

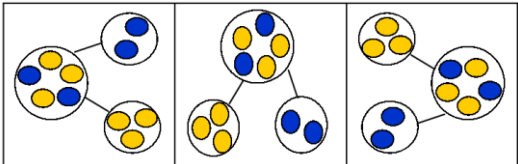
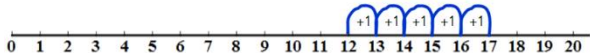


## Westfield Calculation Policy 2021

Both staff and pupil wellbeing have been considered in the review of this policy.

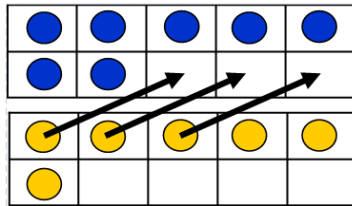
Mathematical understanding is underpinned by a child's secure knowledge of calculation. At Westfield, we believe that children learn effectively through being exposed to a variety of representations. Beginning with concrete (practical resources – dienes equipment, place value coins), moving to pictorial (drawings, empty number lines) which assists abstract (column addition, long multiplication).

This policy demonstrates Westfield's progression of calculation for each operation to ensure a consistent approach from one year group to the next.

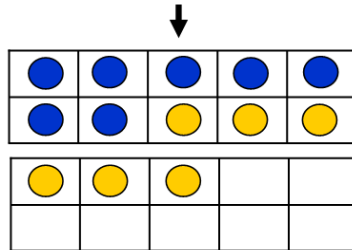
	Concrete and pictorial	Abstract
Addition	<b>Counting objects practically</b> Children use part whole models and practical resources to add numbers together.  	$3 + 2 = 5$
	<b>Number line</b> Children start at the largest number on the number line and jump the number of steps needed to add. The number they land is the answer.  	$12 + 5 = 17$



## Regrouping to make 10



Begin by making 7 and 6



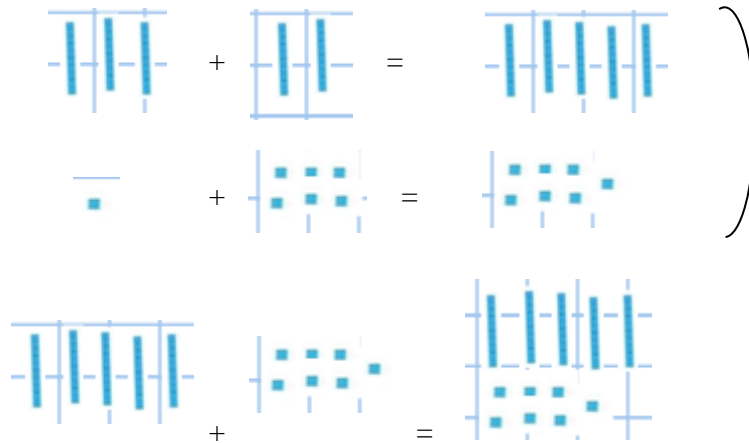
Move (regroup) counters to create a full set of 10, then add the remaining to 10 to find the answer.

$$7 + 6 = 13$$

## Partitioning using base 10 equipment

This method can be used for a range of calculations (2D + 2D, 3D + 2D, 3D + 3D, 4D + 3D, 4D + 4D...)

### Not crossing boundaries



$$31 + 26 =$$

$$30 + 20 = 50$$

$$1 + 6 = 7$$

$$50 + 7 = 57$$

$$31 + 26 = 57$$



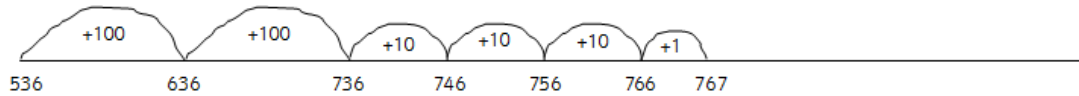
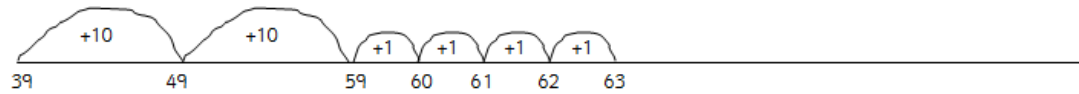
The diagrams illustrate the addition of fractions using area models. The first row shows  $\frac{3}{4} + \frac{1}{2} = \frac{5}{4}$ . The second row shows  $\frac{1}{4} + \frac{3}{4} = 1$ . The third row shows  $\frac{3}{4} + \frac{1}{4} = 1$ . Each diagram uses a grid to represent the fractions and their sum.

