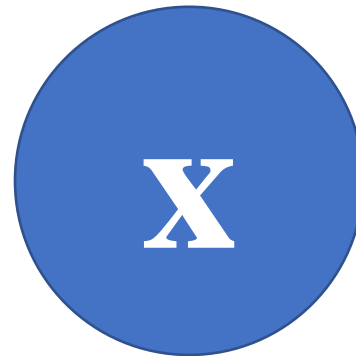
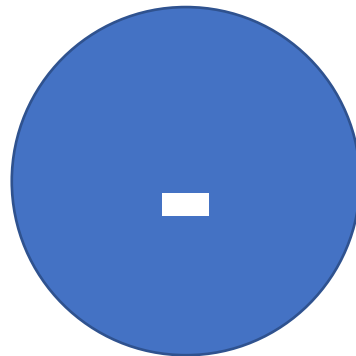


Mathematics Calculation Policy

January 2017

Padstow School



Introduction

The purpose of this document is to create a personalised, updated policy reflecting the requirements of the National Curriculum 2014 and more importantly, the needs of our pupils.

This policy aims to develop, model and explain core understandings and mathematical principles and progression to ensure consistency in the teaching and learning of mathematics in our school.

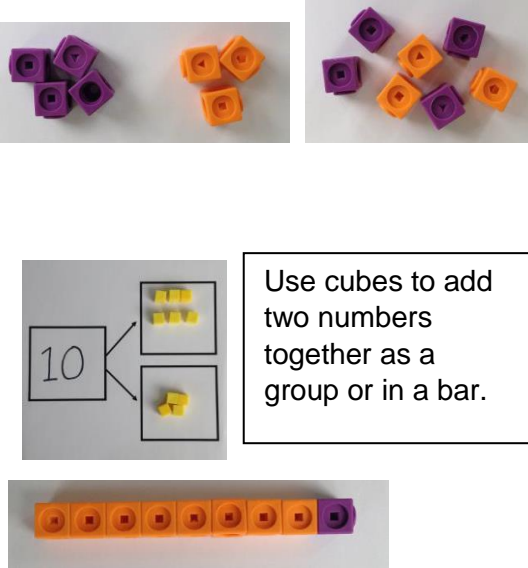
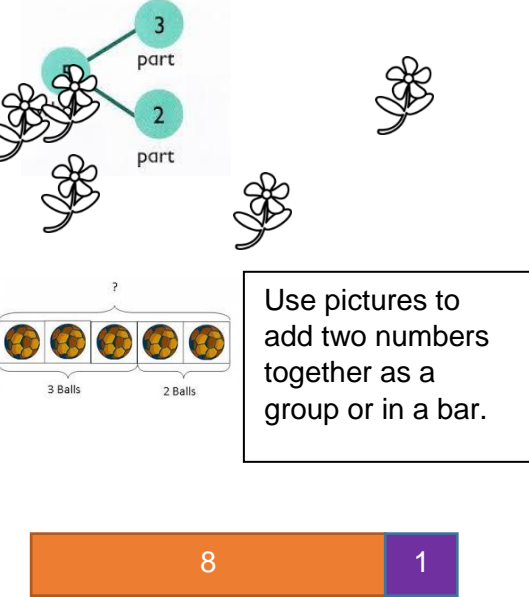
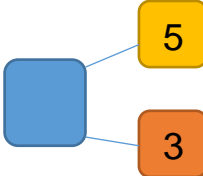

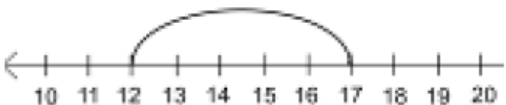
The focus of this policy is the calculation of the four mathematical operations with an emphasis on written strategies to clarify processes and understanding and to make direct links to mental calculating. It is crucial that these mental strategies are discretely taught and linked to written strategies and not confined to starter activities in lessons.

