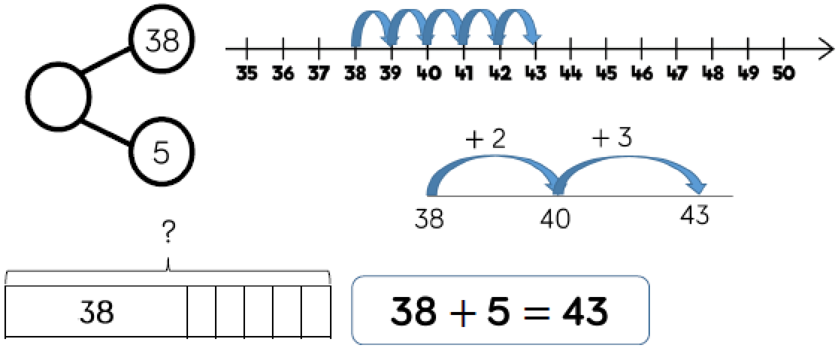
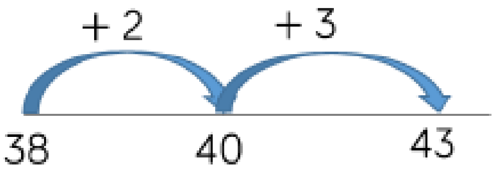
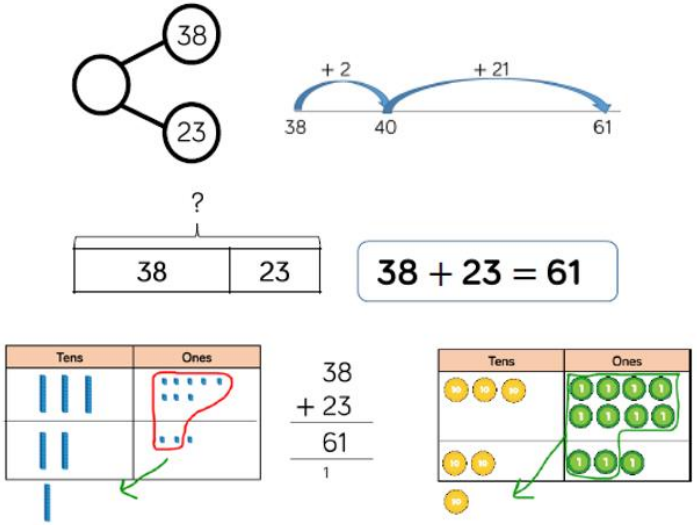
Willowbrook School Calculation Policy

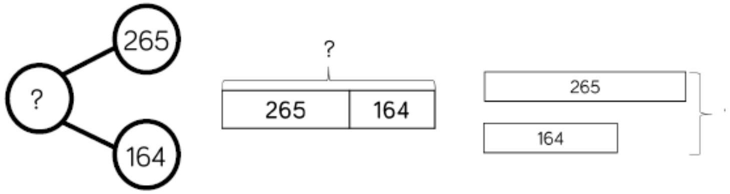
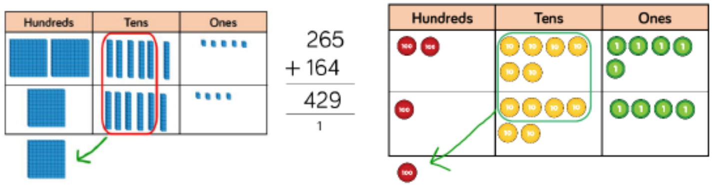
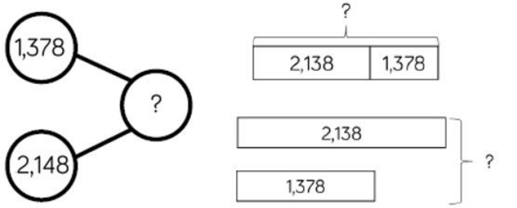
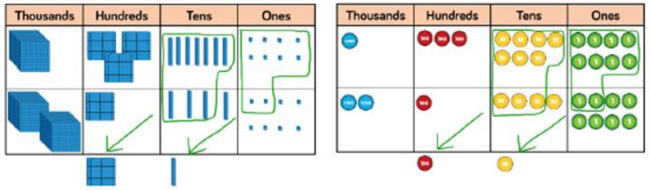
Last updated: 2021

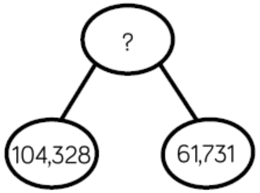
Contents

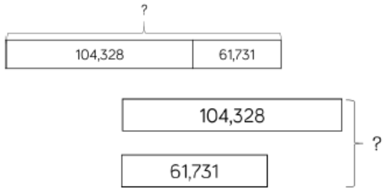
Addition Progression

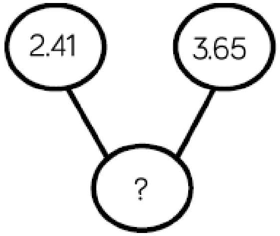
Year group	Skill	Visuals / concrete apparatus	Written algorithms	Notes/guidance
1	Add 1-digit numbers within 10		In Year 1, children will do lots of practical work using the kind of equipment pictured. **Aggregation (combining parts)** They will consolidate their understanding of 'part-whole', recording combinations of parts in part-whole diagrams before learning to record this as a written calculation.  **Augmentation (adding to a quantity)** When solving simple problems, children can learn to count-on using a pre-prepared number track (and then on number lines as the year progresses). 	Teachers need to ensure that children count accurately (1:1 correspondence) when adding values together. They should also check that children understand **conservation of number -** meaning they know they can count on from one number when adding, rather than having to start at 0.
1	Add 1 and 2-digit numbers to 20		From a young age, we want children to learn to bridge through multiples of ten when adding, developing efficient mental methods for adding. One way to model the recording of this is as follows:  These jumps can also be shown on a number-line:  Over time, children can learn to draw out simple number lines of their own when doing this.	Bridging through ten relies on children being able to partition single-digit numbers confidently. It also depends on children knowing number bonds to 10.
2	Add 1 and 2-digit numbers to 20			

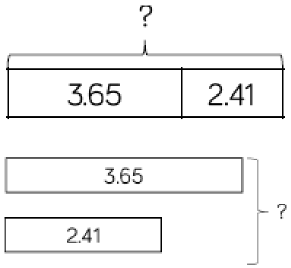
	Add three 1-digit numbers		The addition of three smaller numbers will be done mentally but can be recorded in part-whole diagrams and as written calculations:  7 + 6 + 3 = 16	Children should be encouraged to look for number bonds to 10 or doubles/near doubles to add more efficiently. They need to look at the commutativity of addition – knowing they can add in any order, choosing the most efficient order.
	Add 1-digit and 2-digit numbers to 100		Children should make simple jottings on a number line to show the jumps they've taken:  38 + 5 = 43	Children should learn to count on from the larger number. Known bonds should be explicitly linked to similar examples, e.g. "If I know that 8 + 4 = 12 then I know 38 + 4 = 42"
	Add 2-digit numbers to 100		Before the end of Year 2, we introduce the formal algorithm for addition, alongside practical equipment to encourage understanding. The exact timing is based on the teacher's judgement. $\begin{array}{r} 38 \\ +\ 23 \\ \hline 61 \\ \hline 1 \end{array}$ A helpful link for the process of teaching this algorithm: https://bit.ly/3k2Fkb9	When adding two-digit numbers, children should be encouraged to apply mental approaches where appropriate. E.g. children should be encouraged to use partitioning, e.g. 53+24 = 50+20+3+4 = 77

