St John's Church of England Academy

Part of the

Durham & Newcastle Diocesan Learning Trust

Calculations Policy

2021/2022

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Introduction

At St. John’s, we use the White Rose Maths Hub as the basis for our planning and progression to ensure that all children become confident in mathematical fluency, reasoning and problem solving. In all of our maths work, we use the Concrete-Pictorial-Abstract approach to ensure that children understand the principles of mathematics before applying these skills to reasoning and problem solving activities.

When children leave St. John’s they will:

- 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, which they are able to apply with confidence when they are unable to perform a calculation mentally.

What is this policy for?

This policy demonstrates how we teach different forms of calculation at St John’s. It ensures that teachers and staff members teach calculations consistently across the school and to aid them in helping children who may need extra support or challenges. This policy is also designed to help parents, carers and other family members to support children’s learning by providing an explanation of the methods used in our school.

How do I use this policy?

The policy is organised into four sections: Addition, Subtraction, Multiplication and Division. Each section is progressive, meaning that it begins with basic calculations before moving onto more the more complex. For each objective, examples of concrete, pictorial and abstract strategies for working out are provided. Definitions for concrete, pictorial abstract are below:

Concrete: Actual objects and manipulatives that the children can hold and move around to work out the answer. These may include cubes, beads, counters and cards, as well as everyday objects such as pencils, shells, pinecones and coins.

Pictorial: Picture representations of concrete objects and other diagrams that help with calculations such as part-part whole models, bar models and tens frames.

Abstract: Numerical representations of number and the symbol representations of operations.

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Addition

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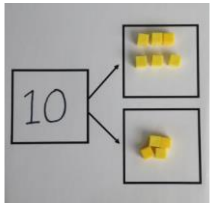
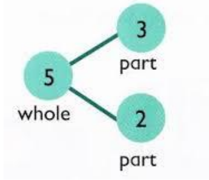
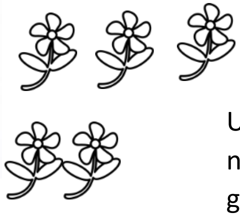
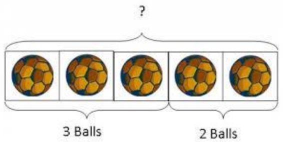
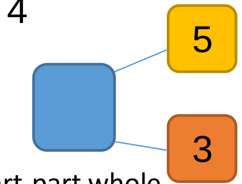
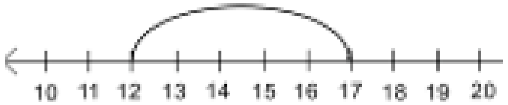
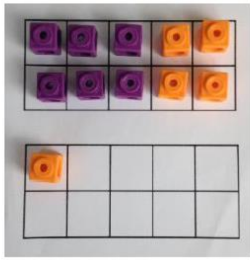
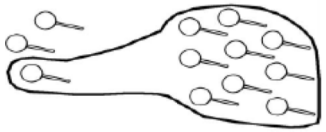
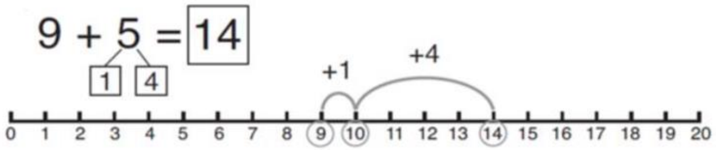
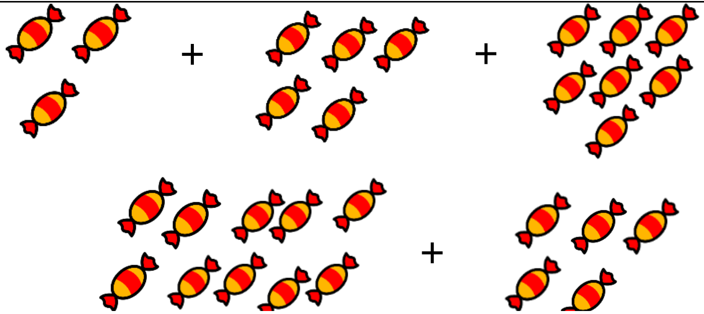
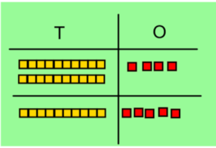
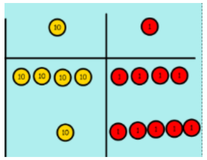
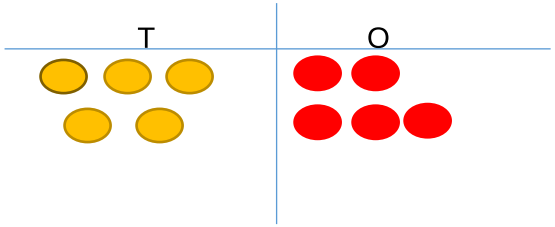
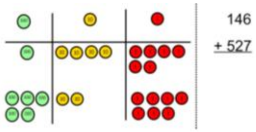
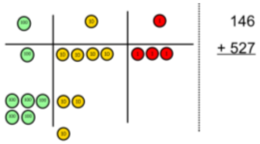
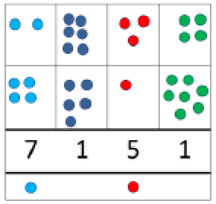
	Concrete	Pictorial	Abstract
Combining two parts to make a whole: part- whole model	   Use cubes to add two numbers together as a group or in a bar. 	  Use pictures to add two numbers together as a group or in a bar.  	4 + 3 = 7 10= 6 + 4  Use the part-part whole diagram as shown above to move into the abstract.
Starting at the bigger number and counting on	 Start with the larger number on the bead string and then count on to the smaller number to find the answer.	12 + 5 = 17  Start at the larger number on the number line and count on in ones or in one jump to find the answer.	5 + 12 = 17 Place the larger number in your head and count on the smaller number to find your answer.
Regrouping to make 10	6 + 5 = 11   Start with the bigger number and use the smaller number to make 10.	 Use pictures or a number line. Regroup or partition the smaller number to make 10. 3 + 9 = 	7 + 4= 11 If I am at seven, how many more do I need to make 10? How many more do I add on now?