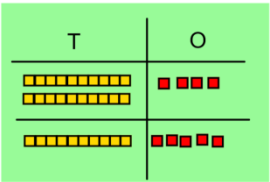
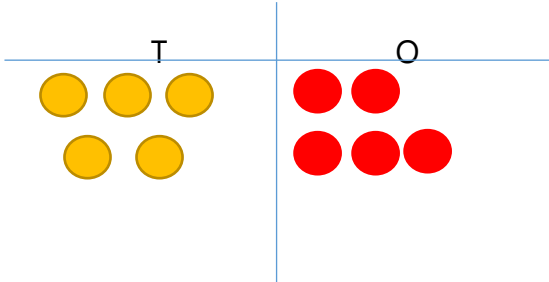
The overall aims of this policy are that, when children leave Padstow school they:

- have a secure knowledge of number facts and a good understanding of the four operations supported by a fluency and understanding of the fundamentals of mathematics.
- know the best strategy to use, estimate before calculating, systematically break problems down into a series of simpler steps with perseverance and use estimation and rounding to check that an answer is reasonable
- are able to use this knowledge and understanding to carry out calculations mentally, solve problems of increasing complexity and develop an ability to recall and apply knowledge rapidly
- make use of diagrams and informal notes and jottings to help record steps and partial answers when using mental methods
- have an efficient, reliable, compact written method of calculation for each operation, which they can apply with confidence when undertaking calculations
- be able to identify when a calculator is the best tool for the task and use this primarily as a way of checking rather than simply a way of calculating
- be able to explain their strategies to calculate and, using spoken language, give mathematical justification, argument or proof

Progression in Calculations

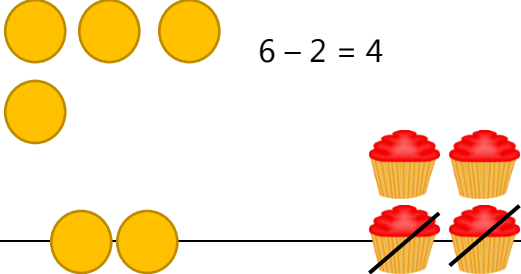
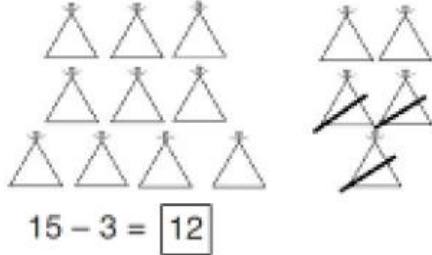
Addition



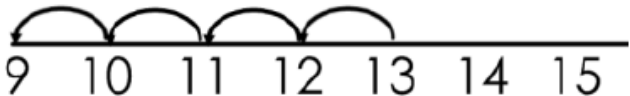
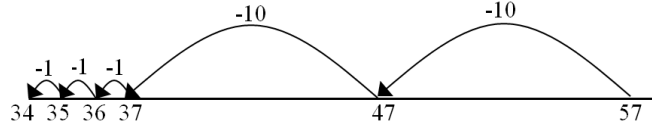
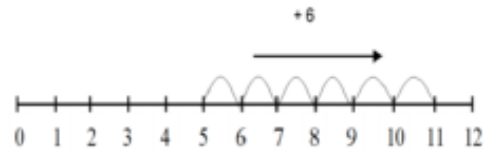
Objective and Strategies	Concrete	Pictorial	Abstract
<p>Combining two parts to make a whole: part- whole model</p>	 <p>Use cubes to add two numbers together as a group or in a bar.</p>	 <p>Use pictures to add two numbers together as a group or in a bar.</p>	<p>$4 + 3 = 7$</p> <p>$10 = 6 + 4$</p>  <p>Use the part-part whole diagram as shown above to move into the abstract.</p>
<p>Starting at the bigger number and counting on</p>	 <p>Start with the larger number on the bead string and then count on to the smaller number 1 by 1 to find the answer.</p>	<p>$12 + 5 = 17$</p>  <p>Start at the larger number on the number line and count on in ones or in one jump to find the answer.</p>	<p>$5 + 12 = 17$</p> <p>Place the larger number in your head and count on the smaller number to find your answer.</p>

	Following on from making 10, make 10 with 2 of the digits (if possible) then add on the third digit.	Add together three groups of objects. Draw a picture to recombine the groups to make 10.	
Formal method- grouping and exchanging of tens	<p>$24 + 15 =$</p> <p>Add together the ones first then add the tens. Use the Base 10 blocks first before moving onto place value counters.</p> 	<p>After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions.</p> 	<div> <p>Calculations</p> <p>$21 + 42 =$</p> <p>$\begin{array}{r} 21 \\ + 42 \\ \hline \end{array}$</p> </div> <p>Start by partitioning the numbers before moving on to clearly show the</p> <div> $\begin{array}{r} 20 + 5 \\ 40 + 8 \\ 60 + 13 = 73 \end{array}$ $\begin{array}{r} 536 \\ + 85 \\ \hline 621 \\ 11 \end{array}$ <p>exchange below the addition.</p> </div>