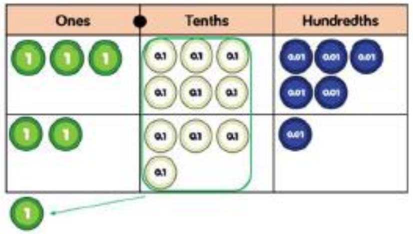
3	Add 1-digit and 2-digit numbers to 100	See equivalent row in the Y2 section.		
	Add 2-digit numbers to 100	See equivalent row in the Y2 section.		
	Add numbers with up to 3-digits	 265 + 164 = 429  	During Year 3, the formal algorithm for addition is used to solve 3-digit additions, but still alongside practical equipment and/or visuals to encourage understanding – particularly of regrouping. 265 + 164 429 1	Children should be encouraged to make rough estimates before calculating. This will help them to spot if they have made a mistake after completing their calculation. Careful recording of calculations becomes more important as numbers become larger.
4	Add numbers with up to 4-digits	 1,378 + 2,148 = 3,526  	During Year 4, the formal algorithm for addition is used to solve 4-digit additions, but still alongside practical equipment and/or visuals to encourage understanding - particularly of regrouping. 1 3 7 8 + 2 1 4 8 3 5 2 6 1 1	Children should make rough estimates before calculating. Careful recording of calculations becomes more important as numbers become larger.

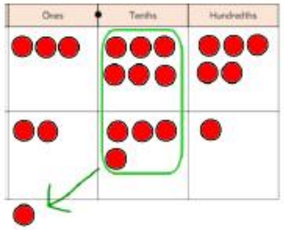
<table>
<tr>
<td rowspan="2">5/6</td>
<td>Add numbers with more than 4-digits</td>
<td>




104,328 + 61,731 = 166,059
</td>
<td>
1 0 4 3 2 8
+ 6 1 7 3 1
1 6 6 0 5 9
1
</td>
<td>At this stage, children should be encouraged to work in the abstract, using this method to add larger numbers efficiently.</td>
</tr>
<tr>
<td>Add numbers with up to 3dp</td>
<td>


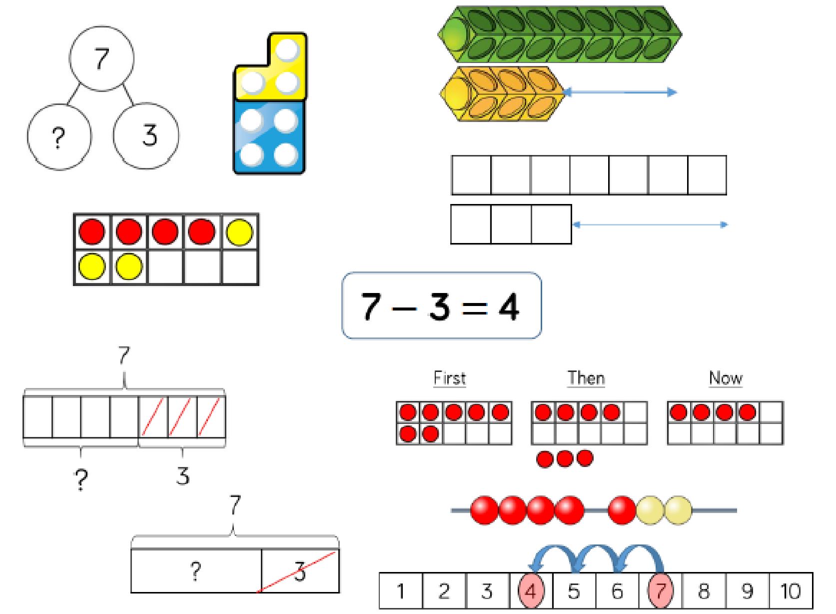
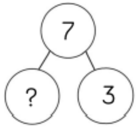
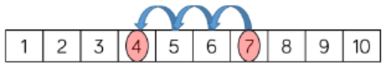
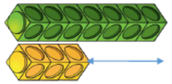
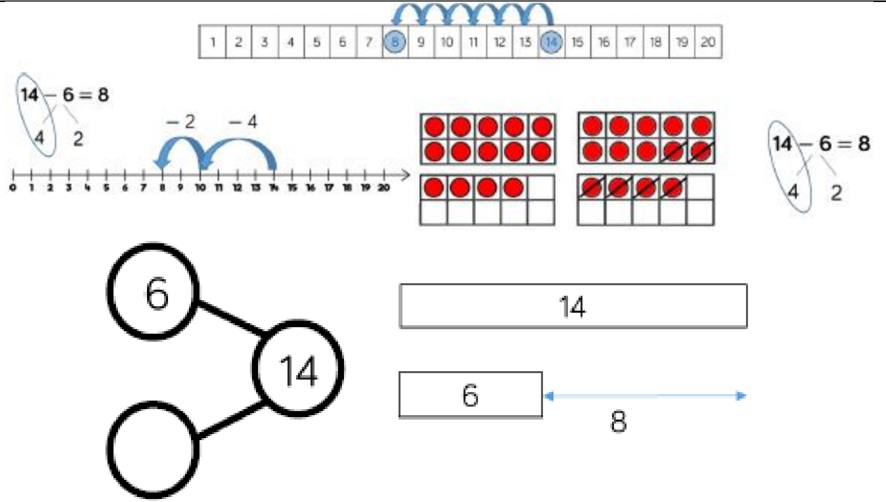
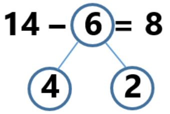
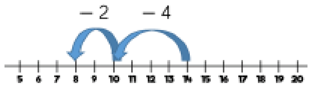


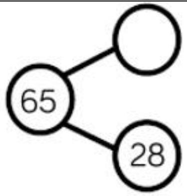
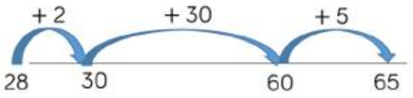
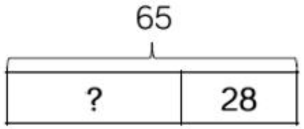
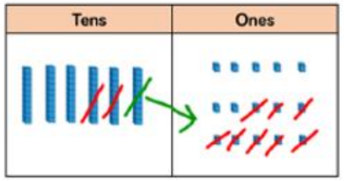
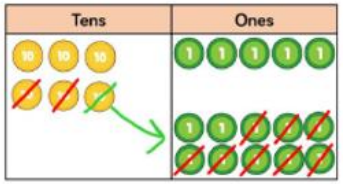
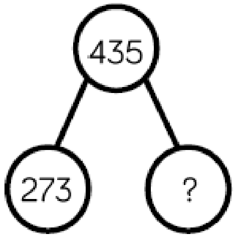
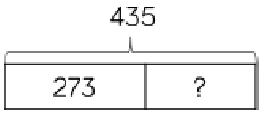
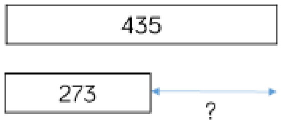
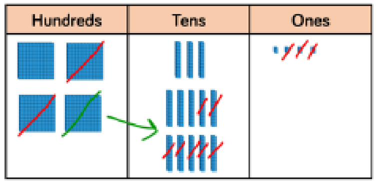
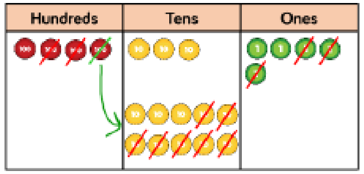
3.65 + 2.41 = 6.06


