Tibshelf Schools Federation Town End Junior School Calculation Policy - September 2022

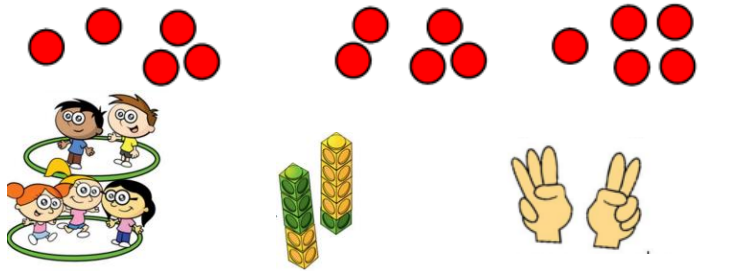At both Tibshelf Schools, we are using the 'White Rose Maths' format as a basis for our planning and Maths curriculum.
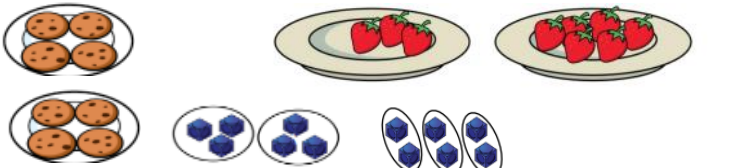
We are using the White Rose philosophy of:

   - **fluency** - using Learning Objectives from the National Curriculum.

   - **reasoning**

   - **problem-solving**

The aim is that when children leave Tibshelf Schools they:

- Have a secure knowledge of number facts and a good understanding of the four calculation operations (addition, subtraction, multiplication and division)
- Make use of jottings, diagrams and informal notes to help record steps and part answers when using mental methods that generate more information than can be kept in their heads
- Have an efficient, reliable, written method of calculation for each operation that they are able to apply with confidence when they are unable to perform a calculation mentally

Early Years

Skill: combine 2 or more parts to make a whole	Foundation Stage
	Using a variety of concrete objects children practically explore in depth number bonds to 5 and then to 10.

Skill: partition whole numbers in 2 or more parts	Foundation Stage
	Using a variety of concrete objects children practically explore in depth number bonds to 5 and then to 10.

Skill: explore and represent doubling patterns	Foundation Stage
	Using a variety of concrete objects children practically explore and represent patterns within numbers up to 10 including double facts.

Skill: explore how quantities can be distributed equally	Foundation Stage
	Using a variety of concrete objects children practically explore sharing and grouping quantities.

Key Vocabulary – Addition and Subtraction

Addend - A number to be added to another.

Aggregation - combining two or more quantities or measures to find a total.

Augmentation - increasing a quantity or measure by another quantity.

Commutative – numbers can be added in any order.

Complement – in addition, a number and its complement make a total e.g. 300 is the complement to 700 to make 1,000

Difference – the numerical difference between two numbers is found by comparing the quantity in each group.

Exchange – Change a number or expression for another of an equal value.

Minuend – A quantity or number from which another is subtracted.

Partitioning – Splitting a number into its component parts.

Reduction – Subtraction as take away.

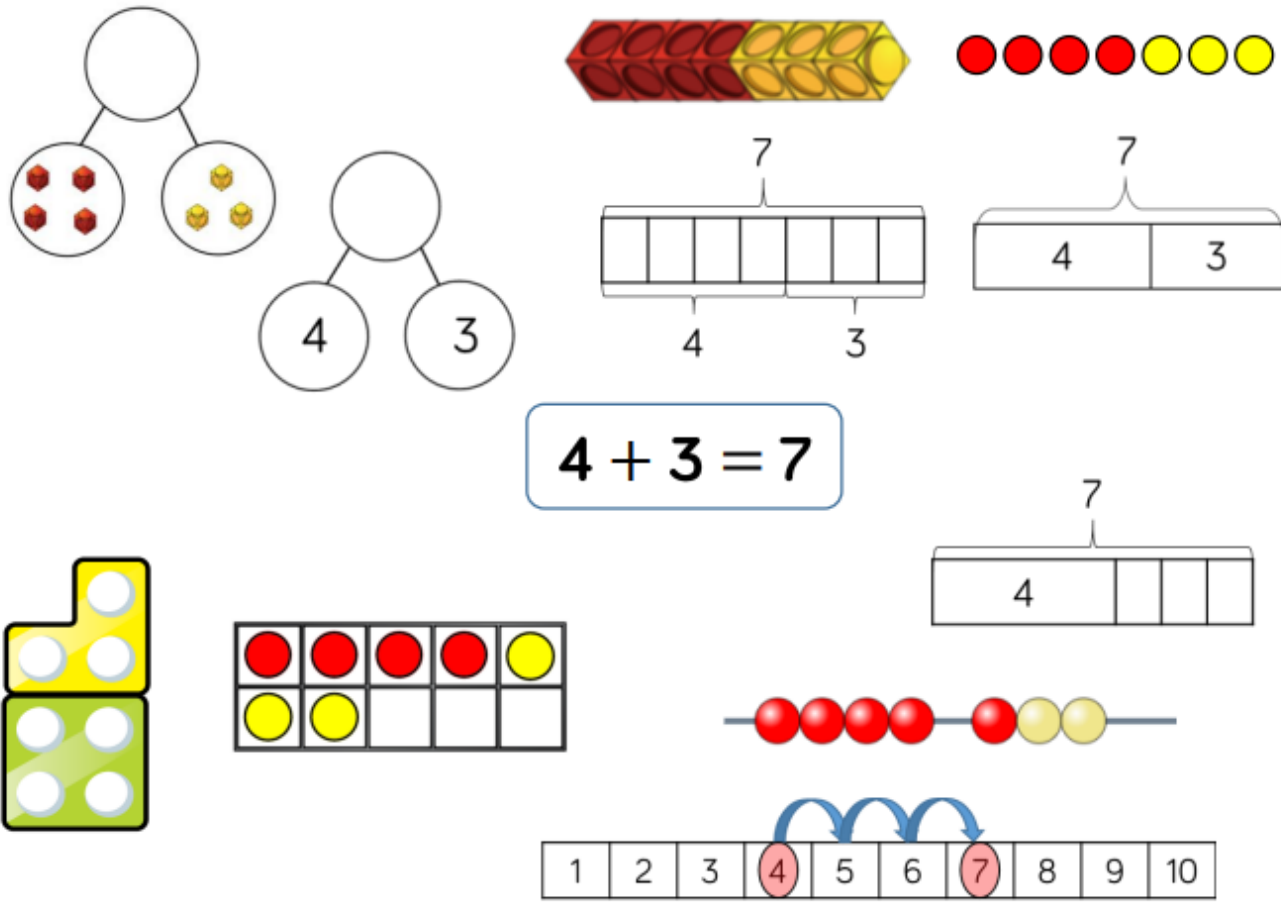**Subitise –** Instantly recognise the number of objects in a small group without needing to count.

Subtrahend - A number to be subtracted from another.

Sum - The result of an addition.

Total – The aggregate or the sum found by addition.

Progression in Calculations

Addition

Skill: Add 1-digit numbers within 10	Year: 1

$$4 + 3 = 7$$

When adding numbers to 10, children can explore both aggregation and augmentation.

The part-whole model, discrete and continuous bar model, number shapes and ten frame support aggregation.

The combination bar model, ten frame, bead string and number track all support augmentation.
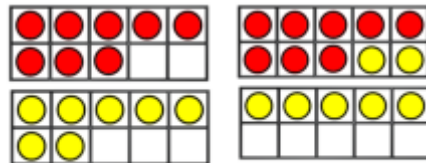
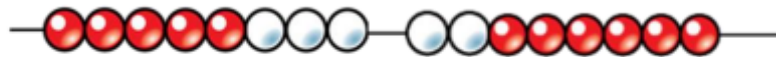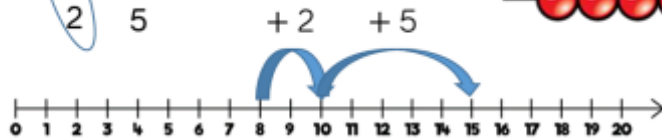| Skill: Add 1 and 2-digit numbers to 20	Year: 1/2

7

8

15

8	7

$$8 + 7 = 15$$

8 + 7 = 15

2   5

+ 2   + 5

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
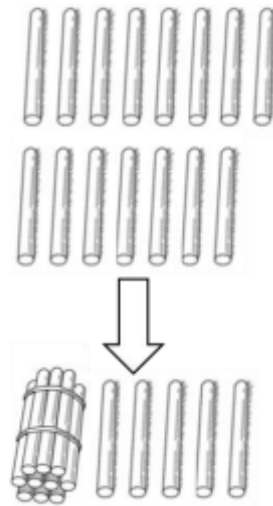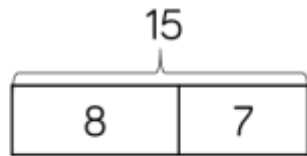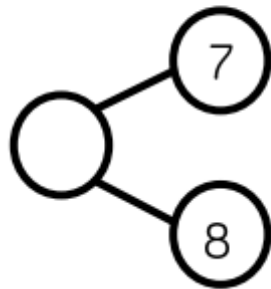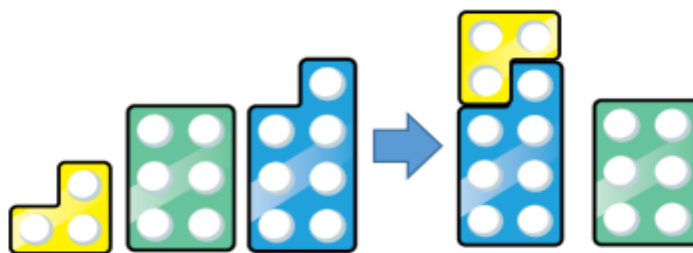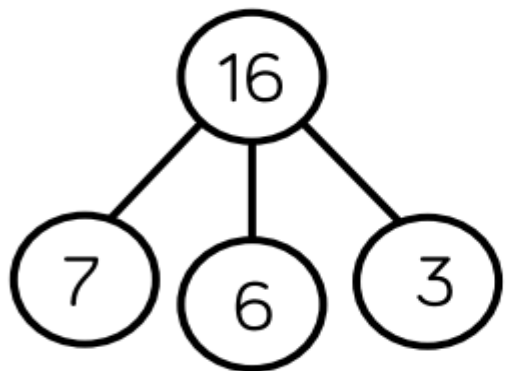
8 + 7 = 15

