



St John's C of E Primary School, Danbury



Mathematics calculation policy, UPPER KS2 – Year 6

KEY STAGE 2

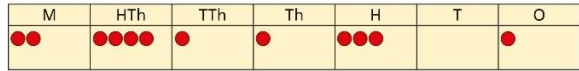
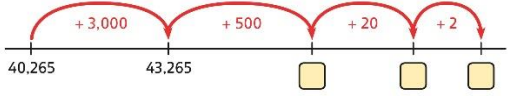
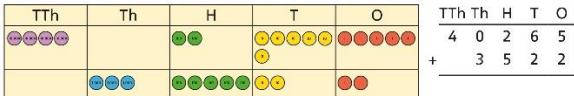
In upper Key Stage 2, children build on secure foundations in calculation, and develop fluency, accuracy and flexibility in their approach to the four operations. They work with whole numbers and adapt their skills to work with decimals, and they continue to develop their ability to select appropriate, accurate and efficient operations.

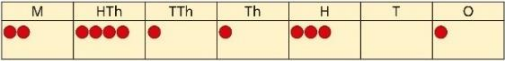
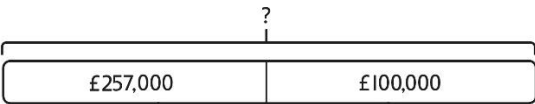
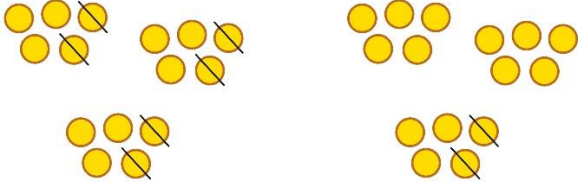
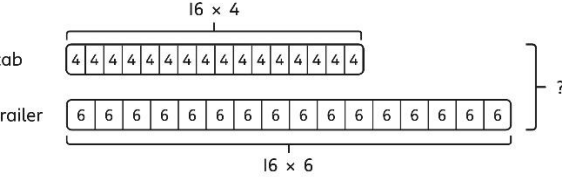
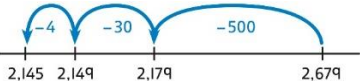
Key language: decimal, column methods, exchange, partition, mental method, ten thousand, hundred thousand, million, factor, multiple, prime number, square number, cube number

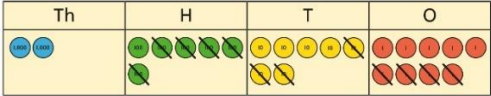
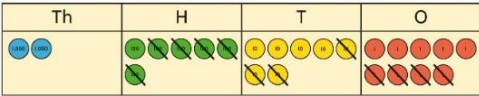
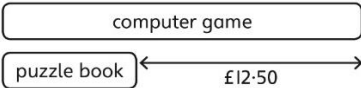
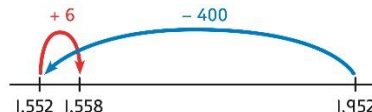
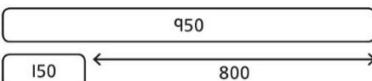
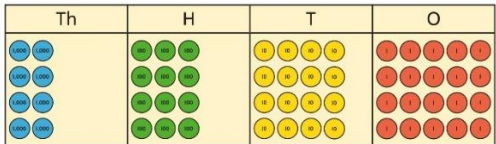
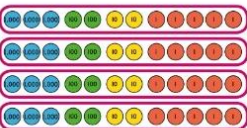
Addition and subtraction: Children build on their column methods to add and subtract numbers with up to seven digits, and they adapt the methods to calculate efficiently and effectively with decimals, ensuring understanding of place value at every stage.
Children compare and contrast methods, and they select mental methods or jottings where appropriate and where these are more likely to be efficient or accurate when compared with formal column methods.
Bar models are used to represent the calculations required to solve problems and may indicate where efficient methods can be chosen.