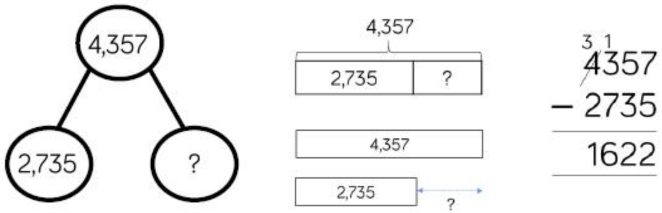
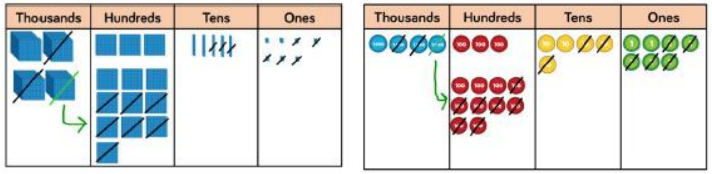
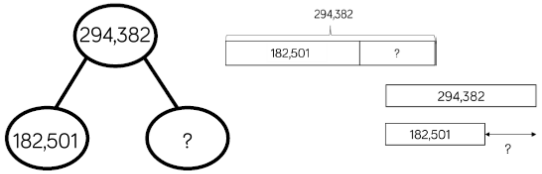
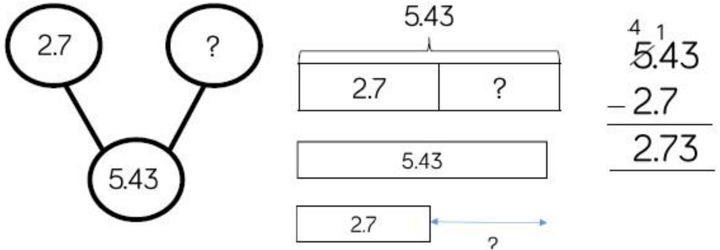
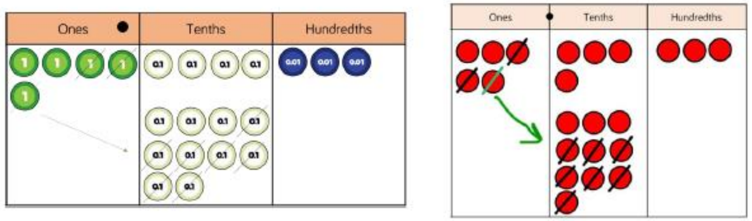


</td>
<td>
When children first start adding with decimals, it’s important they understand that the place value of the columns to the right of the decimal work in the same way as the columns to the left of the decimal. E.g. ten tenths make a whole, ten hundredths make a tenth, and so on.
3.65
+ 2.41
6.06
1
</td>
<td>It is very important children see that the decimal point is in a fixed position. When adding decimals with different amounts of digits, the decimals should always align.
Children should be encouraged to use mental methods when it is efficient to do so, e.g. 4.35 + 1.2.</td>
</tr>
</table>

Subtraction Progression

Year group	Skill	Visuals / concrete apparatus	Written algorithms	Notes/guidance
1	Subtract 1-digit numbers within 10		In Year 1, children will do lots of practical work using the kind of equipment pictured. **Part-whole idea** Children need to understand that when a part is missing, it can be found by subtracting the *known* part from the whole.  7 – 3 = 4 When solving simple problems, children can learn to take away using a pre-prepared number track (and then on number lines as the year progresses).  **Difference** Children should see that the 'gap' between the whole and the known part represents the value we are missing. This develops pupils' understanding of the inverse relationship of addition and subtraction. 	From a fairly early stage, children can compare the efficiency of taking away versus finding the difference. We want them to develop an understanding that difference is much more efficient when the numbers in the subtraction are of a similar size.
	Subtract 1-digit numbers to 20		From a young age, we want children to learn to bridge through multiples of ten when subtracting, developing efficient mental methods. One way to model the recording of this is as follows:  These jumps can also be shown on a number-line:  Over time, children can learn to draw out simple number lines of their own when doing this.	Bridging through ten relies on strong number bond knowledge. Children need to be explicitly taught to use a mental method (finding the difference) when subtracting with numbers of a similar size, e.g. 17-15 = 2.

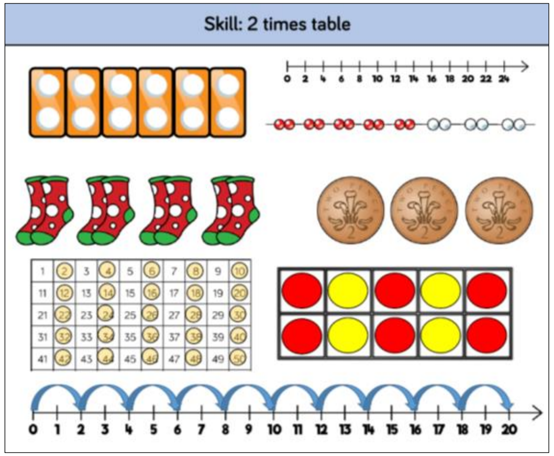
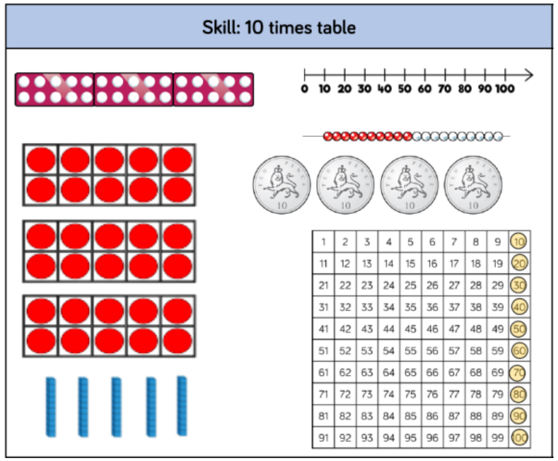
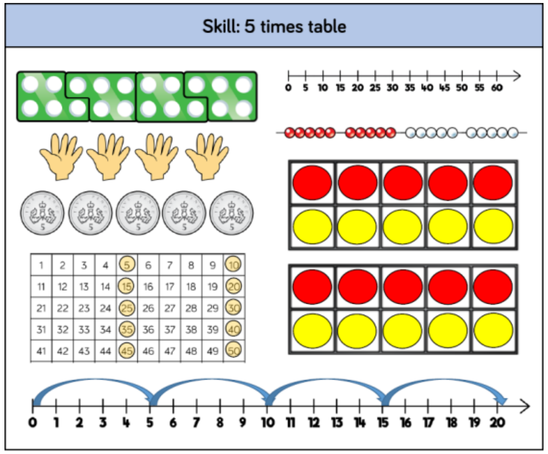
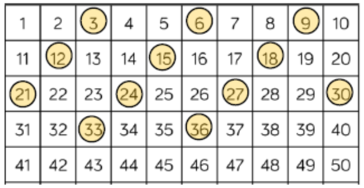
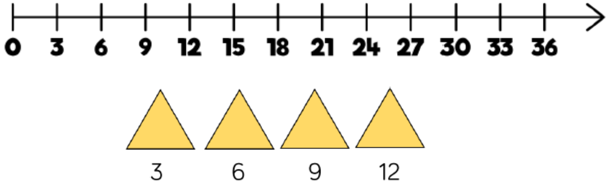
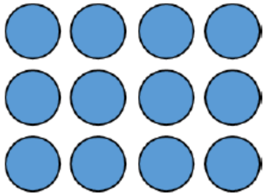
2	Subtract 1-digit numbers to 20	See equivalent row above in the Y1 section		
	Subtract 1 and 2-digit numbers to 100	   65 – 28 = 37  $\begin{array}{r} \overset{5}{\cancel{6}}{}^{1}5 \\ -\ 28 \\ \hline 37 \end{array}$ 	Before the end of Year 2, we introduce the formal algorithm for subtraction, alongside practical equipment to encourage understanding. The exact timing is based on the teacher's judgement. $\begin{array}{r} \overset{5}{\cancel{6}}{}^{1}5 \\ -\ 28 \\ \hline 37 \end{array}$ A helpful link for the process of teaching this algorithm: https://bit.ly/3qWU8JS	The idea of using 'difference' as a mental strategy remains important in Year 2. E.g. for 53 – 47, using columnar subtraction is very inefficient if we can simply see that 53 is 6 more than 47.
3	Subtract numbers with up to 3 digits	   435 – 273 = 262  $\begin{array}{r} \overset{3}{\cancel{4}}{}^{1}35 \\ -\ 273 \\ \hline 262 \end{array}$ 	During Year 3, the formal algorithm for subtraction is used to solve 3-digit subtractions, but still alongside practical equipment and/or visuals to encourage understanding – particularly of exchanging and regrouping. $\begin{array}{r} \overset{3}{\cancel{4}}{}^{1}35 \\ -\ 173 \\ \hline 262 \end{array}$ Example questions should also include the need to exchange 'across' a zero.	Children should be encouraged to make rough estimates before calculating as a way to spot if they have made a mistake once completing the algorithm. Careful recording of calculations becomes more important as numbers become larger.