2   5

When adding one-digit numbers that cross 10, it is important to highlight the importance of ten ones equalling one ten.
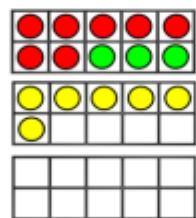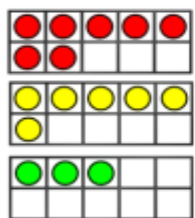
Different manipulatives can be used to represent this exchange. Use concrete resources alongside number lines to support children in understanding how to partition their jumps.
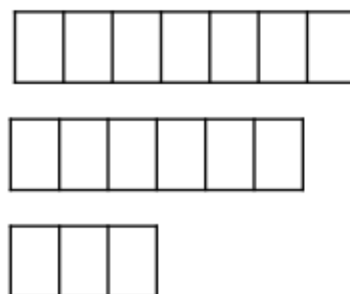
| Skill: Add three 1-digit numbers	Year: 2

7 + 6 + 3 = 16

7 + 6 + 3 = 16

10

16

When adding three 1-digit numbers, children should be encouraged to look for number bonds to 10 or doubles to add the numbers more efficiently.

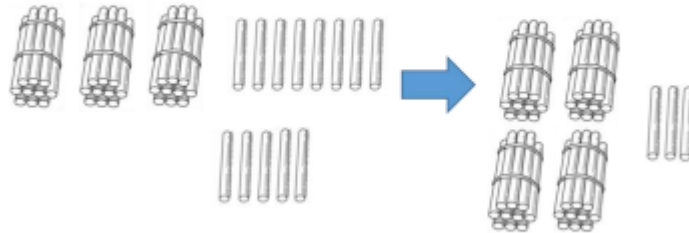This supports children in their understanding of commutativity.

Manipulatives that highlight number bonds to 10 are effective when adding three 1-digit numbers.

Skill: Add 1-digit and 2-digit numbers to 100	Year: 2/3

38 / 5

35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

+2   +3

38   40   43

?

| 38 | | | | | | |
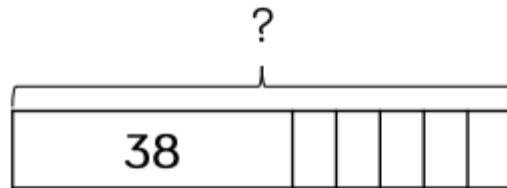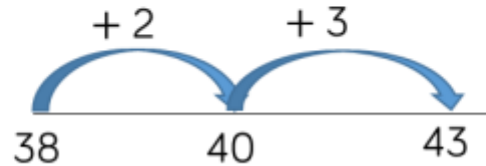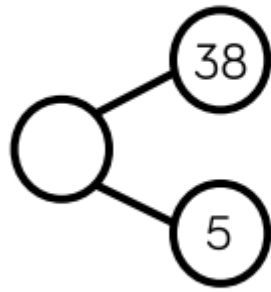
$$38 + 5 = 43$$

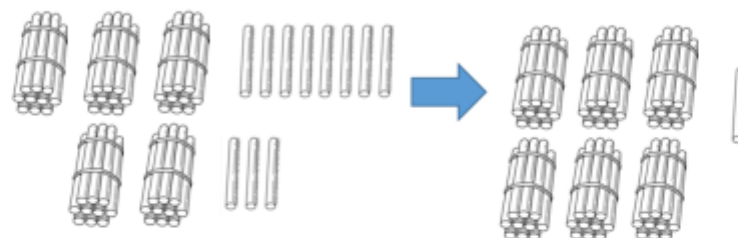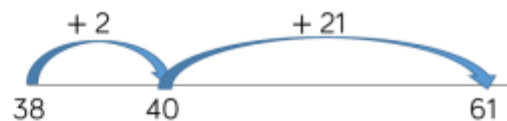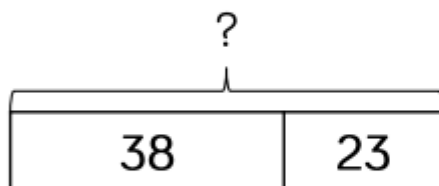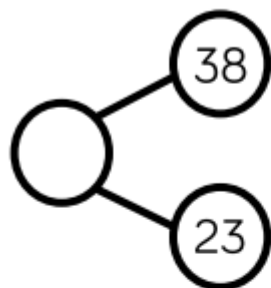| 1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

When adding single digits to a two-digit number, children should be encouraged to count on from the larger number.

They should also apply their knowledge of number bonds to add more efficiently e.g. $8 + 5 = 13$ so $38 + 5 = 43$.

Hundred squares and straws can support children to find the number bond to 10.

Skill: Add two 2-digit numbers to 100	Year: 2/3

38

23

?

| 38 | 23 |

+2   +21

38   40   61

$$38 + 23 = 61$$

Tens	Ones
|||	•••• ••
||	•

```
  38
+ 23
————
  61
   1
```

Tens	Ones
10 10 10	1 1 1 1 1 1 1 1
10 10	1 1 1
10	

At this stage, encourage children to use the formal column method when calculating alongside straws, base 10 or place value counters. As numbers become larger, straws become less efficient.
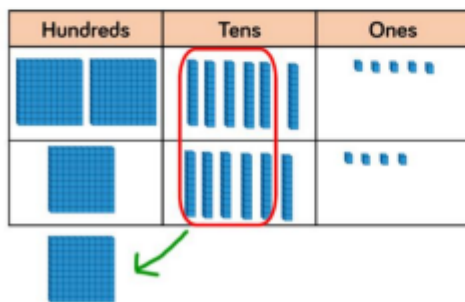
Children can also use a blank number line to count on to find the total. Encourage them to jump to multiples of 10 to become more efficient.
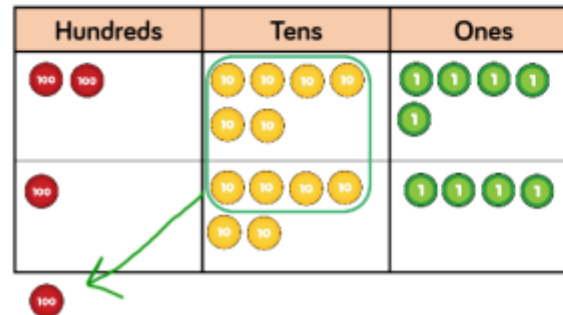
Skill: Add numbers with up to 3 digits	Year: 3
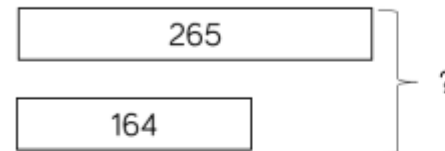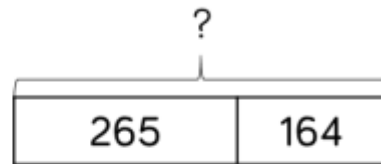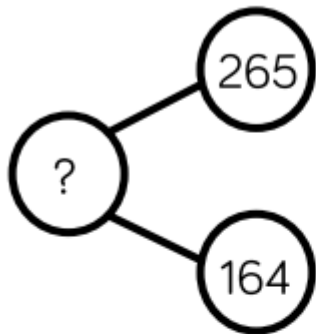
265

?

164

?

| 265 | 164 |

265

164

?

$$265 + 164 = 429$$

Hundreds	Tens	Ones

265
+ 164
429
1

Hundreds	Tens	Ones

Base 10 and place value counters are the most effective manipulatives when adding numbers with up to 3 digits.

Ensure children write out their calculation alongside any concrete resources so they can see the links to the written column method.

Plain counters on a place value grid can also be used to support learning.

Skill: Add numbers with up to 4 digits	Year: 4

1,378

2,148

?

?