Adding three single digits	4 + 7 + 6 = 17 Put 4 and 6 together to make 10. Add on 7.  Following on from making 10, make 10 with two 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.	$\underbrace{4 + 7 + 6}_{10} = \boxed{10} + \boxed{7}$ $= \boxed{17}$ Combine the two numbers that make 10 and then add on the remainder.
Column method- no regrouping	24 + 15= Add together the ones first then add the tens. Use the Base 10 blocks first before moving onto place value counters.  	After practically using the base 10 blocks and place value counters, children can draw the counters to help them to solve additions.  	Calculations 21 + 42 = 21 + 42
Column method- regrouping	Make both numbers on a place value grid.  Add up the units and exchange 10 ones for one 10.  Add up the rest of the columns, exchanging the ten counters from one column for the next place value column until every column has been added. This can also be done with Base 10 to help children clearly see that 10 ones equal 1 ten and 10 tens equal 100. As children move on to decimals, money and decimal place value counters can be used to support learning.	Children can draw a pictorial representation of the columns and place value counters to further support their learning and understanding.  	Start by partitioning the numbers before moving on to show the exchange below the addition. 20 + 5 40 + 8 60 + 13 = 73 536 + 85 621 1 1 As the children move on, introduce decimals. Money can be used here. 72.8 + 54.6 127.4 1 1 £ 2 3 . 5 9 + £ 7 . 5 5 £ 3 1 . 1 4 1 1 1

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Subtraction

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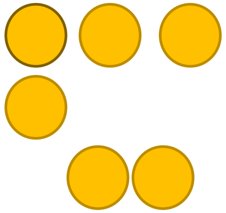
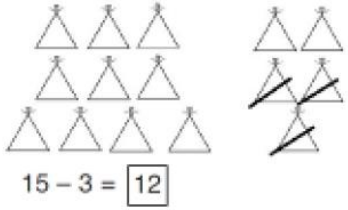
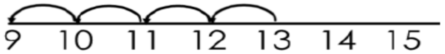
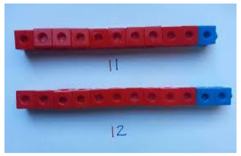
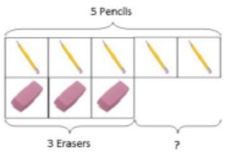
<table>
<tr><th></th><th>Concrete</th><th>Pictorial</th><th>Abstract</th></tr>
<tr><td>Taking away ones</td><td>Use physical objects to show how objects can be taken away.

6 – 2 = 4
</td><td>Cross out drawn objects to show what has been taken away.