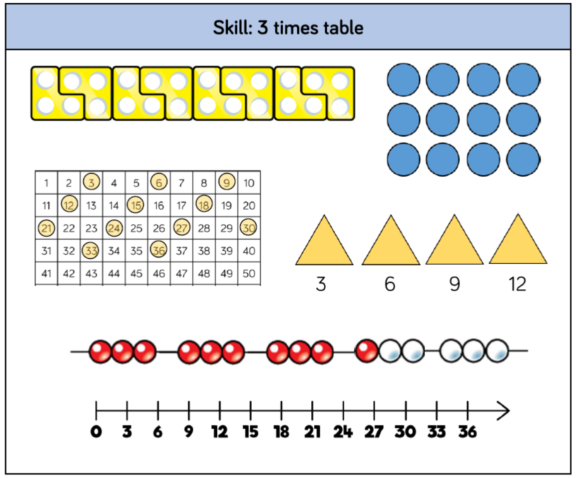
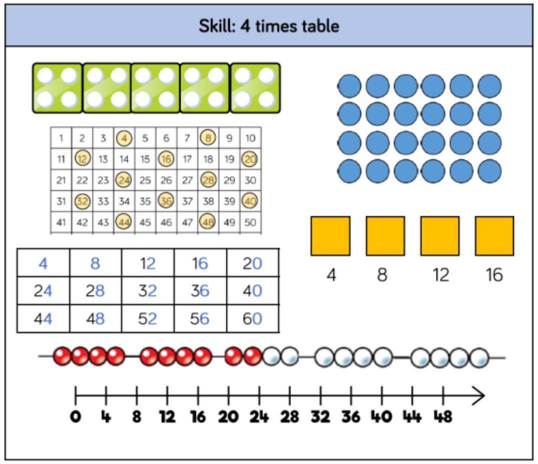
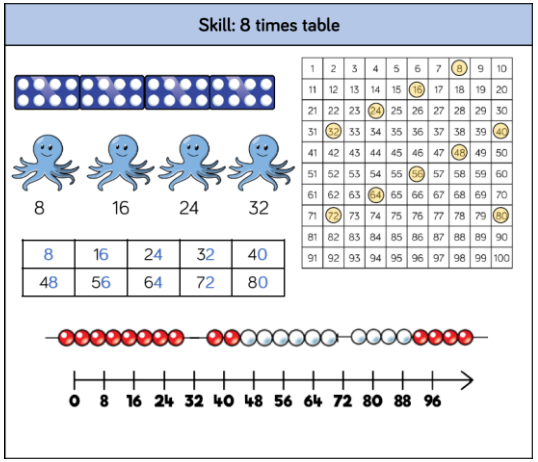
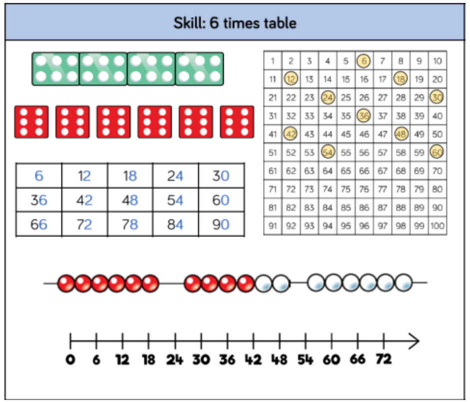
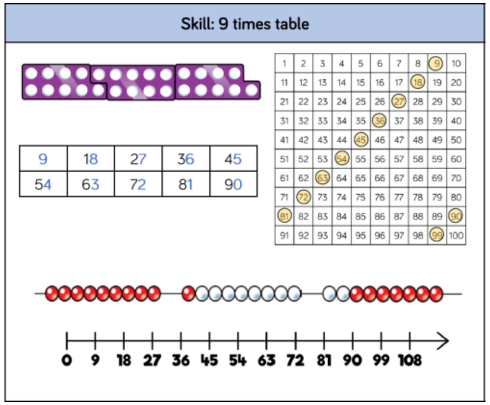
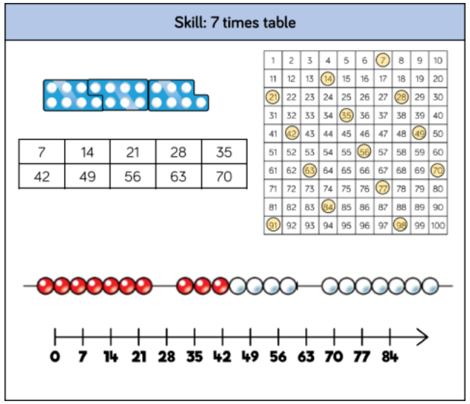
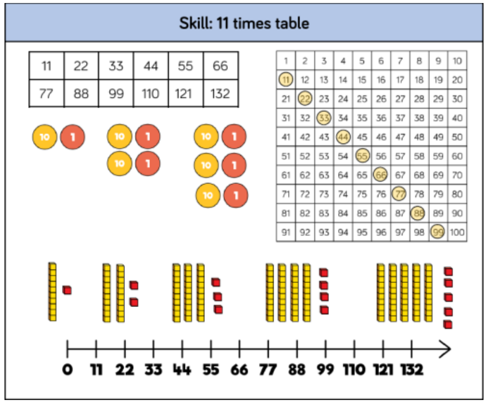
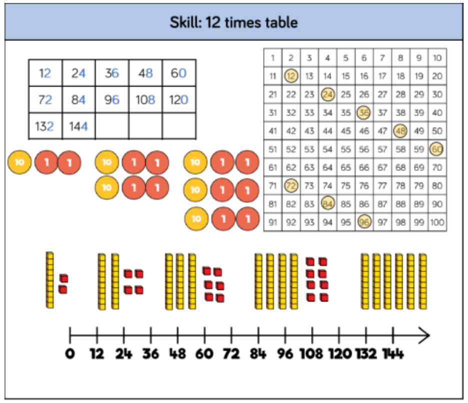
4	Subtract numbers with up to 4 digits	 **4,357 – 2,735 = 1,622** 	During Year 4, the formal algorithm for subtraction is used to solve 4-digit subtractions, but still alongside practical equipment and/or visuals to encourage understanding - particularly of exchanging and regrouping. $\begin{array}{r} {}^{3}\cancel{4}{}^{1}357 \\ -\ 2735 \\ \hline 1622 \\ \hline \end{array}$	Children should make rough estimates before calculating. Careful recording of calculations becomes more important as numbers become larger.
5/6	Subtract numbers with more than 4 digits	 **294,382 – 182,501 = 111,881**	$\begin{array}{c\|c\|c\|c\|c\|c\|c} & 2 & 9 & {}^{3}\cancel{4} & {}^{1}3 & 8 & 2 \\ \hline - & 1 & 8 & 2 & 5 & 0 & 1 \\ \hline & 1 & 1 & 1 & 8 & 8 & 1 \end{array}$	At this stage, children should be encouraged to work in the abstract, using this method to subtract larger numbers efficiently.
	Subtract numbers with up to 3 decimal places	 **5.43 – 2.7 = 2.73** 	When children first start subtracting with decimals, it's important they understand that the place value of the columns to the right of the decimal work in the same way as the columns to the left of the decimal. E.g. ten tenths make a whole, ten hundredths make a tenth, and so on. $\begin{array}{r} {}^{4}\cancel{5}.{}^{1}43 \\ -\ 2.7 \\ \hline 2.73 \\ \hline \end{array}$	It is very important children see that the decimal place is in a fixed position and should always align with the numbers in the calculation. When adding decimals with different amounts of digits, the decimals should always align. Children should use mental methods where more efficient, e.g. 6.75-2.5