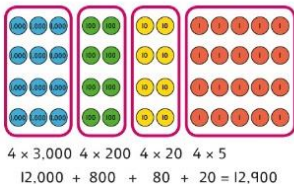
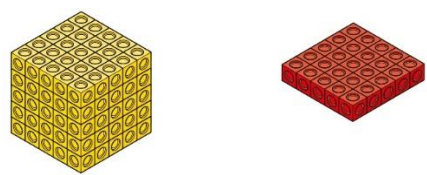
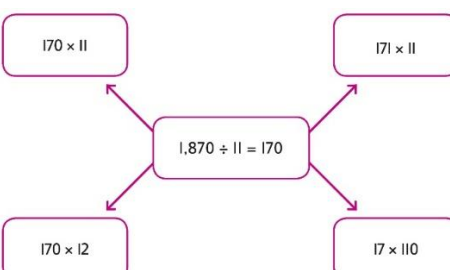
Multiplication and division: Building on their understanding, children develop methods to multiply up to 4-digit numbers by single-digit and 2-digit numbers.
Children develop column methods with an understanding of place value, and they continue to use the key skill of unitising to multiply and divide by 10, 100 and 1,000.
Written division methods are introduced and adapted for division by single-digit and 2-digit numbers and are understood alongside the area model and place value. In Year 6, children develop a secure understanding of how division is related to fractions.
Multiplication and division of decimals are also introduced and refined in Year 6.

Fractions: Children find fractions of amounts, multiply a fraction by a whole number and by another fraction, divide a fraction by a whole number, and add and subtract fractions with different denominators. Children become more confident working with improper fractions and mixed numbers and can calculate with them.
Understanding of decimals with up to 3 decimal places is built through place value and as fractions, and children calculate with decimals in the context of measure as well as in pure arithmetic.
Children develop an understanding of percentages in relation to hundredths, and they understand how to work with common percentages: 50%, 25%, 10% and 1%.

Year 6																																																																			
	Concrete	Pictorial	Abstract																																																																
Year 6 Addition																																																																			
Comparing and selecting efficient methods	<p>Represent 7-digit numbers on a place value grid, and use this to support thinking and mental methods.</p> 	<p>Discuss similarities and differences between methods, and choose efficient methods based on the specific calculation. Compare written and mental methods alongside place value representations.</p>  	<p>Use column addition where mental methods are not efficient. Recognise common errors with column addition.</p> <p>$32,145 + 4,302 = ?$</p> <table style="display: inline-table; margin-right: 20px;"> <tr><td>TTh</td><td>Th</td><td>H</td><td>T</td><td>O</td></tr> <tr><td>3</td><td>2</td><td>1</td><td>4</td><td>5</td></tr> <tr><td>+</td><td>4</td><td>3</td><td>0</td><td>2</td></tr> <tr><td>3</td><td>6</td><td>4</td><td>4</td><td>7</td></tr> </table> <table style="display: inline-table;"> <tr><td>TTh</td><td>Th</td><td>H</td><td>T</td><td>O</td></tr> <tr><td>3</td><td>2</td><td>1</td><td>4</td><td>5</td></tr> <tr><td>+</td><td>4</td><td>3</td><td>0</td><td>2</td></tr> <tr><td>7</td><td>5</td><td>1</td><td>6</td><td>5</td></tr> </table> <p><i>Which method has been completed accurately?</i></p> <p><i>What mistake has been made?</i></p> <p>Column methods are also used for decimal additions where mental methods are not efficient.</p> <table style="margin-left: auto; margin-right: auto;"> <tr><td>H</td><td>T</td><td>O</td><td>·</td><td>Tth</td><td>Hth</td></tr> <tr><td>1</td><td>4</td><td>0</td><td>·</td><td>0</td><td>9</td></tr> <tr><td>+</td><td>4</td><td>9</td><td>·</td><td>8</td><td>9</td></tr> <tr><td>1</td><td>8</td><td>9</td><td>·</td><td>9</td><td>8</td></tr> </table>	TTh	Th	H	T	O	3	2	1	4	5	+	4	3	0	2	3	6	4	4	7	TTh	Th	H	T	O	3	2	1	4	5	+	4	3	0	2	7	5	1	6	5	H	T	O	·	Tth	Hth	1	4	0	·	0	9	+	4	9	·	8	9	1	8	9	·	9	8
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Selecting mental methods for larger numbers	<p>Represent 7-digit numbers on a place value grid, and use this to support thinking and mental methods.</p>	<p>Use a bar model to support thinking in addition problems.</p> <p>$257,000 + 99,000 = ?$</p>	<p>Use place value and unitising to support mental calculations with larger numbers.</p> <p>$195,000 + 6,000 = ?$</p>																																																																