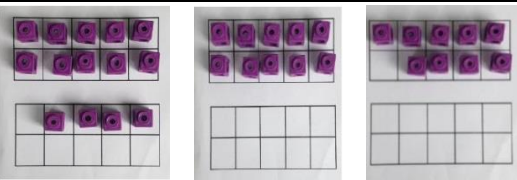
			<p>As the children move on, introduce decimals with the same number of decimal places and</p> $ \begin{array}{r} 23.361 \\ 9.080 \\ 59.770 \\ + 1.300 \\ \hline 93.511 \\ 21.2 \end{array} $ <p>different.</p> $ \begin{array}{r} 72.8 \\ + 54.6 \\ \hline 127.4 \\ 11 \end{array} $ <p>Money can be used here.</p> $ \begin{array}{r} £ 23.59 \\ + £ 7.55 \\ \hline £ 31.14 \\ 11 \end{array} $
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Subtraction

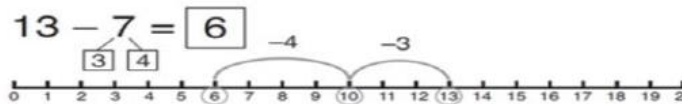
Objective and Strategies	Concrete	Pictorial	Abstract
Subtracting ones	<p>Use physical objects, counters, cubes etc to show how objects can be subtracted.</p> 	<p>Cross out drawn objects to show what has been subtracted.</p> 	<p>18 - 3 = 15</p> <p>8 - 2 = 6</p>

<p>Counting back</p>	<p>Make the larger number in your subtraction. Move the beads along your bead string as you count backwards in ones.</p>  <p>$13 - 4$</p> <p>Use counters and move them away from the group as you subtract, counting backwards as you go.</p> 	<p>Count back on a number line or number track</p>  <p>Start at the bigger number and count back the smaller number showing the jumps on the number line.</p>  <p>This can progress all the way to counting back using two 2 digit numbers.</p>	<p>Put 13 in your head, count back 4. What number are you at? Use your fingers to help.</p>
<p>Find the difference</p>	<p>Compare amounts and objects to find the difference.</p>	 <p>Count on to find the difference.</p>	<p>Hannah has 23 sandwiches, Helen has 15 sandwiches. Find the difference between the number of sandwiches.</p>

	<div data-bbox="432 164 707 344" data-label="Image"> </div> <div data-bbox="432 363 707 539" data-label="Image"> </div> <div data-bbox="730 188 947 392" data-label="Text"> <p>Use cubes to build towers or make bars to find the difference</p> </div> <div data-bbox="730 443 947 563" data-label="Text"> <p>Use basic bar models with items to find the difference</p> </div> <div data-bbox="432 571 618 608" data-label="Text"> <p>the difference</p> </div>	<div data-bbox="1301 148 1603 180" data-label="Section-Header"> <h3>Comparison Bar Models</h3> </div> <div data-bbox="1216 217 1637 268" data-label="Text"> <p>Lisa is 13 years old. Her sister is 22 years old. Find the difference in age between them.</p> </div> <div data-bbox="1238 284 1563 451" data-label="Figure"> </div> <div data-bbox="976 233 1155 435" data-label="Text"> <p>Draw bars to find the difference between 2 numbers.</p> </div>	
<div data-bbox="96 746 331 823" data-label="Section-Header"> <h3>Part Part Whole Model</h3> </div>	<div data-bbox="432 770 629 967" data-label="Image"> </div> <div data-bbox="651 746 920 994" data-label="Text"> <p>Link to addition- use the part whole model to help explain the inverse between addition and subtraction.</p> </div> <div data-bbox="432 1042 936 1126" data-label="Text"> <p>If 10 is the whole and 6 is one of the parts. What is the other part?</p> </div> <div data-bbox="432 1174 539 1206" data-label="Equation-Block"> $10 - 6 =$ </div>	<div data-bbox="976 746 1709 823" data-label="Text"> <p>Use a pictorial representation of objects to show the part part whole model.</p> </div> <div data-bbox="1093 818 1637 1098" data-label="Image"> </div>	<div data-bbox="1805 762 2011 946" data-label="Figure"> </div> <div data-bbox="1742 1042 2085 1166" data-label="Text"> <p>Move to using numbers within the part whole model.</p> </div>
<div data-bbox="96 1217 230 1249" data-label="Section-Header"> <h3>Make 10</h3> </div>	<div data-bbox="432 1217 539 1249" data-label="Equation-Block"> $14 - 9 =$ </div>		<div data-bbox="1742 1257 1850 1294" data-label="Equation-Block"> $16 - 8 =$ </div> <div data-bbox="1742 1345 2119 1425" data-label="Text"> <p>How many do we subtract to reach the next 10?</p> </div>