Multiplication (times-tables progression)

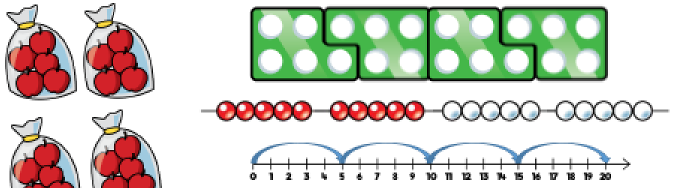
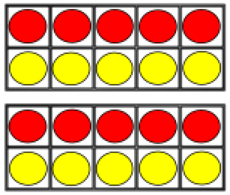
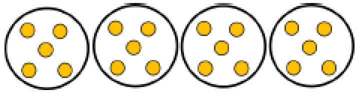
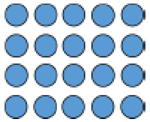
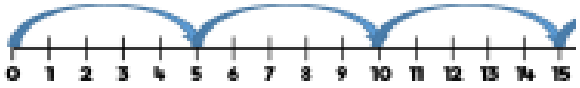
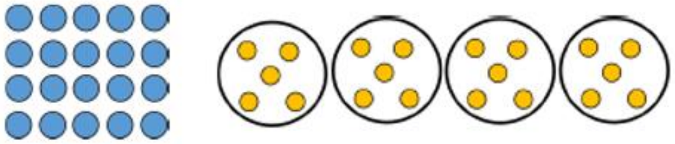
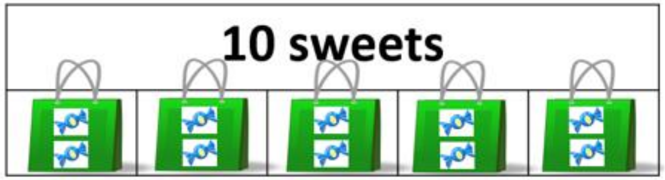
How do we develop pupils' tables knowledge?

Pupils' times-table knowledge is developed through daily counting, which extends to more rapid recall from Y2 onwards, once children become more familiar with the times table they are learning. Teachers will do a lot of counting stick work, as well as using the other visuals/concrete apparatus pictured below. Children are encouraged to spot patterns, and in doing so, they become familiar with the mathematical structure underlying each times table. Children are encouraged to make links between tables which are doubles/halves of each other (e.g. 10s and 5s, 3s and 6s). Teachers follow a termly planner for when each table is taught during the year (see Third Space Learning Planner). The automaticity of these facts is also supported by the use of 'Times Table Rockstars'.

Year group	Progression	Visuals / concrete apparatus
1	Count in 2s, 10s and 5s	 Skill: 2 times table  Skill: 10 times table  Skill: 5 times table
2	Know multiplication and division facts for 10s, 2s and 5s and	
	Extend to counting in 3s	  

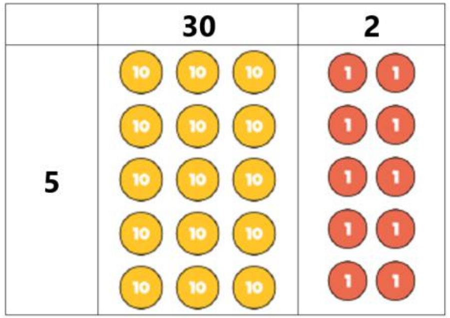
3	Know multiplication and division facts for 3s, 4s and 8s	 Skill: 3 times table  Skill: 4 times table  Skill: 8 times table
4	Know multiplication and division facts for 6s, 9s, 7s, 11s, 12s.	 Skill: 6 times table  Skill: 9 times table  Skill: 7 times table  Skill: 11 times table  Skill: 12 times table
5/6	Consolidate prior facts, increasingly using known facts with examples that are 10, 100 or 1000 times bigger/smaller.	

Multiplication Progression

Year group	Skill	Visuals / concrete apparatus	Written algorithms	Notes/guidance
1	Solve 1-step problems using multiplication	 One bag holds 5 apples. How many apples do 4 bags hold?    $5 + 5 + 5 + 5 = 20$ $4 \times 5 = 20$ $5 \times 4 = 20$	Children do not require a written algorithm at this stage as the size of numbers being used will be mainly within 20. A number line can be used informally to support their mental strategies of repeated addition: 	Children should be using their knowledge of 10s, 2s and 5s within the problems that they solve.
2	Solve 1-step problems using multiplication	 I put 2 sweets into 5 different party bags. How many sweets have I used altogether? 	Number lines can continue to be used to support pupils' mental methods in Year 2. Children may start to draw their own lines rather than needing to use pre-prepared examples. The main difference in Year 2 is that children will begin to record multiplication calculations using appropriate symbols.	Arrays are a key model for developing pupils' conceptual understanding of the commutative rule. The use of equal groups supports pupils' understanding of the inverse relationship of multiplication and division.

<table>
<tr>
<td>3</td>
<td>Understand the distributive law when multiplying two digit numbers by one-digit numbers. (Autumn-Spring)</td>
<td>

32 x 5



</td>
<td>

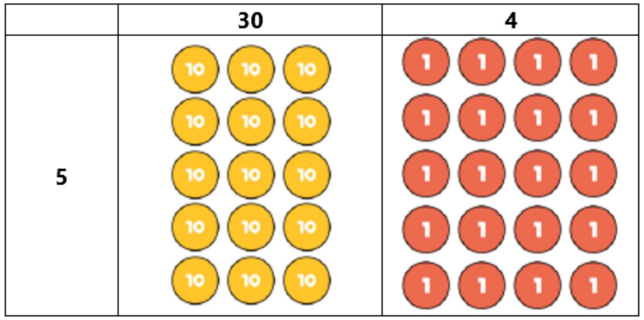
32 x 5 = 160

<table>
<tr><th></th><th>30</th><th>2</th></tr>
<tr><td>5</td><td>150</td><td>10</td></tr>
</table>

150 + 10 = 160

</td>
<td>The grid method helps children to see the distributive law in a very visual way and is a key step in their conceptual understanding of multiplication.</td>
</tr>
<tr>
<td></td>
<td>Use a formal algorithm for 2-digit x 1-digit numbers (Spring-Summer)</td>
<td>

As teachers introduce a more formal written layout (expanded version), they can represent this using the grid layout with place value counters. This helps children to see that we are essentially doing the same Maths in the formal layout as in the grid method, but simply laying it out in a more compact way.