2,138 | 1,378

2,138

1,378

?

```
  1 3 7 8
+ 2 1 4 8
  3 5 2 6
    1 1
```

$$1,378 + 2,148 = 3,526$$

Thousands	Hundreds	Tens	Ones

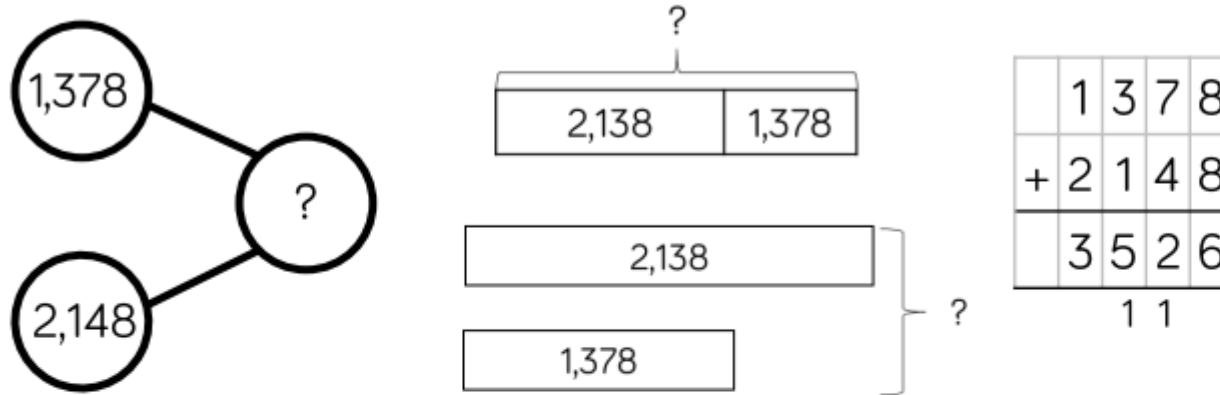| Thousands	Hundreds	Tens	Ones

Base 10 and place value counters are the most effective manipulatives when adding numbers with up to 4 digits.

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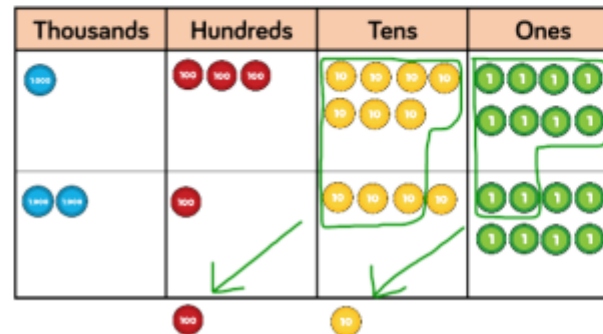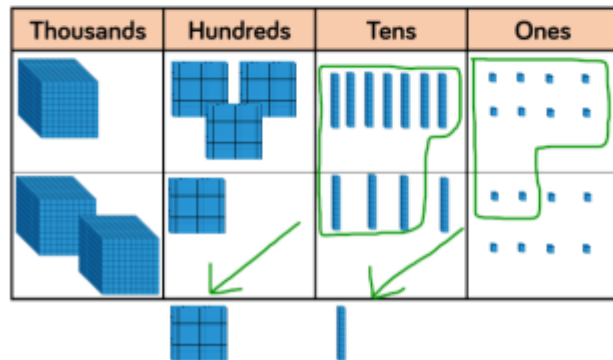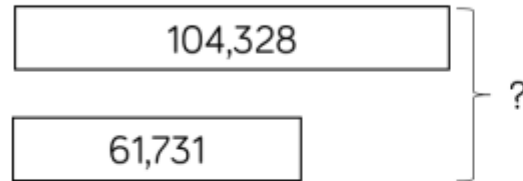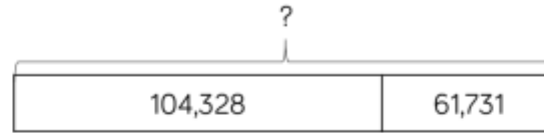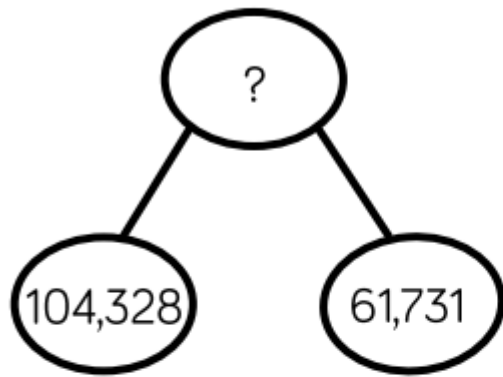
Plain counters on a place value grid can also be used to support learning.

Skill: Add numbers with more than 4 digits	Year: 5/6

?

? — 104,328 — 61,731

?
104,328
61,731

?

104,328 + 61,731 = 166,059

HTh	TTh	Th	H	T	O
100000		1000 1000 1000 1000	100 100 100	10 10	1 1 1 / 1 1 1 / 1 1 1 / 1 1
	10000 10000 10000 10000 10000 10000 1000		100 100 100 / 100 100 100 / 100	10 10 10	1

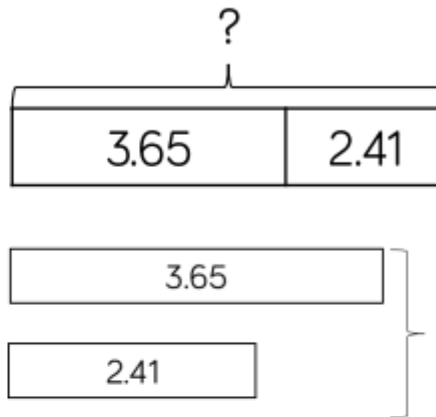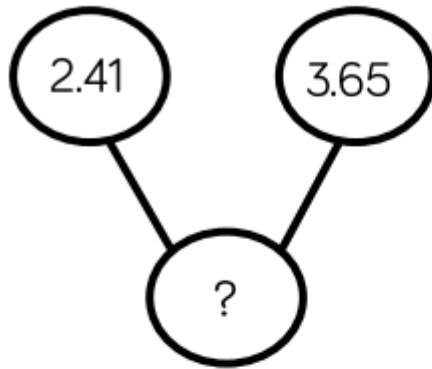|	1	0	4	3	2	8
+		6	1	7	3	1
	1	6	6	0	5	9
			1			

Place value counters or plain counters on a place value grid are the most effective concrete resources when adding numbers with more than 4 digits.

At this stage, children should be encouraged to work in the abstract, using the column method to add larger numbers efficiently.
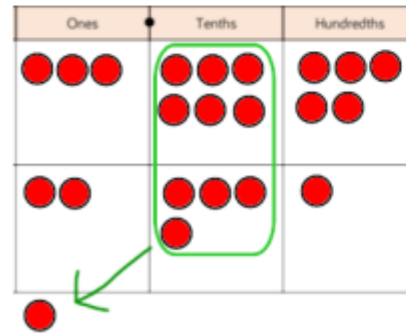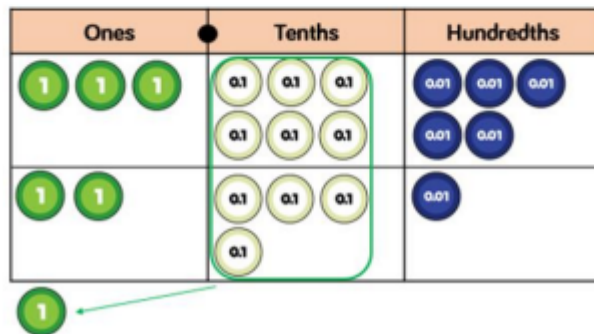
Skill: Add with up to 3 decimal places	Year: 5

2.41   3.65

?

?

3.65	2.41

3.65

2.41

?

$$3.65$$
$$+\ 2.41$$
$$6.06$$
$$\small 1$$

$$3.65 + 2.41 = 6.06$$

Ones		Tenths	Hundredths
1 1 1		0.1 0.1 0.1 / 0.1 0.1 0.1	0.01 0.01 0.01 / 0.01 0.01
1 1		0.1 0.1 0.1 / 0.1	0.01
1			

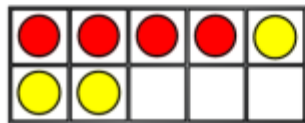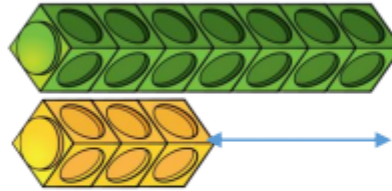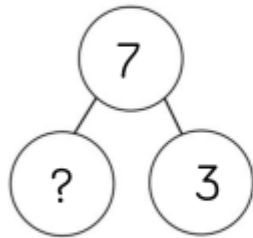| Ones	Tenths	Hundredths
● ● ●	● ● ● / ● ● ●	● ● ● / ● ●
● ●	● ● ● / ●	●
●		

Place value counters and plain counters on a place value grid are the most effective manipulatives when adding decimals with 1, 2 and then 3 decimal places.