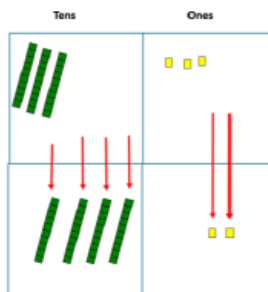
Make 14 on the ten frame. Subtract the 4 first to make 10 and then subtract one more so you have subtracted 5. You are left with the answer of 9.



Start at 13. Subtract 3 to reach 10. Then subtract the remaining 4 so you have subtracted 7 altogether. You have reached your answer.

How many do we have left to subtract?

Formal method with and without exchanging

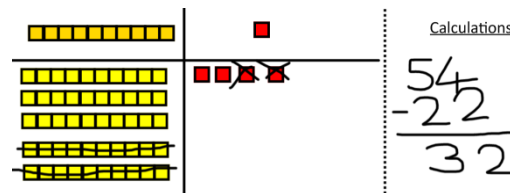


Use Base 10 to make the bigger number then subtract the smaller number.

Show how you partition numbers to subtract. Again make the larger number first.



Draw the Base 10 or place value counters alongside the written. When confident, children can find their own way to record the exchange/regrouping.



$$47 - 24 = 23$$

$$\begin{array}{r} 40 + 7 \\ - 20 + 4 \\ \hline 20 + 3 \end{array}$$

This will lead to a clear

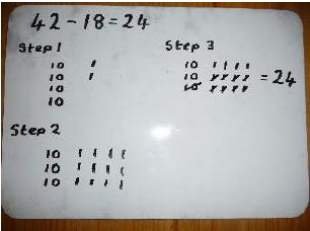
$$\begin{array}{r} 32 \\ - 12 \\ \hline 20 \end{array}$$

$$728 - 582 = 146$$

H	T	U
7	2	8
5	8	2
1	4	6

written column subtraction.

Just writing the numbers as shown here shows that the child understands the method and knows when to exchange/regroup.calculation to help to show working.



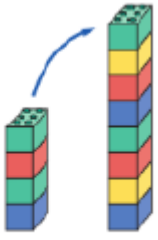

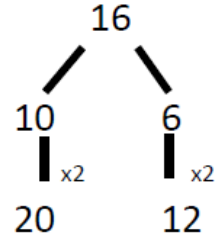
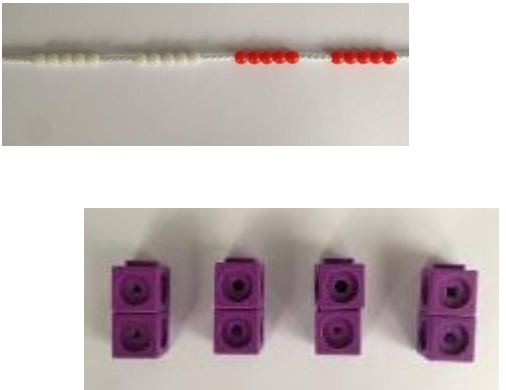
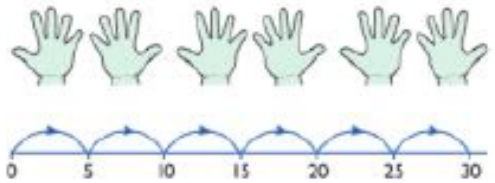
Moving forward the children use a more compact method.