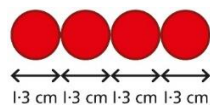
<p>where appropriate</p>	 <p>$2,411,301 + 500,000 = ?$</p> <p><i>This would be 5 more counters in the HTh place.</i></p> <p><i>So, the total is 2,911,301.</i></p> <p>$2,411,301 + 500,000 = 2,911,301$</p>	 <p><i>I added 100 thousands then subtracted 1 thousand.</i></p> <p><i>257 thousands + 100 thousands = 357 thousands</i></p> <p>$257,000 + 100,000 = 357,000$ $357,000 - 1,000 = 356,000$</p> <p><i>So, 257,000 + 99,000 = 356,000</i></p>	<p>$195 + 5 + 1 = 201$</p> <p><i>195 thousands + 6 thousands = 201 thousands</i></p> <p><i>So, 195,000 + 6,000 = 201,000</i></p>
<p>Understanding order of operations in calculations</p>	<p>Use equipment to model different interpretations of a calculation with more than one operation. Explore different results.</p> <p>$3 \times 5 - 2 = ?$</p>  <p> $\begin{array}{r} 3 \times 5 - 2 \\ \downarrow \quad \downarrow \\ 3 \times 3 = 9 \end{array}$ </p> <p> $\begin{array}{r} 3 \times 5 - 2 \\ \downarrow \quad \downarrow \\ 15 - 2 = 13 \end{array}$ </p>	<p>Model calculations using a bar model to demonstrate the correct order of operations in multi-step calculations.</p>  <p>This can be written as: $16 \times 4 + 16 \times 6$</p> <p>$64 + 96 = 160$</p>	<p>Understand the correct order of operations in calculations without brackets.</p> <p>Understand how brackets affect the order of operations in a calculation.</p> <p>$4 + 6 \times 16$ $4 + 96 = 100$</p> <p>$(4 + 6) \times 16$ $10 \times 16 = 160$</p>
<p>Year 6 Subtraction</p>			
<p>Comparing and selecting efficient methods</p>	<p>Use counters on a place value grid to represent subtractions of larger numbers.</p>	<p>Compare subtraction methods alongside place value representations.</p> 	<p>Compare and select methods. Use column subtraction when mental methods are not efficient. Use two different methods for one calculation as a checking strategy.</p>