Ensure children have experience of adding decimals with a variety of decimal places. This includes putting this into context when adding money and other measures.
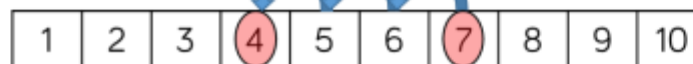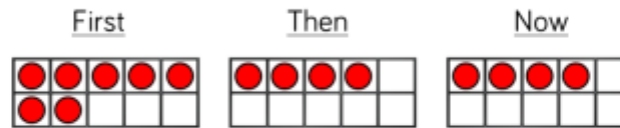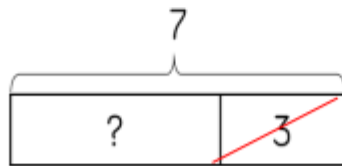
Subtraction

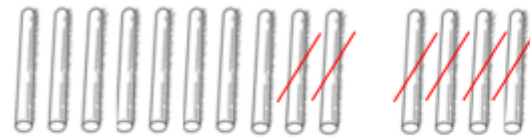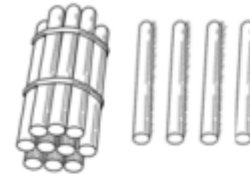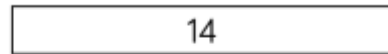| Skill: Subtract 1-digit numbers within 10	Year: 1
	Part-whole models, bar models, ten frames and number shapes support partitioning. Ten frames, number tracks, single bar models and bead strings support reduction. Cubes and bar models with two bars can support finding the difference.
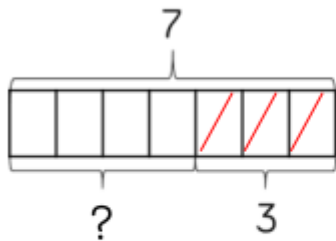
$$7 - 3 = 4$$

Skill: Subtract 1 and 2-digit numbers to 20	Year: 1/2

6

14

14

6 → 8

14 − 6 = 8

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |

14 − 6 = 8
4   2

− 2   − 4

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
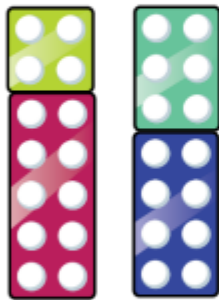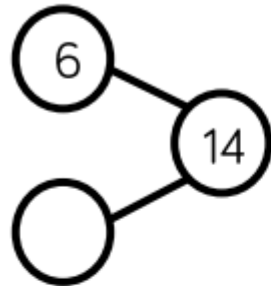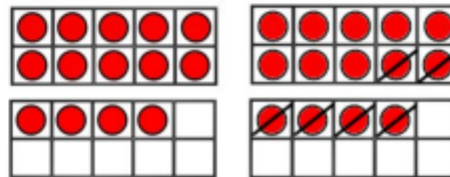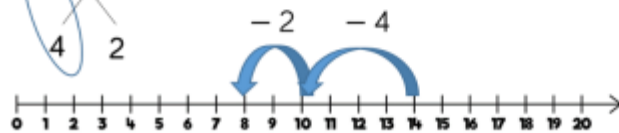
14 − 6 = 8
4   2

When subtracting one-digit numbers that cross 10, it is important to highlight the importance of ten ones equalling one ten.

Children should be encouraged to find the number bond to 10 when partitioning the subtracted number. Ten frames, number shapes and number lines are particularly useful for this.

Skill: Subtract 1 and 2-digit numbers to 100	Year: 2
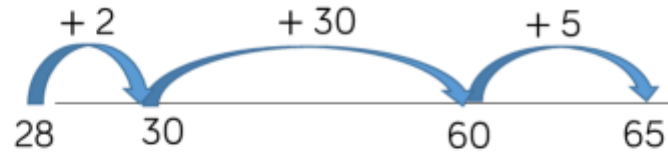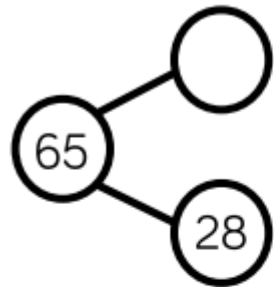
65

28
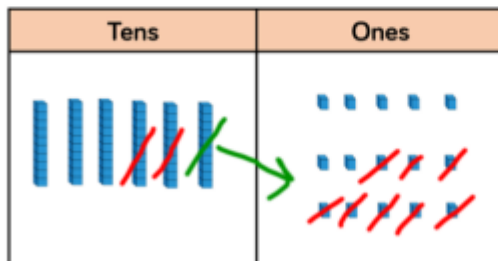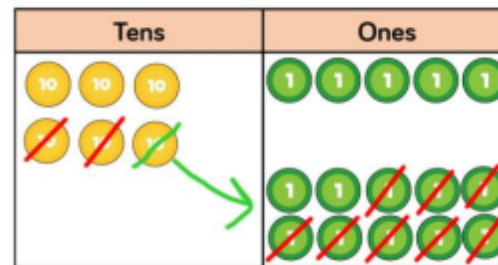
+ 2   + 30   + 5

28   30   60   65

65

| ? | 28 |

$$65 - 28 = 37$$

Tens	Ones

$$\begin{array}{r} ^{5}6^{1}5 \\ -\ 28 \\ \hline 37 \end{array}$$

Tens	Ones

At this stage, encourage children to use the formal column method when calculating alongside straws, base 10 or place value counters. As numbers become larger, straws become less efficient.
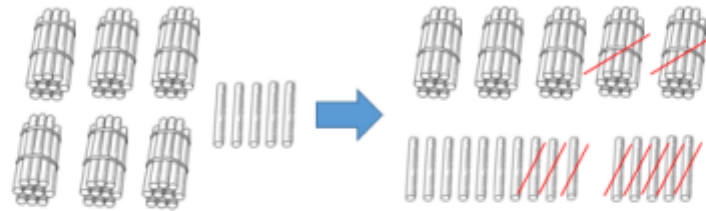
Children can also use a blank number line to count on to find the difference. Encourage them to jump to multiples of 10 to become more efficient.

Skill: Subtract numbers with up to 3 digits	Year: 3

435

273   ?

435

| 273 | ? |

435

| 273 | ? →

$$435 - 273 = 262$$

Hundreds	Tens	Ones

$$\begin{array}{r} ^3\!4^1\!35 \\ -\ 273 \\ \hline 262 \end{array}$$

Hundreds	Tens	Ones

Base 10 and place value counters are the most effective manipulative when subtracting numbers with up to 3 digits.

Ensure children write out their calculation alongside any concrete resources so they can see the links to the written column method.

Plain counters on a place value grid can also be used to support learning.

Skill: Subtract numbers with up to 4 digits	Year: 4

4,357
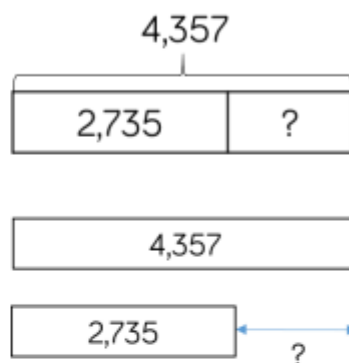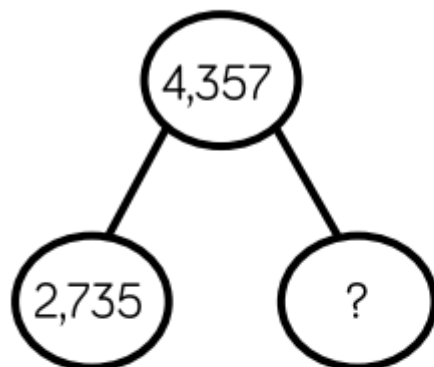
2,735   ?

4,357

2,735   ?

4,357

2,735

4,357

$$4,357 - 2,735 = 1,622$$

$$\begin{array}{r} {}^{3}\cancel{4}{}^{1}357 \\ -\ 2735 \\ \hline 1622 \end{array}$$

Thousands	Hundreds	Tens	Ones

Thousands	Hundreds	Tens	Ones

Base 10 and place value counters are the most effective manipulatives when subtracting numbers with up to 4 digits.

Ensure children write out their calculation alongside any concrete resources so they can see the links to the written column method.

Plain counters on a place value grid can also be used to support learning.

| Skill: Subtract numbers with more than 4 digits	Year: 5/6

294,382

182,501   ?

294,382

| 182,501 | ? |
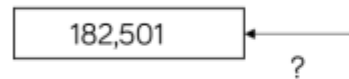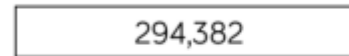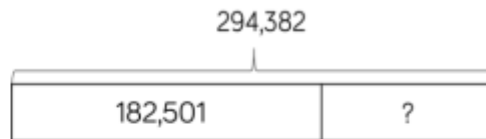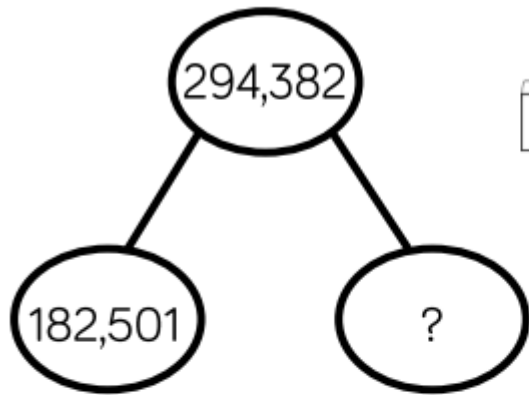
294,382

182,501 ←→
         ?

$$294,382 - 182,501 = 111,881$$

HTh	TTh	Th	H	T	O

		2	9	³⁄ ¹3	8	2
−		1	8	2	5	0	1
		1	1	1	8	8	1

Place value counters or plain counters on a place value grid are the most effective concrete resource when subtracting numbers with more than 4 digits.

At this stage, children should be encouraged to work in the abstract, using column method to subtract larger numbers efficiently.