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

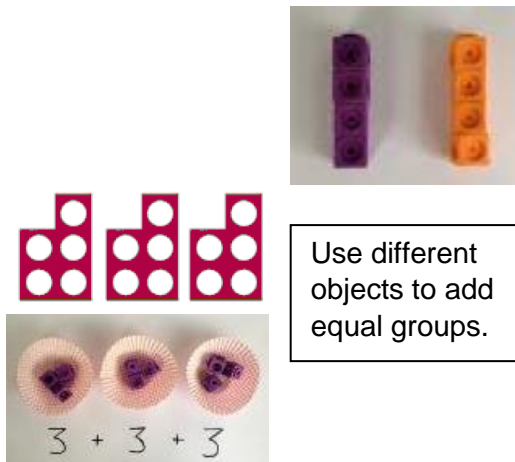
$$\begin{array}{r}
 5 12 1 \\
 2 \cancel{6} \cancel{3} . \textcolor{red}{0} \\
 - 2 6 . 5 \\
 \hline
 2 3 6 . 5
 \end{array}$$

Multiplication

Objective and Strategies	Concrete	Pictorial	Abstract
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<p>Doubling</p>	 <p>double 4 is 8 $4 \times 2 = 8$</p> <p>Use practical activities to show how to double a number.</p>	<p>Draw pictures to show how to double a number.</p> <p>Double 4 is 8</p> 	 <p>Partition a number and then double each part before recombining it back together.</p>
<p>Counting in multiples</p>	 <p>Count in multiples supported by concrete objects in equal groups.</p>	 <p>Use a number line or pictures to continue support in counting in multiples.</p>	<p>Count in multiples of a number aloud.</p> <p>Write sequences with multiples of numbers.</p> <p>2, 4, 6, 8, 10</p> <p>5, 10, 15, 20, 25, 30</p>


Repeated addition



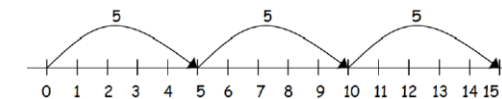
Use different objects to add equal groups.

$$3 + 3 + 3$$

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



2 add 2 add 2 equals 6



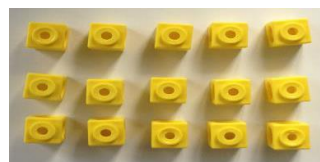
$$5 + 5 + 5 = 15$$

Write addition sentences to describe objects and pictures.

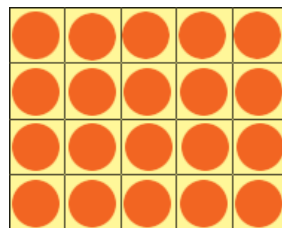
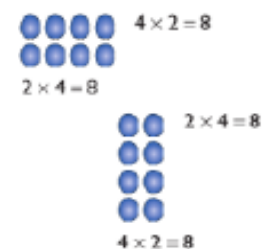


Arrays- showing commutative multiplication

Create arrays using counters/ cubes to show multiplication calculations.



Draw arrays in different rotations to find commutative multiplication calculations.



Link arrays to area of rectangles.

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



$$5 + 5 + 5 = 15$$

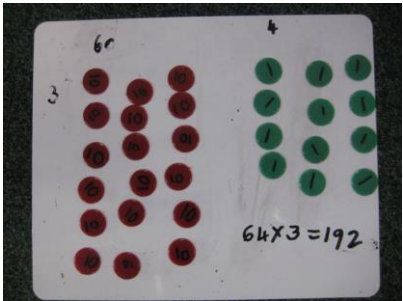
$$3 + 3 + 3 + 3 + 3 = 15$$

$$5 \times 3 = 15$$

$$3 \times 5 = 15$$

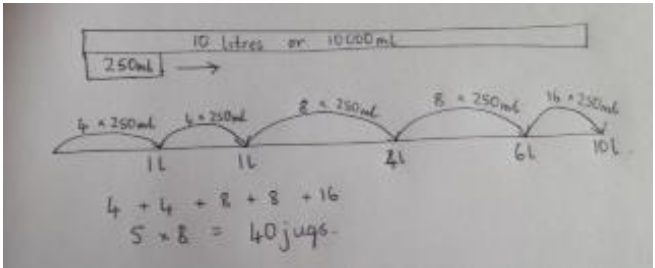
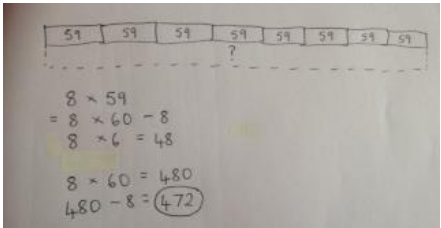
Formal
multiplication

Children can continue to be supported by place value counters at the stage of multiplication.