$$546 + 285 = 831$$



## Empty number lines

The children draw a straight line, start with the largest number at the start and break the numbers down to add on in chunks. Children record what they have added in each jump and record the number they have landed on underneath the number line.



$$39 + 24 = 63$$







$$536 + 231 = 767$$



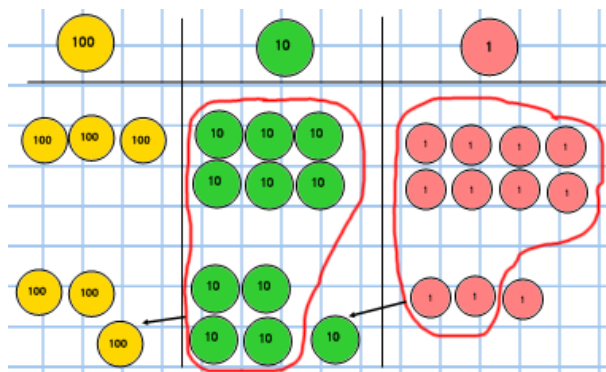
## Column addition

This method can be used for a range of calculations ( $2D + 2D$ ,  $3D + 2D$ ,  $3D + 3D$ ,  $4D + 3D$ ,  $4D + 4D \dots$ )

## Expanded column addition

	Tens	Ones
+		
		
=		

## Regrouping



Start by making each number in the calculation. Start at the right of the place value columns. If there are 10 or more in a column, these can be exchanged.

$$36 + 25 =$$

$$\begin{array}{r} 30 + 6 \\ + 20 + 5 \\ \hline 50 + 11 = 61 \end{array}$$

$$36 + 25 = 61$$

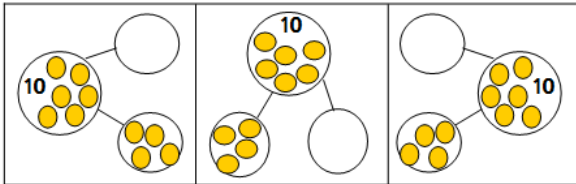
$$\begin{array}{r} \phantom{0}1\phantom{0} \\ 368 \\ + 243 \\ \hline 611 \end{array}$$



## Subtraction

### Counting objects practically

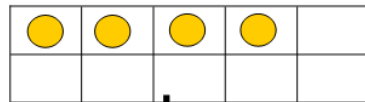
Children use part whole models and practical resources to subtract numbers from each other.



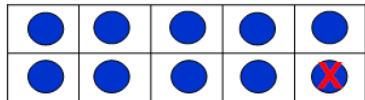
Begin by making the number to take away from using the 10 frame.



10



4



Physically take away counters to find the answer.



$$10 - 4 = 6$$

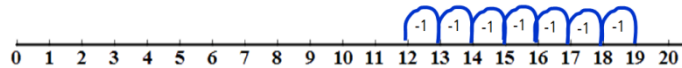
$$14 - 5 = 9$$



## Number line

### Taking away

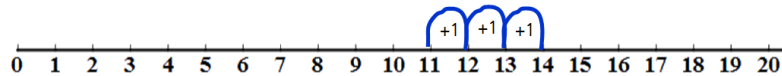
Children start at the largest number on the number line and jump the number of steps backwards needed to take away. The number they land is the answer.



$$19 - 7 = 12$$

### Finding the difference

Children start at the smaller number and count on until they reach the larger number. The number of jumps is the difference.