Skill: Subtract with up to 3 decimal places	Year: 5
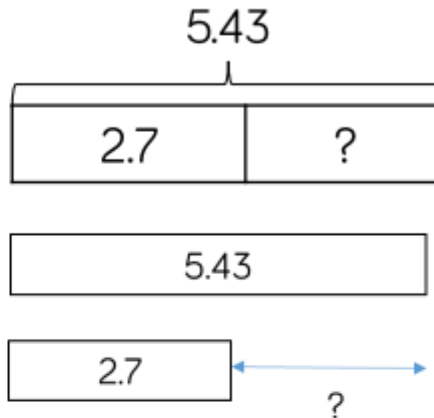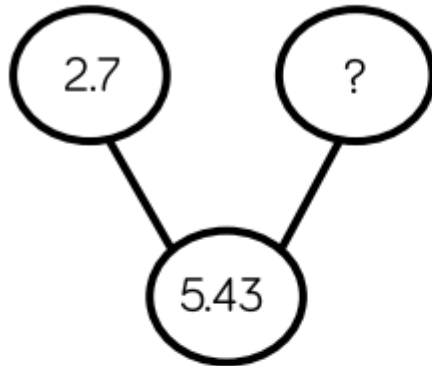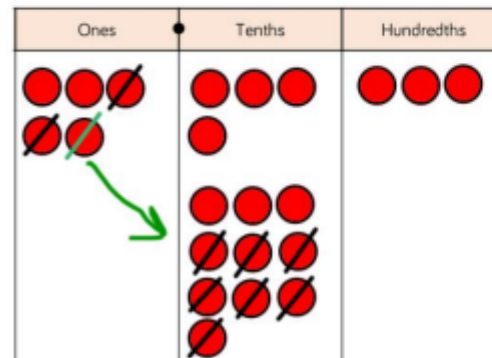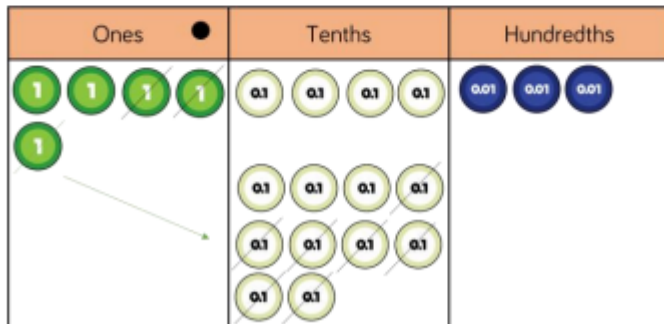
5.43

2.7 | ?

2.7 | ?

5.43

2.7 | ?

$$5.43 - 2.7 = 2.73$$

$$\begin{array}{r} \overset{4}{\cancel{5}}.\overset{1}{4}3 \\ -\ 2.7 \\ \hline 2.73 \end{array}$$

Ones	Tenths	Hundredths

Place value counters and plain counters on a place value grid are the most effective manipulative when subtracting decimals with 1, 2 and then 3 decimal places.

Ensure children have experience of subtracting decimals with a variety of decimal places. This includes putting this into context when subtracting money and other measures.

Key Vocabulary – Multiplication and Division

Array – An ordered collection of counters, cubes or other item in rows and columns.

Commutative – Numbers can be multiplied in any order.

Dividend – In division, the number that is divided.

Divisor – In division, the number by which another is divided.

Exchange – Change a number or expression for another of an equal value.

Factor – A number that multiplies with another to make a product.

Multiplicand – In multiplication, a number to be multiplied by another.

Partitioning – Splitting a number into its component parts.
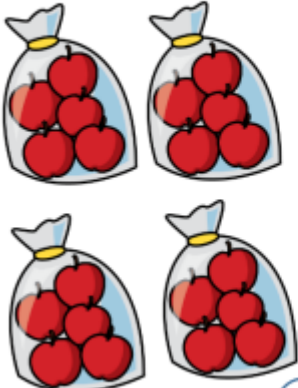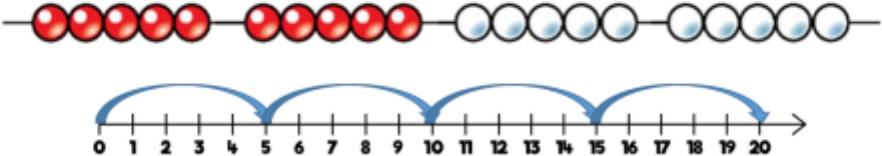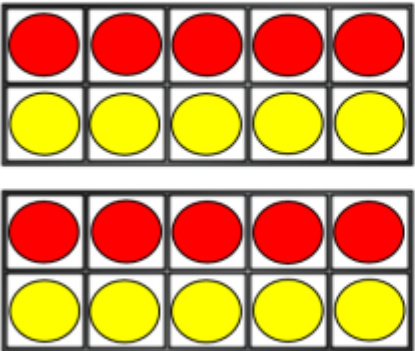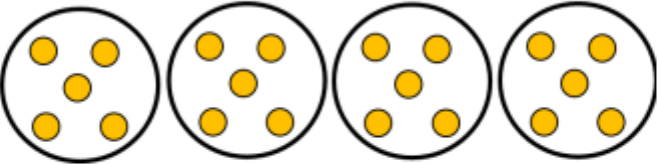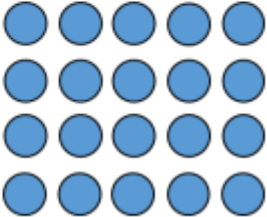
Product – The result of multiplying one number by another.

Quotient – The result of a division

Remainder – The amount left over after a division when the divisor is not a factor of the dividend.

Scaling – Enlarging or reducing a number by a given amount, called the scale factor

Multiplication

Skill: Solve 1-step problems using multiplication	Year: 1/2

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 represent multiplication as repeated addition in many different ways.

In Year 1, children use concrete and pictorial representations to solve problems. They are not expected to record multiplication formally.

In Year 2, children are introduced to the multiplication symbol.

Skill: Multiply 2-digit numbers by 1-digit numbers	Year: 3/4

$$34 \times 5 = 170$$

	H	T	O		
		3	4		
×			5		
		2	0	(5 × 4)	
+	1	5	0	(5 × 30)	
	1	7	0		
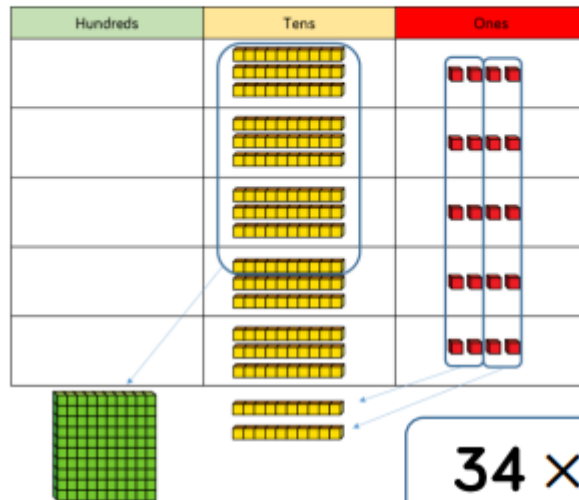
	H	T	O
		3	4
×			5
	1	7	0
	1	2	
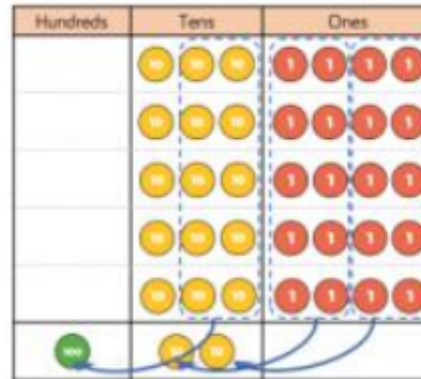
Teachers may decide to first look at the expanded column method before moving on to the short multiplication method.

The place value counters should be used to support the understanding of the method rather than supporting the multiplication, as children should use times table knowledge.

Skill: Multiply 3-digit numbers by 1-digit numbers	Year: 3/4

Hundreds	Tens	Ones

	H	T	O
	2	4	5
×			4
	9	8	0
		1	2

$$245 \times 4 = 980$$

Hundreds	Tens	Ones
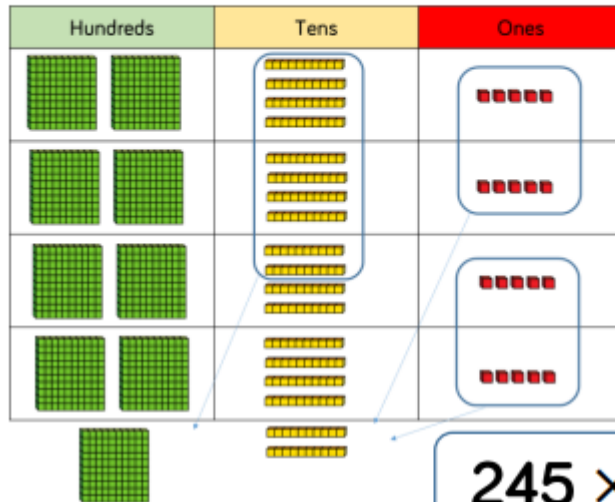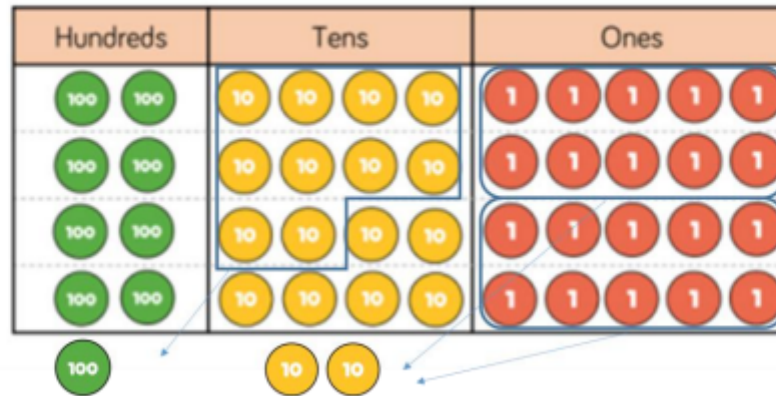
When moving to 3-digit by 1-digit multiplication, encourage children to move towards the short, formal written method.