It is important at this stage that they always multiply the ones first and note down their answer followed by the tens which they note below.

Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods.




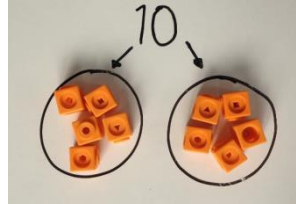
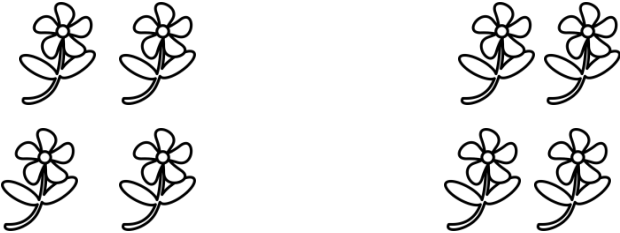
Start with long multiplication, reminding the children about lining up their digits clearly in columns.

If it helps, children can write out what they are solving next to their answer.

$$\begin{array}{r} 32 \\ \times 24 \\ \hline 8 \quad (4 \times 2) \\ 120 \quad (4 \times 30) \\ 40 \quad (20 \times 2) \\ 600 \quad (20 \times 30) \\ \hline 768 \end{array}$$

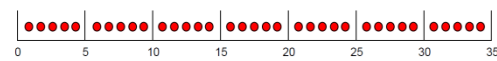
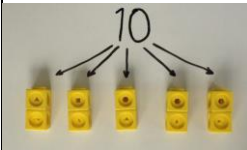
			<p>This moves to the more compact method.</p> $ \begin{array}{r} 231 \\ 1342 \\ \times 18 \\ \hline 10736 \\ 13420 \\ \hline 24156 \\ 1 \end{array} $
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Division

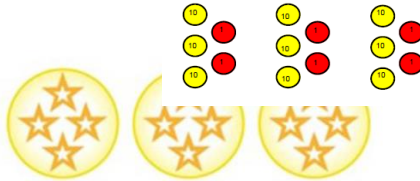
Objective and Strategies	Concrete	Pictorial	Abstract
<p>Dividing objects into groups</p>	<div>  <p>I have 10 cubes, can you share them equally in 2 groups?</p>  </div>	<p>Children use pictures or shapes to share quantities.</p> <div>  <div> $8 \div 2 = 4$ </div> </div>	<p>Share 9 buns between three people.</p> <p>$9 \div 3 = 3$</p>

Division as grouping

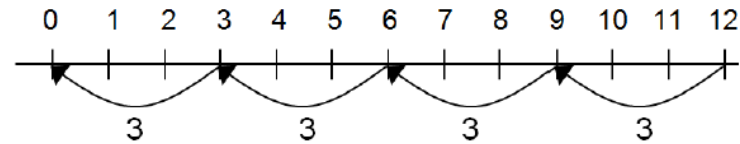
Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.



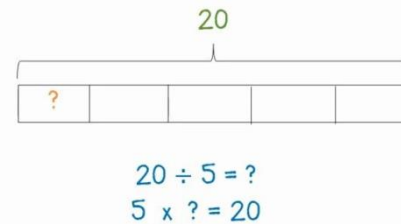
$$96 \div 3 = 32$$



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



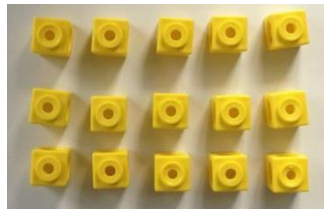
Think of the bar as a whole. Split it into the number of groups you are dividing by and work out how many would be within each group.



$$28 \div 7 = 4$$

Divide 28 into 7 groups. How many are in each group?