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<p>Subtracting mentally with larger numbers</p>		<p>Use a bar model to show how unitising can support mental calculations.</p> <p>$950,000 - 150,000$ That is 950 thousands - 150 thousands</p>  <p>So, the difference is 800 thousands. $950,000 - 150,000 = 800,000$</p>	<p>Subtract efficiently from powers of 10.</p> <p>$10,000 - 500 = ?$</p>																																																																																								
<p>Year 6 Multiplication</p>																																																																																											
<p>Multiplying up to a 4-digit number by a single digit number</p>	<p>Use equipment to explore multiplications.</p>  <p>4 groups of 2,345</p>	<p>Use place value equipment to compare methods.</p> <p>Method 1</p>  <table border="1" style="margin-top: 10px;"> <tbody> <tr><td>3</td><td>2</td><td>2</td><td>5</td></tr> <tr><td>3</td><td>2</td><td>2</td><td>5</td></tr> <tr><td>3</td><td>2</td><td>2</td><td>5</td></tr> <tr><td>3</td><td>2</td><td>2</td><td>5</td></tr> <tr><td colspan="4"><hr/></td></tr> <tr><td>1</td><td>2</td><td>9</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td><td>2</td><td></td><td></td></tr> </tbody> </table>	3	2	2	5	3	2	2	5	3	2	2	5	3	2	2	5	<hr/>				1	2	9	0	0	1	1	2			<p>Understand area model and short multiplication.</p> <p>Compare and select appropriate methods for specific multiplications.</p>																																																										
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	<p><i>This is a multiplication:</i></p> $4 \times 2,345$ $2,345 \times 4$	<p>Method 2</p>  <p> $4 \times 3,000$ 4×200 4×20 4×5 $12,000 + 800 + 80 + 20 = 12,900$ </p>	<p>Method 3</p> <table border="1" data-bbox="1545 159 1769 223"> <tr> <td></td> <td>3,000</td> <td>200</td> <td>20</td> <td>5</td> </tr> <tr> <td>4</td> <td>12,000</td> <td>800</td> <td>80</td> <td>20</td> </tr> </table> <p>$12,000 + 800 + 80 + 20 = 12,900$</p> <p>Method 4</p> $\begin{array}{r} 3\ 2\ 2\ 5 \\ \times\ 4 \\ \hline 1\ 2\ 9\ 0\ 0 \\ \ 2 \\ \hline 1\ 2\ 9\ 0\ 0 \end{array}$		3,000	200	20	5	4	12,000	800	80	20					
	3,000	200	20	5														
4	12,000	800	80	20														
<p>Multiplying up to a 4-digit number by a 2-digit number</p>		<p>Use an area model alongside written multiplication.</p> <p>Method 1</p> <table border="1" data-bbox="940 590 1321 710"> <tr> <td></td> <td>1,000</td> <td>200</td> <td>30</td> <td>5</td> </tr> <tr> <td>20</td> <td>20,000</td> <td>4,000</td> <td>600</td> <td>100</td> </tr> <tr> <td>1</td> <td>1,000</td> <td>200</td> <td>30</td> <td>5</td> </tr> </table> $\begin{array}{r} 1\ 2\ 3\ 5 \\ \times\ 2\ 1 \\ \hline 5\ 1 \times 5 \\ 3\ 0\ 1 \times 30 \\ 2\ 0\ 0\ 1 \times 200 \\ 1\ 0\ 0\ 0\ 1 \times 1,000 \\ 1\ 0\ 0\ 20 \times 5 \\ 6\ 0\ 0\ 20 \times 30 \\ 4\ 0\ 0\ 0\ 20 \times 200 \\ 2\ 0\ 0\ 0\ 0\ 20 \times 1,000 \\ \hline 2\ 5\ 9\ 3\ 5 \end{array}$ <p>$21 \times 1,235$</p>		1,000	200	30	5	20	20,000	4,000	600	100	1	1,000	200	30	5	<p>Use compact column multiplication with understanding of place value at all stages.</p> $\begin{array}{r} 1\ 2\ 3\ 5 \\ \times\ 2\ 1 \\ \hline 1\ 2\ 3\ 5 \\ 2\ 4\ 7\ 0\ 0 \\ \hline 2\ 5\ 9\ 3\ 5 \end{array}$ <p> $1 \times 1,235$ $20 \times 1,235$ $21 \times 1,235$ </p>
	1,000	200	30	5														
20	20,000	4,000	600	100														
1	1,000	200	30	5														
<p>Using knowledge of factors and partitions to compare methods for multiplications</p>	<p>Use equipment to understand square numbers and cube numbers.</p>  $5 \times 5 = 5^2 = 25$ $5 \times 5 \times 5 = 5^3 = 25 \times 5 = 125$	<p>Compare methods visually using an area model. Understand that multiple approaches will produce the same answer if completed accurately.</p>	<p>Use a known fact to generate families of related facts.</p> 															

			<p>Use factors to calculate efficiently.</p> 15×16 $= 3 \times 5 \times 2 \times 8$ $= 3 \times 8 \times 2 \times 5$ $= 24 \times 10$ $= 240$
<p>Multiplying by 10, 100 and 1,000</p>	<p>Use place value equipment to explore exchange in decimal multiplication.</p> <p>Represent 0.3.</p> <p>Multiply by 10.</p> <p>Exchange each group of ten tenths.</p> <p>$0.3 \times 10 = ?$ 0.3 is 3 tenths. 10×3 tenths are 30 tenths. 30 tenths are equivalent to 3 ones.</p>	<p>Understand how the exchange affects decimal numbers on a place value grid.</p> <p>$0.3 \times 10 = 3$</p>	<p>Use knowledge of multiplying by 10, 100 and 1,000 to multiply by multiples of 10, 100 and 1,000.</p> $8 \times 100 = 800$ $8 \times 300 = 800 \times 3$ $= 2,400$ $2.5 \times 10 = 25$ $2.5 \times 20 = 2.5 \times 10 \times 2$ $= 50$
<p>Multiplying decimals</p>	<p>Explore decimal multiplications using place value equipment and in the context of measures.</p>	<p>Represent calculations on a place value grid.</p>	<p>Use known facts to multiply decimals.</p> $4 \times 3 = 12$ $4 \times 0.3 = 1.2$ $4 \times 0.03 = 0.12$ $20 \times 5 = 100$ $20 \times 0.5 = 10$ $20 \times 0.05 = 1$

3 groups of 4 tenths is 12 tenths.
4 groups of 3 tenths is 12 tenths.