Base 10 and place value counters continue to support the understanding of the written method. Limit the number of exchanges needed in the questions and move children away from resources when multiplying larger numbers.

Skill: Multiply 4-digit numbers by 1-digit numbers	Year: 5

Thousands	Hundreds	Tens	Ones
1000	100 100 100 100 / 100 100 100 100	10 10	1 1 1 / 1 1 1
1000	100 100 100 100 / 100 100 100 100	10 10	1 1 1 / 1 1 1
1000	100 100 100 100 / 100 100 100 100	10 10	1 1 1 / 1 1 1

1000 1000 → (Hundreds)

10 → (Tens/Ones)

$$1{,}826 \times 3 = 5{,}478$$

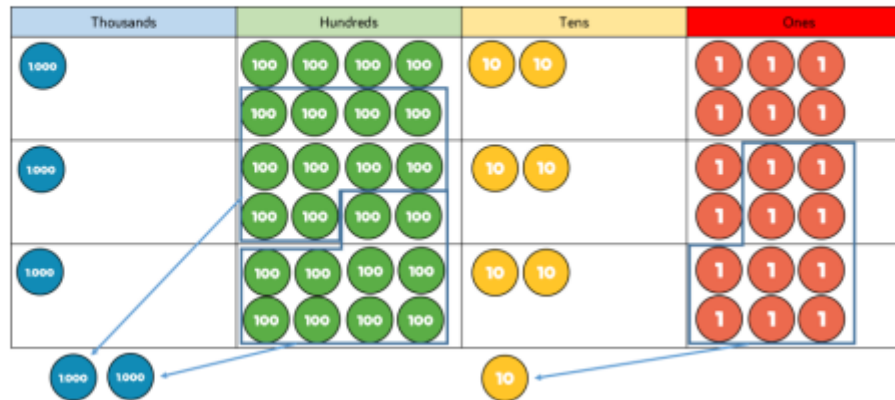|	Th	H	T	O
	1	8	2	6
×				3
	5	4	7	8
		2		1

When multiplying 4-digit numbers, place value counters are the best manipulative to use to support children in their understanding of the formal written method.

If children are multiplying larger numbers and struggling with their times tables, encourage the use of multiplication grids so children can focus on the use of the written method.

Skill: Multiply 2-digit numbers by 2-digit numbers	Year: 5

When multiplying a multi-digit number by 2-digits, use the area model to help children understand the size of the numbers they are using. This links to finding the area of a rectangle by finding the space covered by the Base 10.

The grid method matches the area model as an initial written method before moving on to the formal written multiplication method.
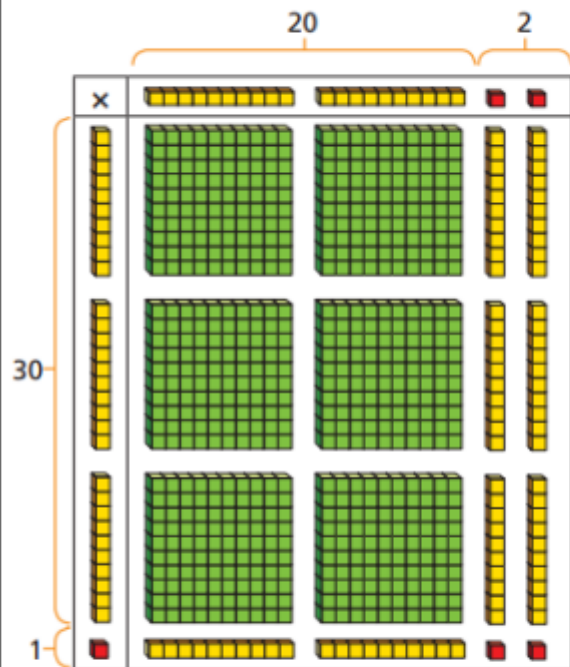
×	20	2
30	600	60
1	20	2

	H	T	O
		2	2
×		3	1
		2	2
	6	6	0
	6	8	2

22 × 31 = 682

Skill: Multiply 3-digit numbers by 2-digit numbers	Year: 5
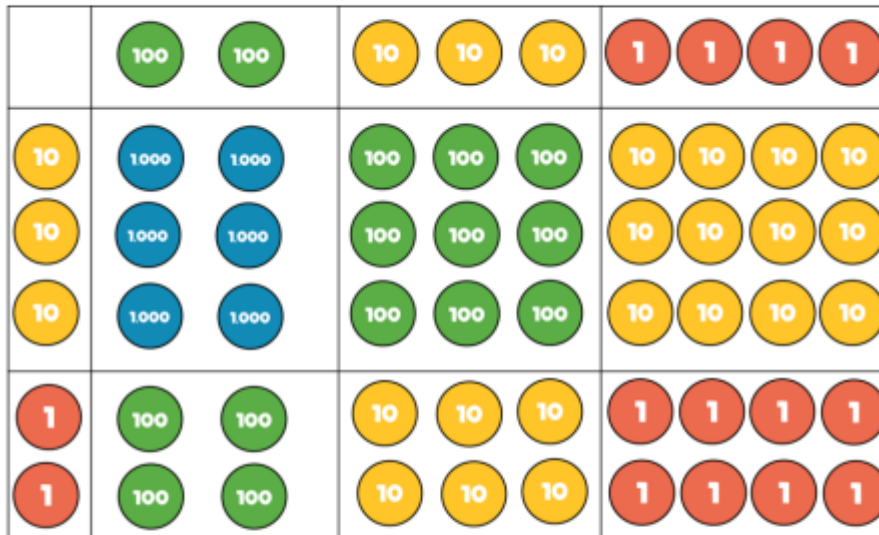
Th	H	T	O
	2	3	4
×		3	2
	4	6	8
$_17$	$_10$	2	0
7	4	8	8

×	200	30	4
30	6,000	900	120
2	400	60	8

234 × 32 = 7,488

Children can continue to use the area model when multiplying 3-digits by 2-digits. Place value counters become more efficient to use but Base 10 can be used to highlight the size of numbers.

Encourage children to move towards the formal written method, seeing the links with the grid method.

Skill: Multiply 4-digit numbers by 2-digit numbers	Year: 5/6

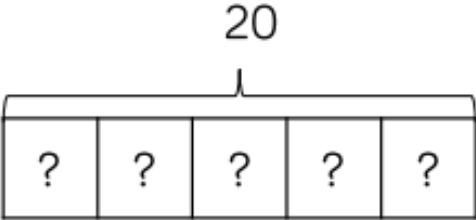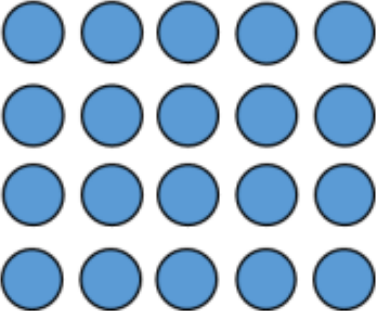| TTh	Th	H	T	O
	2	7	3	9
×			2	8
2 ₂	1 ₅	9 ₃	1 ₇	2
5 ₁	4	7 ₁	8	0
7	6	6	9	2

1

$2{,}739 \times 28 = 76{,}692$

When multiplying 4-digits by 2-digits, children should be confident in the written method.

If they are still struggling with times tables, provide multiplication grids to support when they are focusing on the use of the method.

Consider where exchanged digits are placed and make sure this is consistent.

Division

Skill: Solve 1-step problems using multiplication (sharing)	Year: 1/2
20 ? ? ? ? ? There are 20 apples altogether. They are shared equally between 5 bags. How many apples are in each bag? $20 \div 5 = 4$	Children solve problems by sharing amounts into equal groups. In Year 1, children use concrete and pictorial representations to solve problems. They are not expected to record division formally. In Year 2, children are introduced to the division symbol.