5 x 30 = 150

5 x 4 = 20

150 + 20 = 170

When children are ready for the compact method, teachers can simply point out that the 2 tens made by 5 x 4 are put straight into the tens column (below the 3 tens) and added as we go, rather than at the end of the calculation.

</td>
<td>

Expanded:

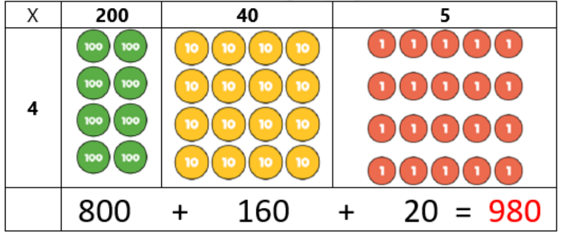
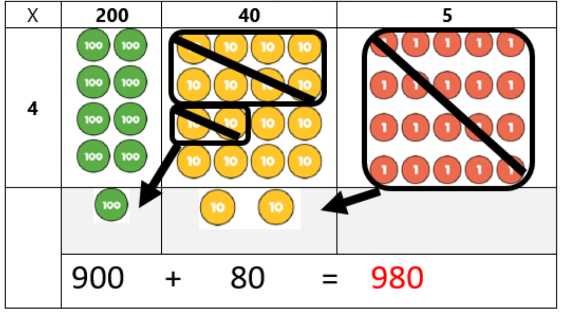
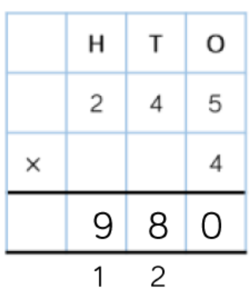
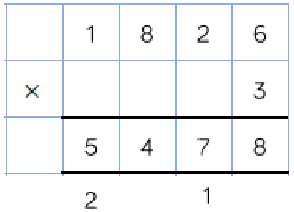
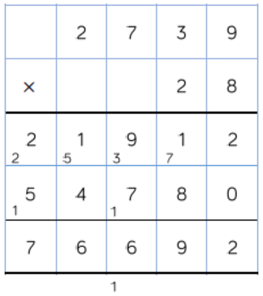
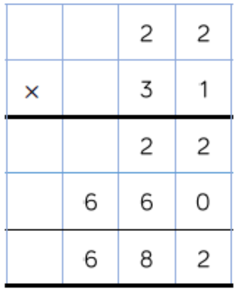
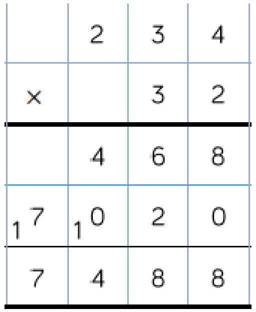
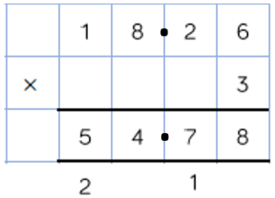
<table>
<tr><th></th><th>H</th><th>T</th><th>O</th><th></th></tr>
<tr><td></td><td></td><td>3</td><td>4</td><td></td></tr>
<tr><td>×</td><td></td><td></td><td>5</td><td></td></tr>
<tr><td></td><td></td><td>2</td><td>0</td><td></td></tr>
<tr><td>+</td><td>1</td><td>5</td><td>0</td><td></td></tr>
<tr><td></td><td>1</td><td>7</td><td>0</td><td></td></tr>
</table>

Short written (compact) method

<table>
<tr><th></th><th>H</th><th>T</th><th>O</th><th></th></tr>
<tr><td></td><td></td><td>3</td><td>4</td><td></td></tr>
<tr><td>×</td><td></td><td></td><td>5</td><td></td></tr>
<tr><td></td><td>1</td><td>7</td><td>0</td><td></td></tr>
<tr><td></td><td>1</td><td>2</td><td></td><td></td></tr>
</table>

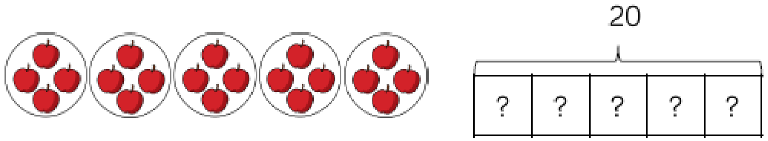
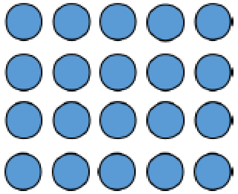
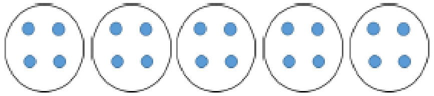
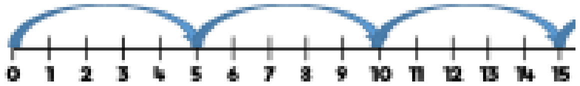
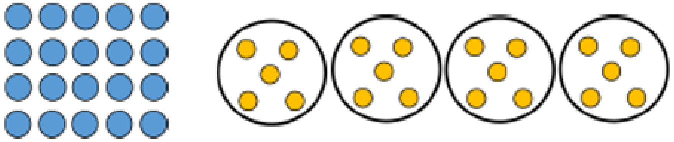
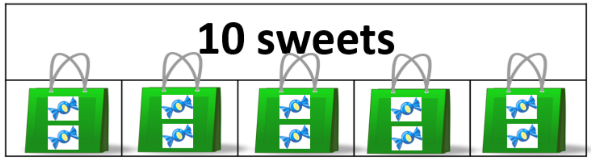
</td>
<td>The move to the expanded formal layout should happen in the Spring term – teachers make a judgement as to the exact timing of when the class are ready for this shift.