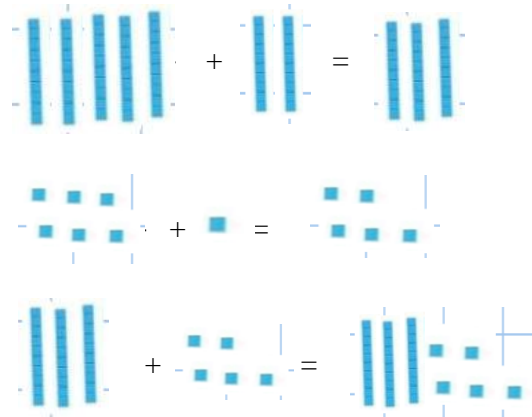


$$14 - 11 = 3$$

## Partitioning using base 10 equipment

This method can be used for a range of calculations (2D - 2D, 3D - 2D, 3D - 3D, 4D - 3D, 4D - 4D...)

### Not crossing boundaries



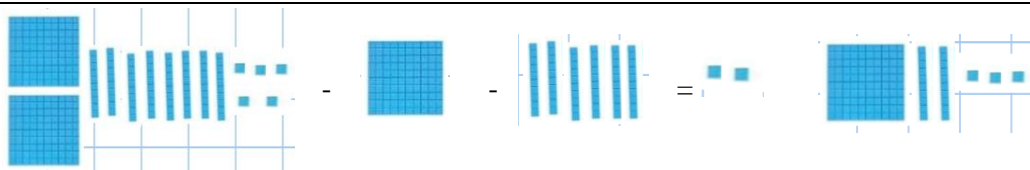
Or

$$56 - 21 =$$

$$50 - 20 = 30$$

$$6 - 1 = 5$$

$$30 + 5 = 35$$



## Crossing boundaries

Children use their secure knowledge of place value to subtract. Start by subtracting from the largest place value digit within the number and count backwards through the numbers.

$$52 - 25 = 27$$

$$52 - 20 = 32$$
$$52 \dots 42 \dots 32$$

$$32 - 5 = 27$$
$$32 \dots 31 \dots 30 \dots 29 \dots 28 \dots 27$$

## And

$$573 - 257 = 216$$

$$573 - 200 = 373$$
$$573 \dots 473 \dots 373$$

$$373 - 50 = 323$$
$$373 \dots 363 \dots 353 \dots 343 \dots 333 \dots 323$$

$$323 - 7 = 316$$
$$323 \dots 322 \dots 321 \dots 320 \dots 319 \dots 318 \dots 317 \dots 316$$

$$285 - 162 =$$

$$285 - 100 - 60 - 2 = 123$$

$$52 - 25 = 27$$

$$52 - 20 - 5 = 27$$

$$573 - 257 = 216$$

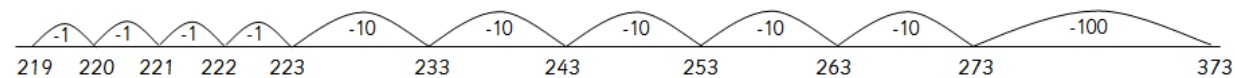
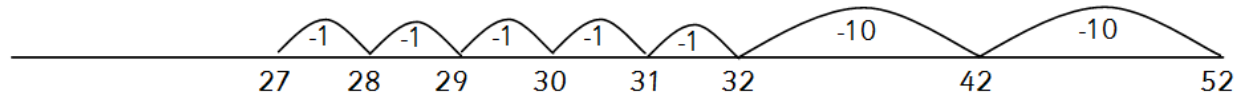
$$573 - 200 - 50 - 7 = 316$$



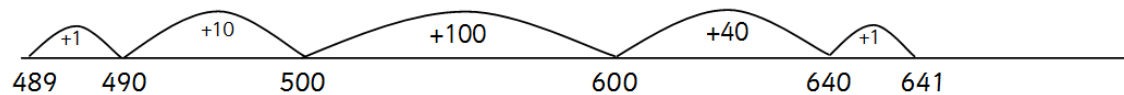
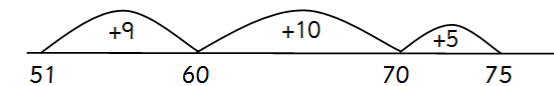


## Empty number lines

Children draw a straight line, start with the largest number at the end and break the numbers down to subtract in chunks. Children record what they have subtracted in each jump and record the number they have landed on underneath the number line.