$4 \times 1 \text{ cm} = 4 \text{ cm}$
 $4 \times 0.3 \text{ cm} = 1.2 \text{ cm}$
 $4 \times 1.3 = 4 + 1.2 = 5.2 \text{ cm}$

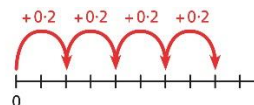
$3 \times 3 = 9$

$3 \times 0.3 = 0.9$

T	O	.	Tth
			0.1 0.1 0.1
			0.1 0.1 0.1
			0.1 0.1 0.1

Understand the link between multiplying decimals and repeated addition.

T	O	.	Tth
			0.1 0.1 0.1
			0.1 0.1 0.1



Find families of facts from a known multiplication.

I know that $18 \times 4 = 72$.

This can help me work out:

$1.8 \times 4 = ?$
 $18 \times 0.4 = ?$
 $180 \times 0.4 = ?$
 $18 \times 0.04 = ?$

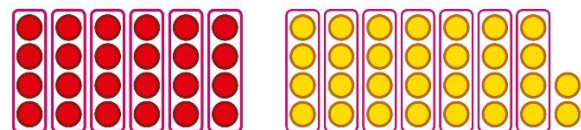
Use a place value grid to understand the effects of multiplying decimals.

	H	T	O	.	Tth	Hth
2×3			6	.		
0.2×3			0	.	6	
0.02×3				.		

Year 6 Division

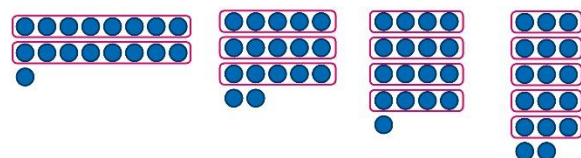
Understanding factors

Use equipment to explore different factors of a number.



4 is a factor of 24 but is not a factor of 30.

Recognise prime numbers as numbers having exactly two factors. Understand the link with division and remainders.



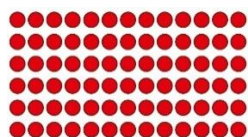
$17 \div 2 = 8 \text{ r } 1$ $17 \div 3 = 5 \text{ r } 2$ $17 \div 4 = 4 \text{ r } 1$ $17 \div 5 = 3 \text{ r } 2$

Recognise and know primes up to 100. Understand that 2 is the only even prime, and that 1 is not a prime number.

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

Dividing by a single digit

Use equipment to make groups from a total.



There are 78 in total.
There are 6 groups of 13.
There are 13 groups of 6.

H	T	O
●	●●●	●●

How many groups of 6 are in 100? $6 \overline{) 100}$

H	T	O
●	●●●●	●●

How many groups of 6 are in 13 tens? $6 \overline{) 130}$

H	T	O
	●●●●●	●●●●

How many groups of 6 are in 12 ones? $6 \overline{) 12}$

Use short division to divide by a single digit.

$$\begin{array}{r} 0 \\ 6 \overline{) 132} \\ \underline{6} \\ 7 \\ \underline{6} \\ 12 \\ \underline{12} \\ 0 \end{array}$$

$$\begin{array}{r} 0 \\ 6 \overline{) 132} \\ \underline{6} \\ 7 \\ \underline{6} \\ 12 \\ \underline{12} \\ 0 \end{array}$$

$$\begin{array}{r} 0 \\ 6 \overline{) 132} \\ \underline{6} \\ 7 \\ \underline{6} \\ 12 \\ \underline{12} \\ 0 \end{array}$$

Use an area model to link multiplication and division.

$6 \times ? = 132$	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="width: 20px;">10</td><td style="width: 20px;">10</td><td style="width: 10px;">1</td><td style="width: 10px;">1</td></tr> <tr><td>60</td><td>60</td><td>6</td><td>6</td></tr> </table>	10	10	1	1	60	60	6	6
10	10	1	1						
60	60	6	6						
	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td style="width: 20px;">20</td><td style="width: 20px;">2</td></tr> <tr><td>120</td><td>12</td></tr> </table>	20	2	120	12				
20	2								
120	12								
	$132 = 120 + 12$ $132 \div 6 = 20 + 2 = 22$								

Dividing by a 2-digit number using factors

Understand that division by factors can be used when dividing by a number that is not prime.

Use factors and repeated division.

$1,260 \div 14 = ?$



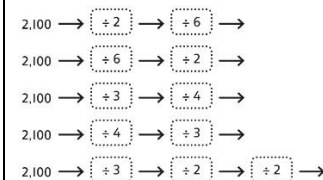
$1,260 \div 2 = 630$

$630 \div 7 = 90$

$1,260 \div 14 = 90$

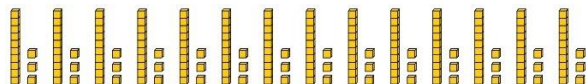
Use factors and repeated division where appropriate.