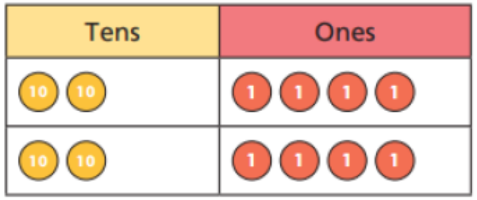
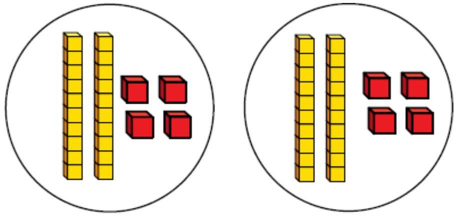
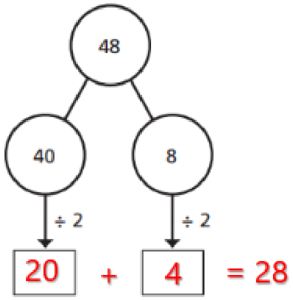
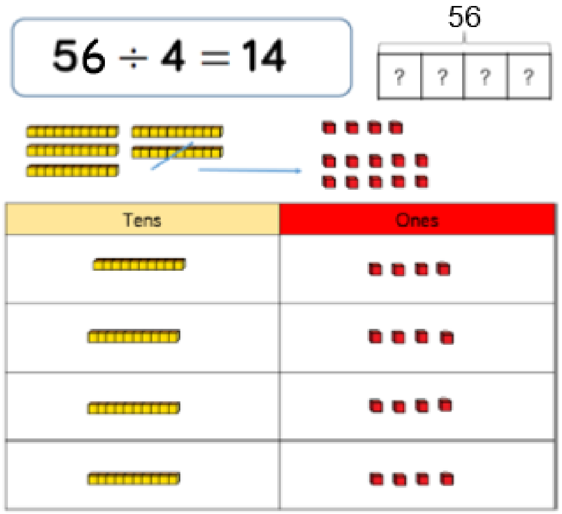
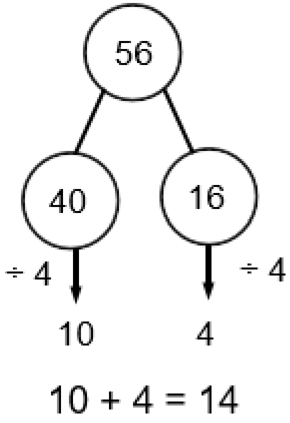
The expanded method should only be used for a short time to bridge children from the grid method to the more compact version.</td>
</tr>
</table>

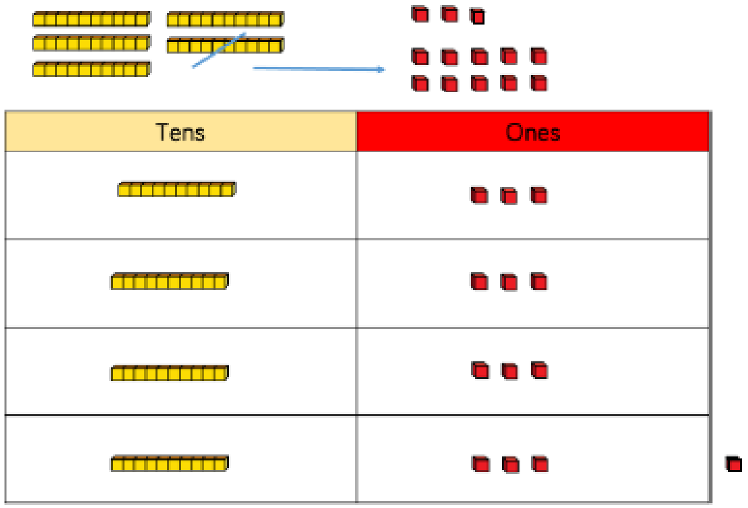
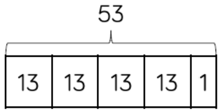
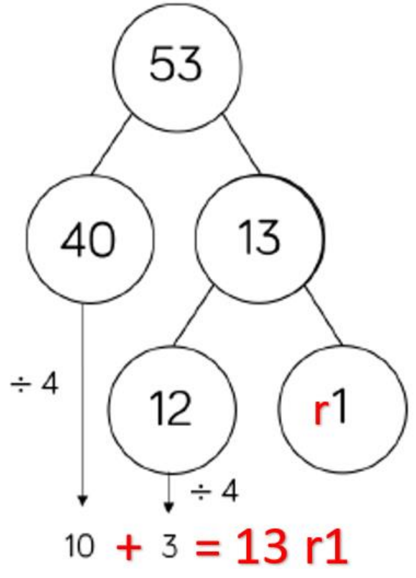
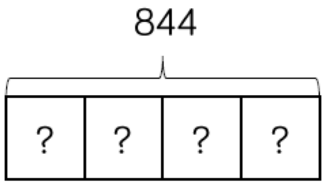
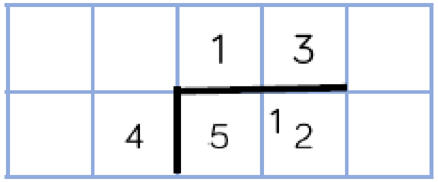
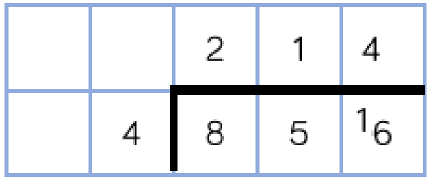
<table>
<tr>
<td>4</td>
<td>Use formal algorithm for 2-digit x 1-digit numbers and extend to 3-digit x 1-digit numbers.</td>
<td>Without regrouping:

With regrouping:
 </td>
<td>
<table>
<tr><td></td><td>H</td><td>T</td><td>O</td></tr>
<tr><td></td><td>2</td><td>4</td><td>5</td></tr>
<tr><td>×</td><td></td><td></td><td>4</td></tr>
<tr><td></td><td>9</td><td>8</td><td>0</td></tr>
<tr><td></td><td>1</td><td>2</td><td></td></tr>
</table>
The visuals (left) are not a method, but a way of visualising what is happening within the written algorithm. When using these visuals, teachers must explicitly show children how groups of ones are regrouped into tens, and groups of tens into 100. In this example, it's good for children to see how 800+160+20 gives us the same answer as when we've regrouped using the place value columns in the short written algorithm. Regrouping while we calculate just makes the process of adding the total up more efficient.</td>
<td>Examples chosen by teachers should give children lots of opportunities to apply the tables they've been learning in class.</td>
</tr>
<tr>
<td>5/6</td>
<td>Use formal algorithm for:
4-digit x 1-digit,
4-digit x 2-digit,
2-digit x 2-digit,
3-digit x 2-digit, and
whole numbers x decimal numbers.</td>
<td colspan="2">By Year 5/6, children's conceptual knowledge of place value should be secure enough for them to focus on the efficient algorithms for written multiplication without need for visual representations. However, the grid representation (with place value counters) that was used throughout lower KS2 can still be drawn upon to address any misconceptions.
<table>
<tr><th>4-digit x 1-digit</th><th>4-digit x 2-digit</th><th>2-digit x 2-digit</th><th>3-digit x 2-digit</th><th>Whole x decimals</th></tr>
<tr>
<td>
<table>
<tr><td></td><td>1</td><td>8</td><td>2</td><td>6</td></tr>
<tr><td>×</td><td></td><td></td><td></td><td>3</td></tr>
<tr><td></td><td>5</td><td>4</td><td>7</td><td>8</td></tr>
<tr><td></td><td>2</td><td></td><td>1</td><td></td></tr>
</table></td>
<td>
<table>
<tr><td></td><td>2</td><td>7</td><td>3</td><td>9</td></tr>
<tr><td>×</td><td></td><td></td><td>2</td><td>8</td></tr>
<tr><td>$_{2}2$</td><td>$_{5}1$</td><td>$_{3}9$</td><td>$_{7}1$</td><td>2</td></tr>
<tr><td>$_{1}5$</td><td>4</td><td>$_{1}7$</td><td>8</td><td>0</td></tr>
<tr><td>7</td><td>6</td><td>6</td><td>9</td><td>2</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
</table></td>
<td>
<table>
<tr><td></td><td></td><td>2</td><td>2</td></tr>
<tr><td>×</td><td></td><td>3</td><td>1</td></tr>
<tr><td></td><td></td><td>2</td><td>2</td></tr>
<tr><td></td><td>6</td><td>6</td><td>0</td></tr>
<tr><td></td><td>6</td><td>8</td><td>2</td></tr>
</table></td>
<td>
<table>
<tr><td></td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>×</td><td></td><td>3</td><td>2</td></tr>
<tr><td></td><td>4</td><td>6</td><td>8</td></tr>
<tr><td>$_{1}7$</td><td>$_{1}0$</td><td>2</td><td>0</td></tr>
<tr><td>7</td><td>4</td><td>8</td><td>8</td></tr>
</table></td>
<td>
<table>
<tr><td></td><td>1</td><td>8 •</td><td>2</td><td>6</td></tr>
<tr><td>×</td><td></td><td></td><td></td><td>3</td></tr>
<tr><td></td><td>5</td><td>4 •</td><td>7</td><td>8</td></tr>
<tr><td></td><td>2</td><td></td><td>1</td><td></td></tr>
</table>
In the example above, the '3' sits in the same column as the 6 tenths. The key is that the decimal point stays in the same place.</td>
</tr>
</table></td>
<td>Example questions should give children the opportunity to apply their times table knowledge of <u>all</u> tables.