Alternatively, children draw a straight line, start with the number they are subtracting at the beginning of the number line and count on in chunks to find the difference. Children jump to the next rounded number, recording how many they have counted on in each jump and record the number they have landed on underneath until they reach the number they started with. The answer is the total jumps when they have been added together. This method is often preferable if the numbers are closer together.



$$52 - 25 = 27$$

$$373 - 154 = 219$$

$$75 - 51 = 24$$

$$10 + 9 + 5 = 24 \text{ numbers jumped}$$

$$641 - 489 = 152$$

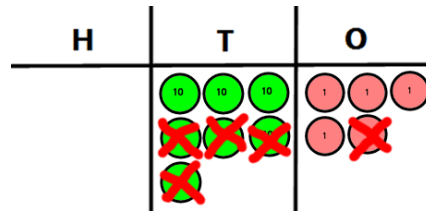
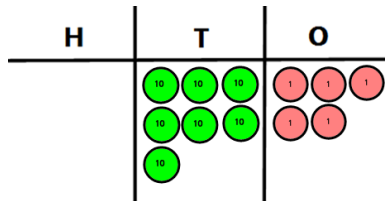
$$100 + 40 + 10 + 1 + 1 = 152 \text{ numbers jumped}$$



## Column subtraction

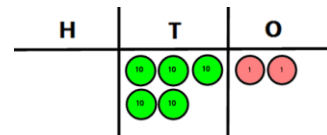
This method can be used for a range of calculations (2D - 2D, 3D - 2D, 3D - 3D, 4D - 3D, 4D - 4D...)

### No exchanging

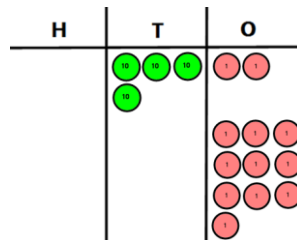


$$\begin{array}{r} 75 \\ - 41 \\ \hline 34 \end{array}$$

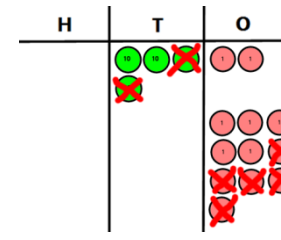
### Exchanging



Start with 52

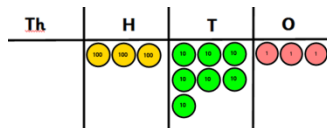


Exchange 1 ten for 10 ones

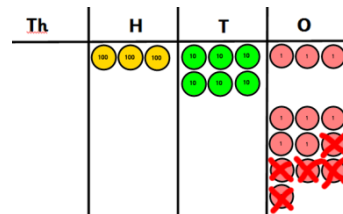


Subtract ones then tens

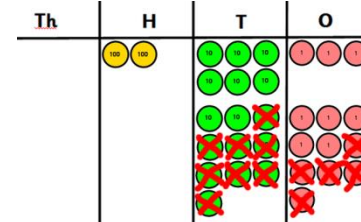
$$\begin{array}{r} 4 \ 1 \\ 52 \\ - 25 \\ \hline 27 \end{array}$$