</td><td>18 – 3 = 15

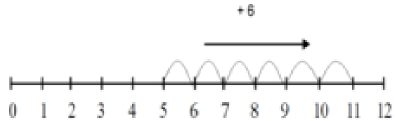
8 – 2 = 6</td></tr>
<tr><td>Counting back</td><td>Make the larger number in your subtraction. Move the beads along your bead string as you count backwards in ones.
13 – 4

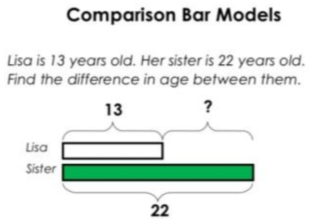
Use counters and move them away from the group as you take them away, counting backwards as you go.
</td><td>Count back on a number line or number track


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

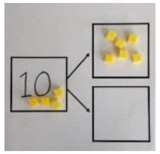

This can progress all the way to counting back using two 2-digit numbers.</td><td>Put 13 in your head, count back 4. What number are you at? Use your fingers to help.</td></tr>
<tr><td>Find the difference</td><td>Compare amounts and objects to find the difference.


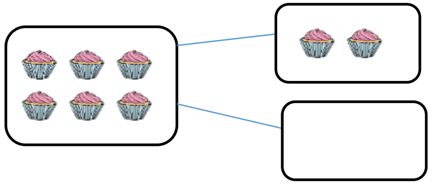
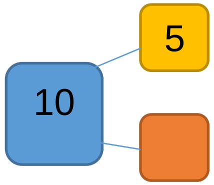
Use cubes to build towers or make bars to find the difference.


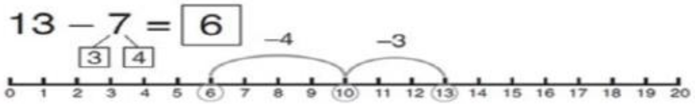
Use basic bar models with items to find the difference.</td><td>

Count on to find the difference.


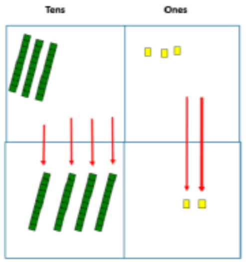
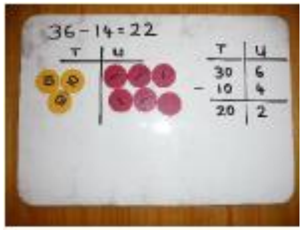
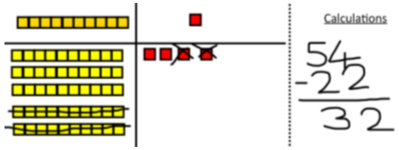
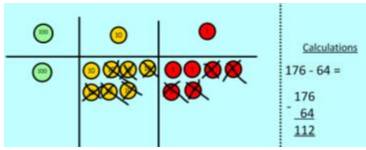
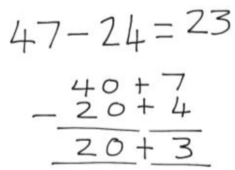
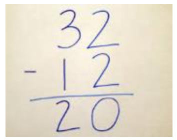
Draw bars to find the difference between 2 numbers.</td><td>Hannah has 23 sandwiches and Helen has 15 sandwiches. Find the difference between the numbers of sandwiches.</td></tr>
</table>

<table>
<tr>
<td>Part, Part Whole</td>
<td>
Link to addition: Use the part whole model to help explain the inverse between addition and subtraction.

If 10 is the whole and 6 is one of the parts. What is the other part?
10 - 6 =</td>
<td>Use a pictorial representation of objects to show the part, part whole model.
</td>
<td>
Move to using numbers within the part whole model.</td>
</tr>
<tr>
<td>Make 10</td>
<td>14 – 9 =

Make 14 on the tens frame. Take away the four first to make 10 and then take away one more so you have taken away 5. You are left with the answer of 9.</td>
<td>
Start at 13. Take away 3 to reach 10 then take away the remaining 4 so you have taken away 7 altogether. You have reached your answer.</td>
<td>16 – 8=

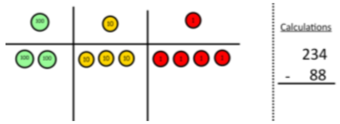
How many do we take off to reach the next 10?