Skill: Solve 1-step problems using division (grouping)	Year: 1/2
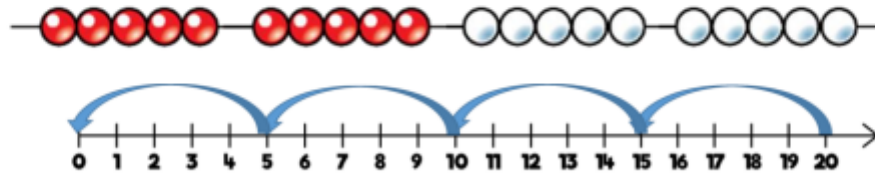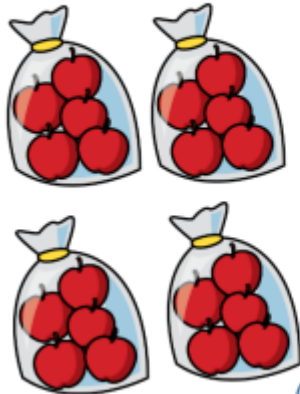
There are 20 apples altogether.
They are put in bags of 5.
How many bags are there?
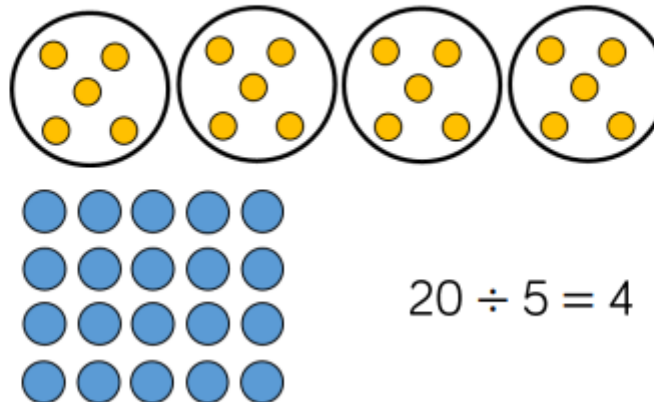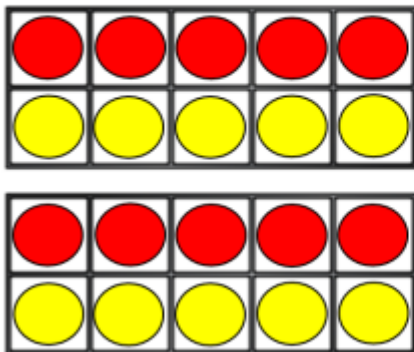
$20 \div 5 = 4$

Children solve problems by grouping and counting the number of groups. Grouping encourages children to count in multiples and links to repeated subtraction on a number line. They can use concrete representations in fixed groups such as number shapes which helps to show the link between multiplication and division.
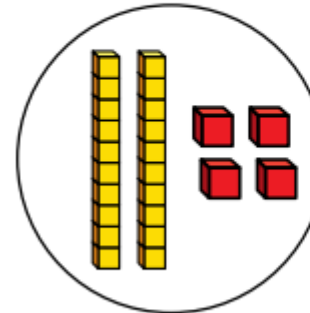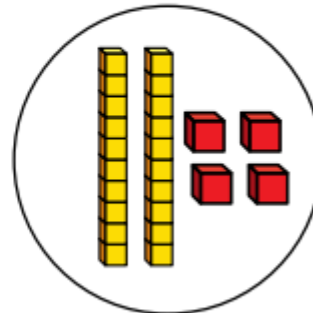
Skill: Divide 2-digits by 1-digit (sharing with no exchange)	Year: 1/2

Tens	Ones
10 10	1 1 1 1
10 10	1 1 1 1
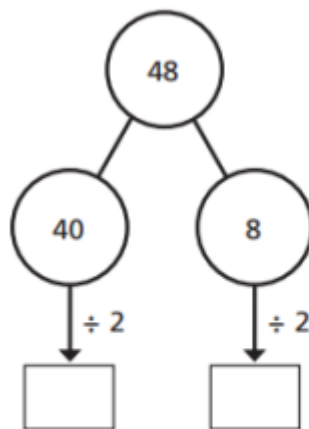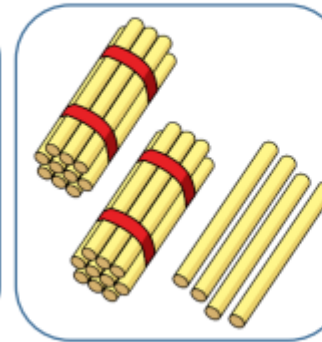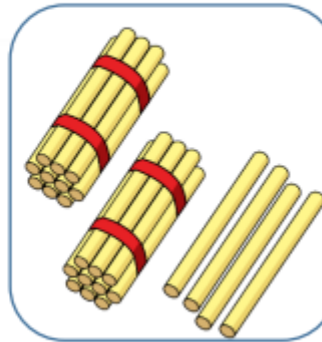
$$48 \div 2 = 24$$

When dividing larger numbers, children can use manipulatives that allow them to partition into tens and ones.

Straws, Base 10 and place value counters can all be used to share numbers into equal groups.

Part-whole models can provide children with a clear written method that matches the concrete representation.

Skill: Divide 2-digits by 1-digit (sharing with exchange)	Year: 3/4

Tens	Ones

$$52 \div 4 = 13$$

52

?	?	?	?

52

40   12

$\div 4$ $\div 4$

10   3

$10 + 3 = 13$

Tens	Ones

When dividing numbers involving an exchange, children can use Base 10 and place value counters to exchange one ten for ten ones. Children should start with the equipment outside the place value grid before sharing the tens and ones equally between the rows.

Flexible partitioning in a part-whole model supports this method.

Skill: Divide 2-digits by 1-digit (sharing with remainders)	Year: 3/4

$$53 \div 4 = 13 \text{ r}1$$

When dividing numbers with remainders, children can use Base 10 and place value counters to exchange one ten for ten ones. Starting with the equipment outside the place value grid will highlight remainders, as they will be left outside the grid once the equal groups have been made.

Flexible partitioning in a part-whole model supports this method.

Skill: Divide 2-digits by 1-digit (grouping)	Year: 4/5

Tens	Ones

$$52 \div 4 = 13$$

		1	3	
	4	5	$^{1}2$	

Tens	Ones
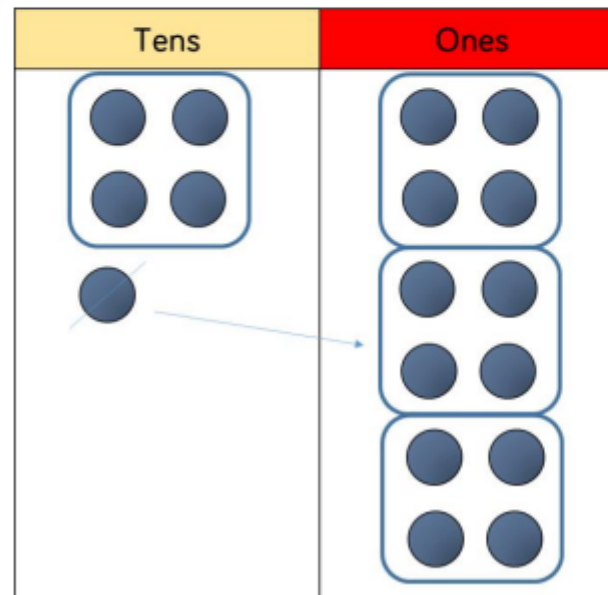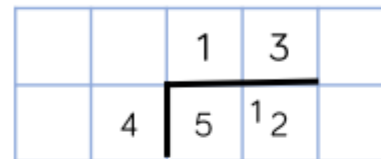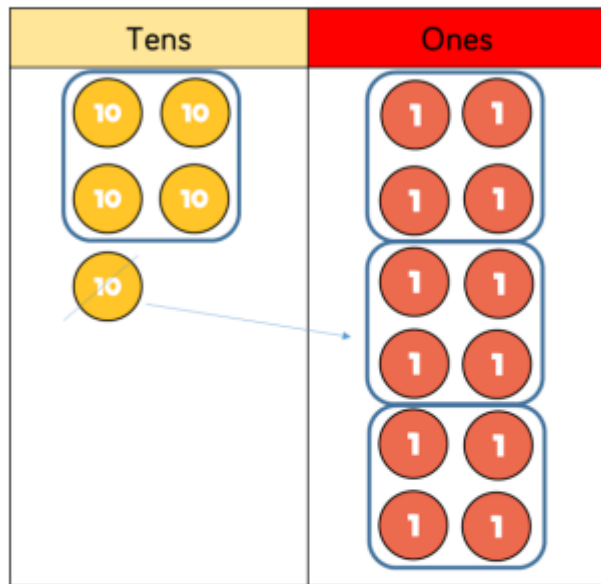
When using the short division method, children use grouping. Starting with the largest place value, they group by the divisor.

Language is important here. Children should consider 'How many groups of 4 tens can we make?' and 'How many groups of 4 ones can we make?'

Remainders can also be seen as they are left ungrouped.