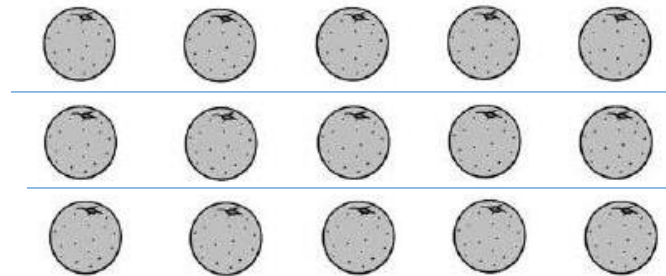
Division within arrays



Link division to

multiplication by creating an array and thinking about the calculations that can be created.

Eg $15 \div 3 = 5$ $5 \times 3 = 15$
 $15 \div 5 = 3$ $3 \times 5 = 15$



Draw an array and use lines to split the array into groups to make multiplication and division calculations.

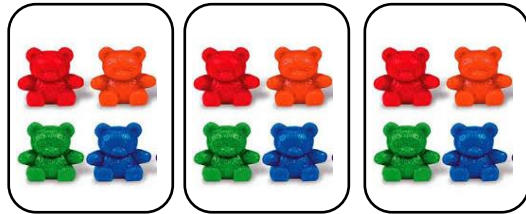
Find the inverse of multiplication and division sentences by creating four linking calculations.

$7 \times 4 = 28$
 $4 \times 7 = 28$
 $28 \div 7 = 4$
 $28 \div 4 = 7$

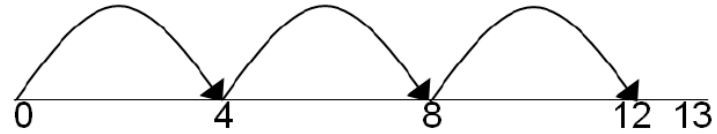
Division with a remainder

$$14 \div 3 =$$

Divide objects between groups and see how much is left over



Jump forward in equal jumps on a number line then



see how many more you need to jump to find a remainder.

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



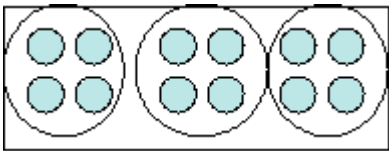
Complete written divisions and show the remainder using r.

$$29 \div 8 = 3 \text{ REMAINDER } 5$$

↑ ↑ ↑ ↑
dividend divisor quotient remainder

Short division

Students can continue to use drawn diagrams with dots or circles to help them divide numbers into equal groups.



Encourage them to move towards counting in multiples to divide more efficiently.

Begin with divisions that divide equally with no remainder.

$$\begin{array}{r} 218 \\ 4 \overline{) 872} \\ \underline{8} \\ 0 \\ \underline{0} \\ 0 \\ \underline{0} \\ 0 \end{array}$$

Move onto divisions with a remainder.

$$\begin{array}{r} 86 \text{ r } 2 \\ 5 \overline{) 432} \\ \underline{40} \\ 32 \\ \underline{30} \\ 2 \end{array}$$

Finally move into decimal places to divide the total accurately.

$$\begin{array}{r} 14.6 \\ 35 \overline{) 511.0} \\ \underline{35} \\ 16 \\ \underline{14} \\ 21 \\ \underline{21} \\ 0 \end{array}$$

Long division

First, set the calculation out as shown:

$$\begin{array}{r} 51 \overline{)748} \end{array}$$

We work out 74 divided by 51, and write the answer (1) above the 4. $1 \times 51 = 51$, so we write this underneath 74.

Subtract 51 from 74 to get the remainder (23).

$$\begin{array}{r} 1 \\ 51 \overline{)748} \\ -51 \\ \hline 23 \end{array}$$

We now bring down the next digit (8) and write it on the end of the 23.

$$\begin{array}{r} 1 \\ 51 \overline{)748} \\ -51 \\ \hline 238 \end{array}$$

We now work out 238 divided by 51, and write the answer (4) above the 8. You use estimation skills here: 51 is roughly 50 and $4 \times 50 = 200$. You can work out $51 \times 4 = 204$ separately.

We write 204 underneath the 238 and subtract to find the remainder. There are no more digits to

			<p>bring down, so we have our answer:</p> $\begin{array}{r} 14 \\ 51 \overline{)748} \\ \underline{-51} \\ 238 \\ \underline{-204} \\ 34 \end{array}$ <p>So the answer is 14 remainder 34.</p> <p>Move onto remainder being shown as a decimal and then as a fraction.</p>
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