How many do we have left to take off?</td>
</tr>
<tr>
<td>Column method without regrouping</td>
<td>Use Base 10 to make the bigger number then take the smaller number away.


Show how you partition numbers to subtract. Put the larger number first.</td>
<td>

Draw the Base 10 or place value counters alongside the written calculation to help to show working.</td>
<td>
This will lead to a clear written column subtraction.
</td>
</tr>
</table>

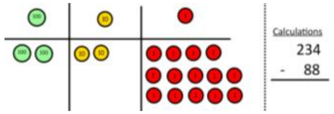
Column method with regrouping

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

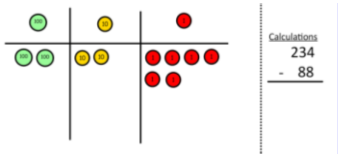
Make the larger number with the place value counters



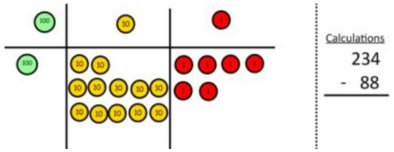
Start with the ones, can I take away 8 from 4 easily? I need to exchange one of my tens for ten ones.



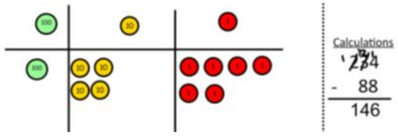
Now I can subtract my ones.



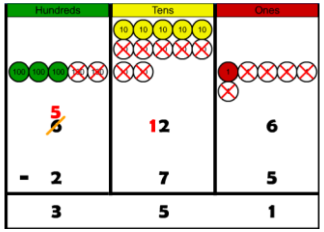
Now look at the tens, can I take away 8 tens easily? I need to exchange one hundred for ten tens.



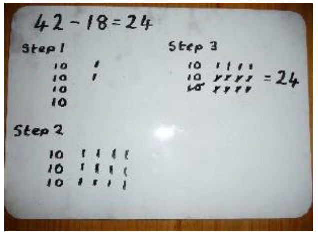
Now I can take away eight tens and complete my subtraction.



Show children how the concrete method links to the written method alongside your working. Cross out the numbers when exchanging and show where we write our new amount.

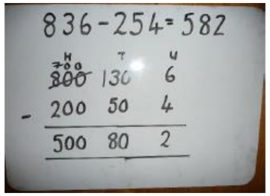


Draw the counters onto a place value grid and show what you have taken away by crossing the counters out as well as clearly showing the exchanges you make.

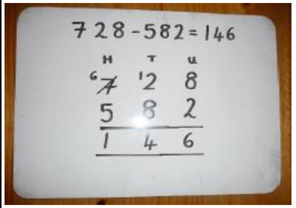


When confident, children can find their own way to record the exchange/regrouping.

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



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



Moving forward, the children use a more compact method.

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

$$\begin{array}{crrrcr} & 2 & {}^{5}\cancel{6} & {}^{12}\cancel{3} & . & {}^{1}0 \\ - & & 2 & 6 & . & 5 \\ \hline & 2 & 3 & 6 & . & 5 \end{array}$$

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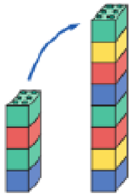
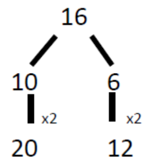
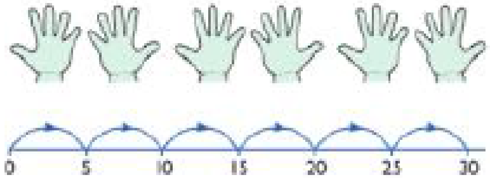
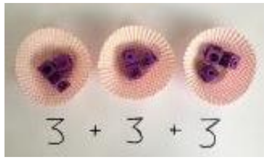
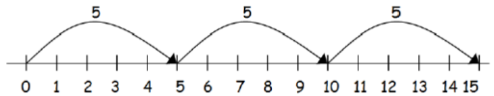
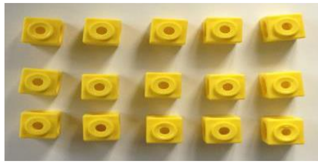
Multiplication