Skill: Divide 3-digits by 1-digit (sharing)	Year: 4

844 ÷ 4 = 211

844

| ? | ? | ? | ? |
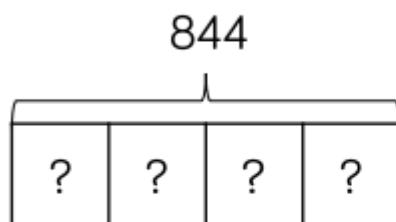
H	T	O
100 100	10	1
100 100	10	1
100 100	10	1
100 100	10	1

844
800 40 4
÷ 4 ÷ 4 ÷ 4

844 ÷ 4 = 211

856
800 40 16
÷ 4 ÷ 4 ÷ 4
200 10 4
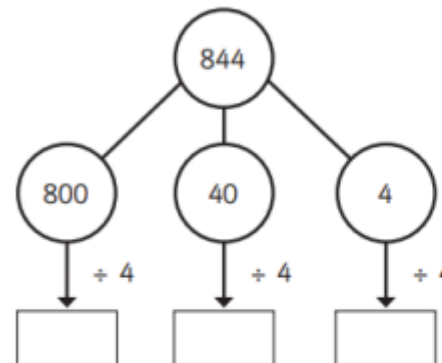
100 100 100 100   10 10 10 10   1 1 1 1
100 100 100 100   10   1 1
                               1 1 1 1 1
                               1 1 1 1 1
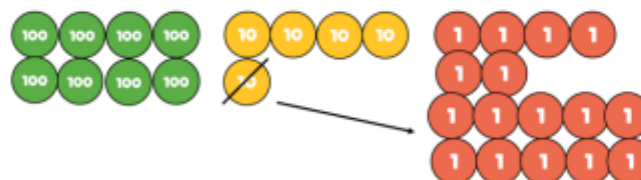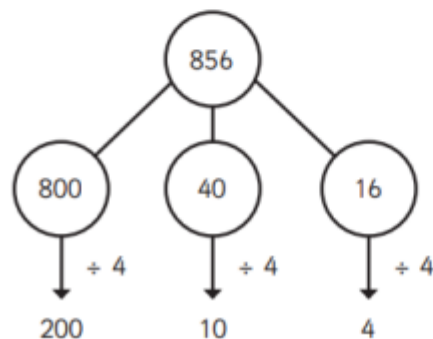
Hundreds	Tens	Ones
100 100	10	1 1 1 1
100 100	10	1 1 1 1
100 100	10	1 1 1 1
100 100	10	1 1 1 1

Children can continue to use place value counters to share 3-digit numbers into equal groups. Children should start with the equipment outside the place value grid before sharing the hundreds, tens and ones equally between the rows. This method can also help to highlight remainders. Flexible partitioning in a part-whole model supports this method.
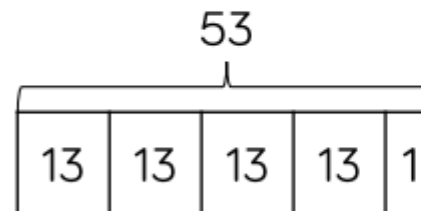
Skill: Divide 3-digits by 1-digit (grouping)	Year: 5
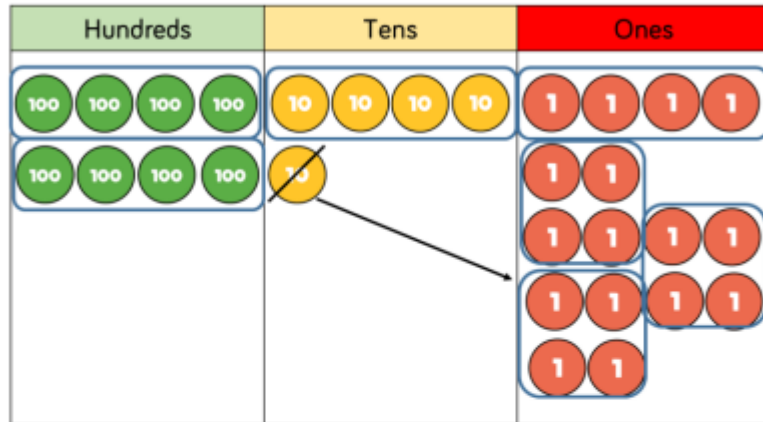
			2	1	4
	4	8	5	^{1}6
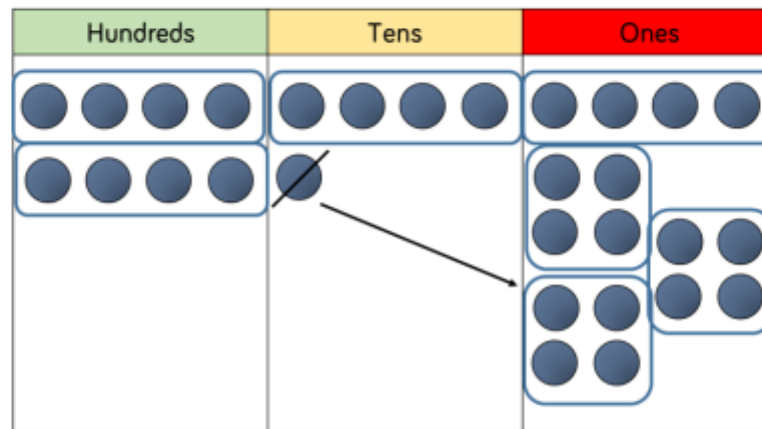
$$856 \div 4 = 214$$

Children can continue to use grouping to support their understanding of short division when dividing a 3-digit number by a 1-digit number.

Place value counters or plain counters can be used on a place value grid to support this understanding. Children can also draw their own counters and group them through a more pictorial method.

Skill: Divide 4-digits by 1-digit (grouping)	Year: 5

Th	H	T	O
1,000 1,000	100 100	10 10	1 1
1,000 1,000	100 100	10 →	1 1
1,000 1,000	100 →	10 10	1 1
1,000 1,000		10 10	1 1
		10 10	1 1
		10 10	1 1
		10 10	
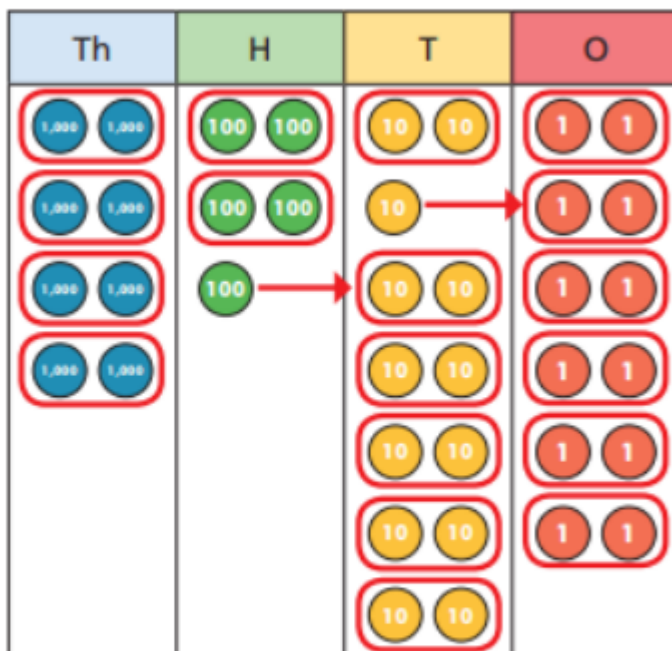
	4	2	6	6
2	8	5	^{1}3	^{1}2

$$8{,}532 \div 2 = 4{,}266$$

Place value counters or plain counters can be used on a place value grid to support children to divide 4-digits by 1-digit. Children can also draw their own counters and group them through a more pictorial method.

Children should be encouraged to move away from the concrete and pictorial when dividing numbers with multiple exchanges.

Skill: Divide multi digits by 2-digits (short division)	Year: 6

			0	3	6		432 ÷ 12 = 36
	12		4	^{4}3	^{7}2		

7,335 ÷ 15 = 489

		0	4	8	9
	15	7	^{7}3	^{13}3	^{13}5

15	30	45	60	75	90	105	120	135	150

When children begin to divide up to 4-digits by 2-digits, written methods become the most accurate as concrete and pictorial representations become less effective. Children can write out multiples to support their calculations with larger remainders. Children will also solve problems with remainders where the quotient can be rounded as appropriate.

Skill: Divide multi-digits by 2-digits (long division)	Year: 6

```
        0  3  6
  1  2 |4  3  2    (×30)
     -  3  6  0
           7  2   (×6)
     -     7  2
              0
```

12 × 1 = 12
12 × 2 = 24
12 × 3 = 36
12 × 4 = 48
12 × 5 = 60
12 × 6 = 72
12 × 7 = 84
12 × 8 = 96
12 × 7 = 108
12 × 10 = 120

$$432 \div 12 = 36$$

$$7{,}335 \div 15 = 489$$

```
        0  4  8  9
  15   |7  3  3  5
     -  6  0  0  0   (×400)
        1  3  3  5
     -  1  2  0  0   (×80)
           1  3  5
     -     1  3  5   (×9)
                 0
```

1 × 15 = 15
2 × 15 = 30
3 × 15 = 45
4 × 15 = 60
5 × 15 = 75
10 × 15 = 150

Children can also divide by 2-digit numbers using long division.

Children can write out multiples to support their calculations with larger remainders.

Children will also solve problems with remainders where the quotient can be rounded as appropriate.

Skill: Divide multi digits by 2-digits (long division)	Year: 6

$$372 \div 15 = 24 \text{ r12}$$

			2	4	r	1	2
1	5	3	7	2			
	−	3	0	0			
			7	2			
		−	6	0			
			1	2			

$1 \times 15 = 15$
$2 \times 15 = 30$
$3 \times 15 = 45$
$4 \times 15 = 60$
$5 \times 15 = 75$
$10 \times 15 = 150$

			2	4	$\frac{4}{5}$
1	5	3	7	2	
	−	3	0	0	
			7	2	
		−	6	0	
			1	2	

$$372 \div 15 = 24\frac{4}{5}$$

When a remainder is left at the end of a calculation, children can either leave it as a remainder or convert it to a fraction.
This will depend on the context of the question.

Children can also answer questions where the quotient needs to be rounded according to the context.