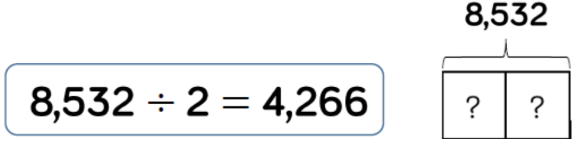
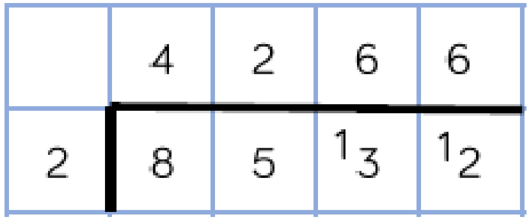
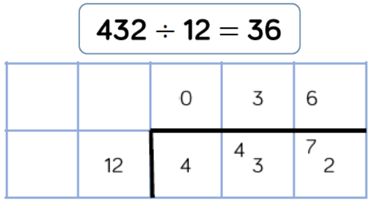
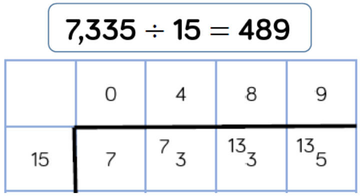
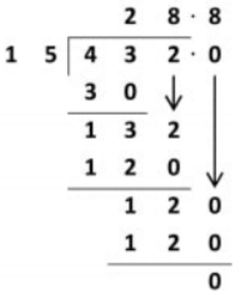
As calculations become increasingly complex, children need to ensure they record their working very neatly and accurately.</td>
</tr>
</table>

Division Progression

Year group	Skill	Visuals / concrete apparatus	Written algorithms	Notes/guidance
1	Solve 1-step division problems involving sharing into equal groups.	 There are 20 apples altogether. They are shared equally between 5 bags. How many apples are in each bag?   $20 \div 5 = 4$	Children do not require a written algorithm at this stage as the size of numbers being used will be mainly within 20. A number line can be used informally to support their mental strategies of repeated jumps:  We do not recommend the use of repeated subtraction, but rather the use of their known facts/counting skills. Repeated addition can help children to find total groups.	Children should be using their knowledge of 10s, 2s and 5s within the problems that they solve.
2	Solve 1-step division problems involving sharing into equal groups. Apply this in problems using known tables facts.	 I buy 10 sweets to share equally into 5 party bags. How many will go in each bag? 	Number lines can continue to be used to support pupils' mental methods in Year 2. Children may start to draw their own lines rather than needing to use pre-prepared examples. Like Y1, we recommend counting up in repeated groups, rather than backwards. The main difference in Year 2 is that children will begin to record division calculations using appropriate symbols.	Arrays are a key model for developing pupils' conceptual understanding of the commutative rule. The use of equal groups supports pupils' understanding of the inverse relationship of multiplication and division.

2	Use partitioning as a strategy for dividing larger 2-digit numbers by 1-digit numbers (no remainders).	48 ÷ 2 = 24  	In Year 2, pupils start dividing larger two digit numbers where there won't be remainders. At this stage they're only needing to partition according to the dividend's place value headings.  Children should also be taught to use mental methods to estimate, using near-multiples to help them. E.g. in a calculation such as 65 ÷ 5, children may know 60 ÷ 5 = 12, so there is going to be one more group of 5 for this answer.	Place value counters and diennes can support with visualising the partitioning process. The written algorithm can be done alongside this as children develop more confidence. Children should be dividing with 2s, 5s and 10s.
3	Use flexible partitioning as a strategy for dividing larger 2-digit numbers by 1-digit numbers (no remainders)	56 ÷ 4 = 14  This visual shows one of the tens in 56 being exchanged for ten ones. The number 56 is now represented as 40 + 16, with each part being divisible by 4.	In Year 3, children will solve problems where flexible partitioning is needed, e.g:  In examples such as this, the dividend needs partitioning into two multiples of the divisor.	Using flexible partitioning correctly relies upon children's ability to partition numbers in a range of ways (could be practised in EBM time) and good tables knowledge. Children should be applying their knowledge of learned facts while developing confidence with this algorithm.

	Use flexible partitioning as a strategy for dividing larger 2-digit numbers by 1-digit numbers (with remainders)	$53 \div 4 = 13\ r1$  This visual shows one of the tens in 53 being exchanged for ten ones. The number 53 is now represented as 40 + 13, with each part being divided by 4. Because 13 leaves us with a remainder of 1, this is represented by the block outside of the table. This can also be represented in a bar: 	 As with the previous version of this method, children partition the dividend into two numbers that they can divide by 4. In the example above, 13 needs partitioning again so that 12 can be divided by 4, leaving a remainder of 1. Children should be taught to put an 'r' by any remainders to remind them what to do with them in their answers.	If the division applies to a word problem, children need to be taught what to do with the remainder. E.g. in the word problem "4 people are in each team, so how many teams can be made from 53 children?" then the answer is 13, not 13r1. If the problem was something like "The driver can take 4 children at a time, so how many trips will he need to do for 53 children?" then the answer would be 14, so that there isn't a child left behind! Examples chosen should give children opportunities to apply the tables they've been learning in class.
4	Use flexible partitioning as a strategy for dividing larger 2-digit numbers by 1-digit numbers (with remainders)			
	Advance to short written method of division (During Spring term), involving 3-digit dividends.	Children should be taught to visualise problems using bar models. This link helps when finding fractions of a number. $844 \div 4 = 211$ 	 	Example questions should give children the opportunity to apply their times table knowledge of <u>all</u> tables.

5	Consolidate short written method and advance to 4-digit dividends divided by 1 digit divisors.	Children should be taught to visualise problems using bar models. This link helps when finding fractions of a number.  	 	Example questions should give children the opportunity to apply their times table knowledge of all tables.
6	Advance to two-digit divisors.	Whether children use the short or longer division method, they need to be taught to write out multiples of the divisor ahead of calculating. They can do this by using partitioning if the number is a bit awkward for them to count in mentally. E.g. If solving 1257 ÷ 35, multiples of 35 can be written like this if children find it helpful to do so: **30 + 5 = 35** 60 + 10 = 70 90 + 15 = 105 120 + 20 = 140 150 + 25 = 175 180 + 30 = 210 210 + 35 = 245	Short method:   Long division: 432 ÷ 15 = 28.8  More detail on this method can be found here: https://thirdspacelearning.com/blog/teach-long-division-method-ks2-steps/	Children need to be taught to make decisions about when to stick with the short written method (e.g. when divisor is a smaller 2-digit number) and when to use long-division method (larger divisors, likely to give big remainders).