Durham & Newcastle Diocesan Learning Trust

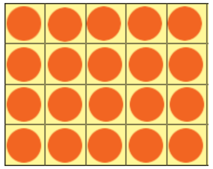
	Concrete	Pictorial	Abstract
Doubling	Use practical activities to show how to double a number.  double 4 is 8 $4 \times 2 = 8$	Draw pictures to show how to double a number. Double 4 is 8 	 Partition a number and then double each part before recombining it back together.
Counting in multiples	  Count in multiples supported by concrete objects in equal groups.	 Use a number line or pictures to continue support in counting in multiples.	Count in multiples of a number aloud. Write sequences with multiples of numbers. 2, 4, 6, 8, 10 5, 10, 15, 20, 25 , 30
Repeated addition	   Use different objects to add equal groups.	There are 3 plates. Each plate has 2 star biscuits on. How many biscuits are there?  2 add 2 add 2 equals 6  5 + 5 + 5 = 15	Write addition sentences to describe objects and pictures.  2 + 2 + 2 + 2 + 2 = 10

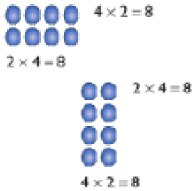
Arrays

Create arrays using counters/cubes to show multiplication sentences.



Draw arrays in different rotations to find commutative multiplication sentences.





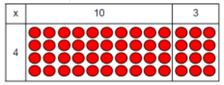
Link arrays to area of rectangles.

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

5 + 5 + 5 = 15
3 + 3 + 3 + 3 + 3 = 15
5 x 3 = 15
3 x 5 = 15

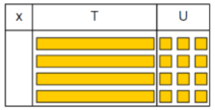
Grid Method

Show the link with arrays to first introduce the grid method.



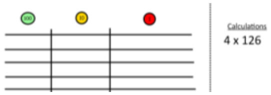
Four rows of 10; four rows of 3

Move on to using Base 10 to move towards a more compact method.

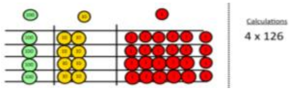


4 rows of 13

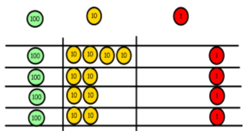
Move on to place value counters to show how we are finding groups of a number. We are multiplying by 4 so we need 4 rows.



Fill each row with 126.

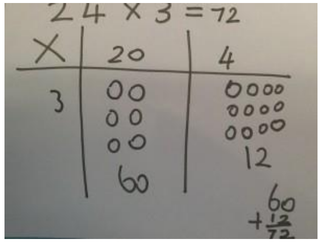


Add up each column, starting with the ones, making any exchanges needed.



Then you have your answer.

Children can represent the work they have done with place value counters in a way that they understand.
They can draw the counters, using colours to show different amounts or just use circles in the different columns to show their thinking as shown below.



Start with multiplying by one digit numbers and showing the clear addition alongside the grid.

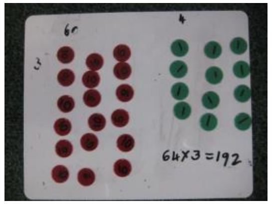
×	30	5
7	210	35

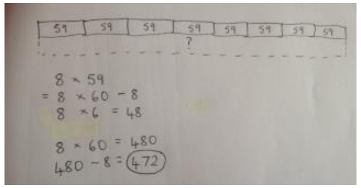
210 + 35 = 245

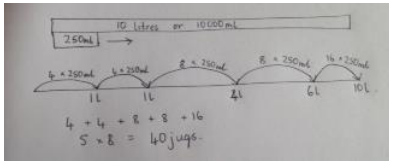
Moving forward, multiply by a 2-digit number showing the different rows within the grid method.

	10	8
10	100	80
3	30	24

X	1000	300	40	2
10	10000	3000	400	20
8	8000	2400	320	16

<table>
<tr>
<td>Column Multiplication</td>
<td>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.</td>
<td>Bar modelling and number lines can support learners when solving problems with multiplication alongside the formal written methods.



</td>
<td>Start with long multiplication, reminding the children about lining up their numbers clearly in columns. If it helps, children can write out what they are solving next to their answer.

32
x 24
8 (4 x 2)
120 (4 x 30)
40 (20 x 2)
600 (20 x 30)
768

7 4
× 6 3
1 2
2 1 0
2 4 0
+ 4 2 0 0
4 6 6 2

This moves to the more compact method.