$2,100 \div 12 = ?$



Dividing by a 2-digit number using long division

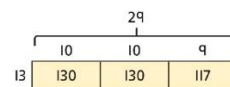
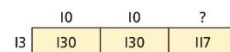
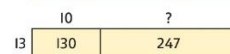
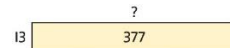
Use equipment to build numbers from groups.



*182 divided into groups of 13.
There are 14 groups.*

Use an area model alongside written division to model the process.

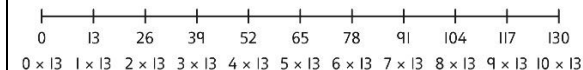
$$377 \div 13 = ?$$



$$377 \div 13 = 29$$

Use long division where factors are not useful (for example, when dividing by a 2-digit prime number). Write the required multiples to support the division process.

$$377 \div 13 = ?$$



$$\begin{array}{r} 13 \overline{) 377} \\ - 130 \quad 10 \\ \hline 247 \\ - 130 \quad 10 \\ \hline 117 \\ - 117 \quad 9 \\ \hline 0 \quad 29 \end{array}$$

$$377 \div 13 = 29$$

A slightly different layout may be used, with the division completed above rather than at the side.

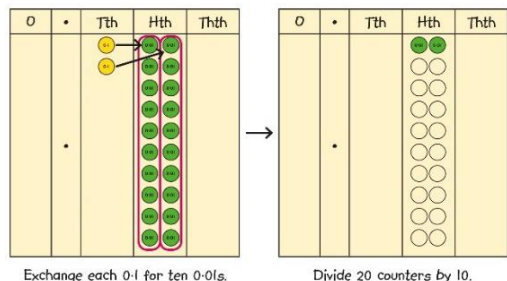
$$\begin{array}{r} 3 \\ 21 \overline{) 798} \\ - 630 \\ \hline 168 \end{array}$$

$$\begin{array}{r} 38 \\ 21 \overline{) 798} \\ - 630 \\ \hline 168 \\ - 168 \\ \hline 0 \end{array}$$

Divisions with a remainder explored in problem-solving contexts.

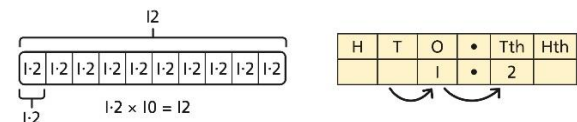
Dividing by 10, 100 and 1,000

Use place value equipment to explore division as exchange.

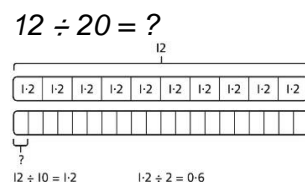


0.2 is 2 tenths.
 2 tenths is equivalent to 20 hundredths.
 20 hundredths divided by 10 is 2 hundredths.

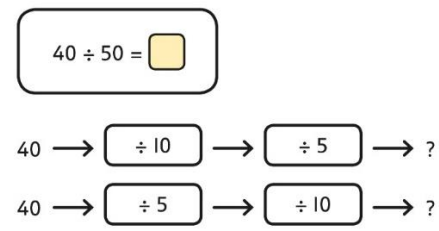
Represent division to show the relationship with multiplication. Understand the effect of dividing by 10, 100 and 1,000 on the digits on a place value grid.



Understand how to divide using division by 10, 100 and 1,000.



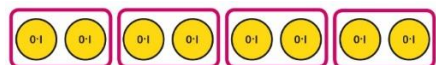
Use knowledge of factors to divide by multiples of 10, 100 and 1,000.



$40 \div 5 = 8$
 $8 \div 10 = 0.8$
 So, $40 \div 50 = 0.8$

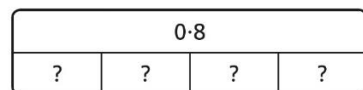
Dividing decimals

Use place value equipment to explore division of decimals.



8 tenths divided into 4 groups. 2 tenths in each group.

Use a bar model to represent divisions.



$4 \times 2 = 8$ $8 \div 4 = 2$
 So, $4 \times 0.2 = 0.8$ $0.8 \div 4 = 0.2$

Use short division to divide decimals with up to 2 decimal places.