1 3 4 2
x 1 8
1 3 4 2 0
1 0 7 3 6
2 4 1 5 6</td>
</tr>
</table>

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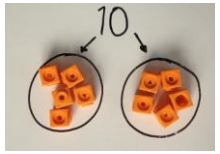
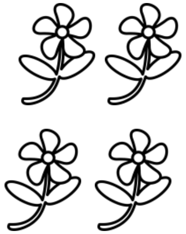
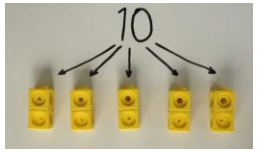
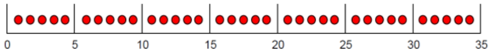
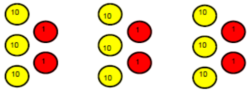
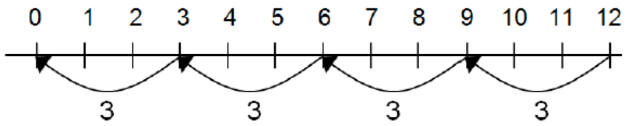
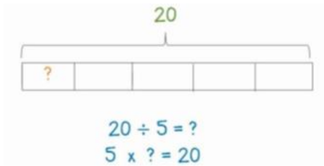
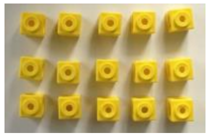
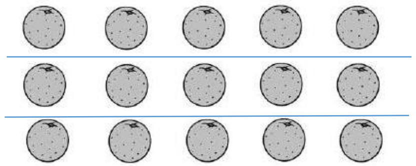
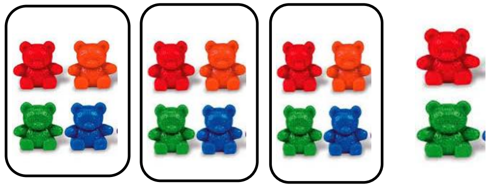
Trust

	Concrete	Pictorial	Abstract
Sharing objects into groups	   I have 10 cubes; can you share them equally in 2 groups?	Children use pictures or shapes to share quantities.  8 ÷ 2 = 4 	Share 9 buns between three people. 9 ÷ 3 = 3
Division as grouping	 Divide quantities into equal groups. Use cubes, counters, objects or place value counters to aid understanding.  96 ÷ 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 ÷ 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 number sentences that can be created. 15 ÷ 3 = 5 5 x 3 = 15 15 ÷ 5 = 3 3 x 5 = 15	 Draw an array and use lines to split the array into groups to make multiplication and division sentences.	Find the inverse of multiplication and division sentences by creating four linking number sentences. 7 x 4 = 28 4 x 7 = 28 28 ÷ 7 = 4 28 ÷ 4 = 7

Division with a remainder

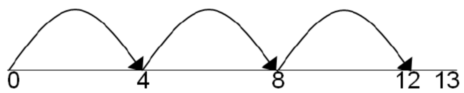
$14 \div 3 =$

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.

$13 \div 4 =$

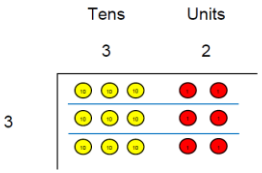


Draw dots and group them to divide an amount and clearly show a remainder.

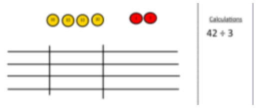
$14 \div 3 =$

Complete written divisions and show the remainder using r.

Short division

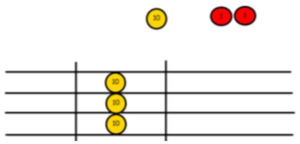


Use place value counters to divide using the bus stop method alongside

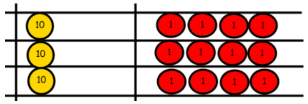


$42 \div 3=$

Start with the biggest place value, we are sharing 40 into three groups. We can put 1 ten in each group and we have 1 ten left over.

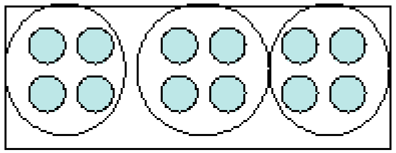


We exchange this ten for ten ones and then share the ones equally among the groups.



We look how much in 1 group so the answer is 14.

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.

```
    2  1  8
  ---------
         3
4 | 8  7  2
```

Move onto divisions with a remainder.

```
    8  6  r  2
  ---------
       3
5 | 4  3  2
```

Finally move into decimal places to divide the total accurately.

```
         1  4  .  6
      ---------------
           16     21
3  5 | 5  1  1  .  0
```