Start with 373



Exchange 1 ten for 10 ones  
and subtract 5

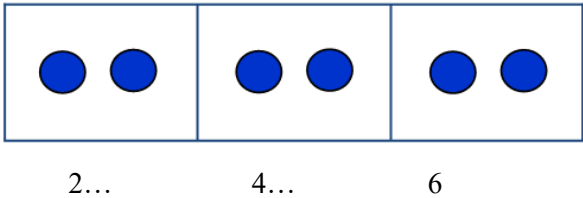
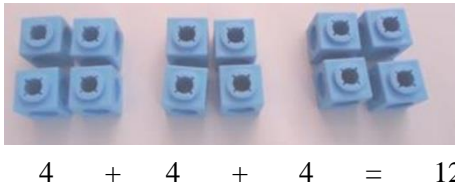
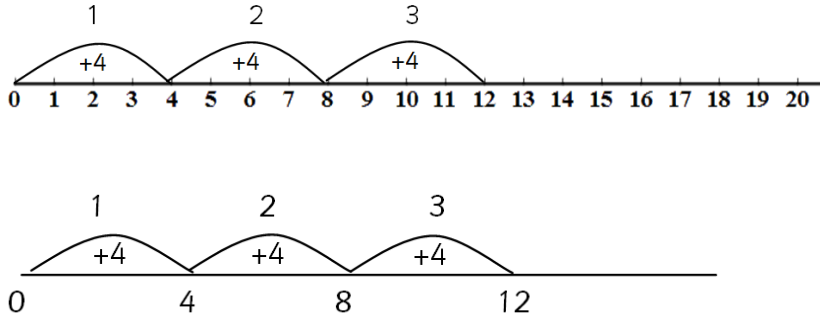


Exchange 1 hundred for 10 tens  
and subtract 8

$$\begin{array}{r} 2 \ 16 \ 1 \\ 373 \\ - 185 \\ \hline 219 \end{array}$$

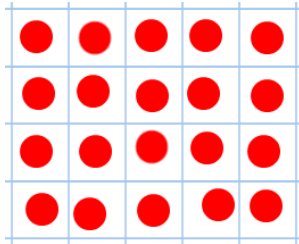
Children create their number. Begin with the ones and work through each column. Exchange where needed.



Multiplication	<b>Counting in equal steps</b>  2... 4... 6	$3 \times 2 = 6$
	<b>Repeated addition</b> Children continue to count in equal steps but recognise this as repeated addition for multiplication.  $4 + 4 + 4 = 12$  This method can also be shown on a number line or empty number line.  Counting in 4s 3 times. The number landed on is the answer.	$3 \times 4 = 12$

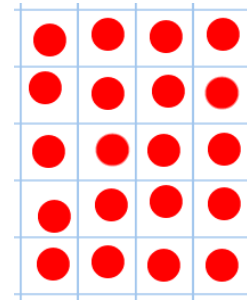


## Arrays



$$4 \times 5 = 20$$

**Or**



$$5 \times 4 = 20$$

$$4 \times 5 = 20$$

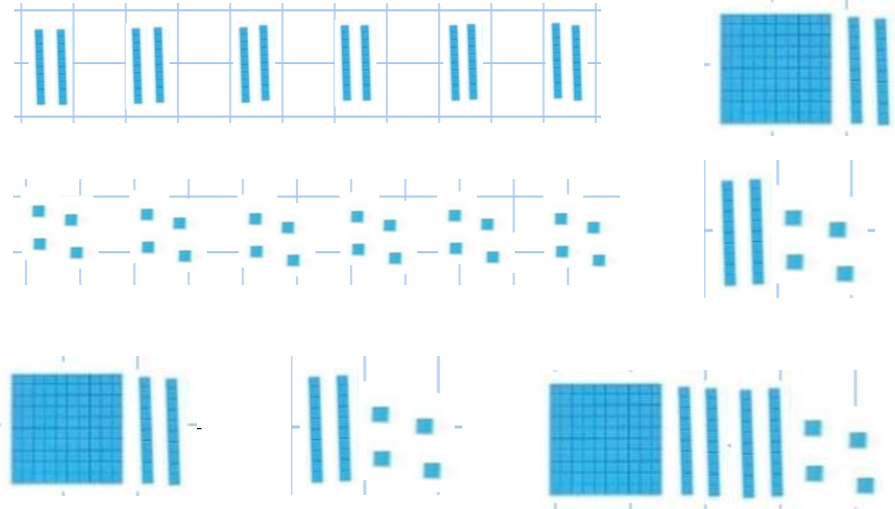
Or

$$5 \times 4 = 20$$

Children draw arrays using equal groups and then counting in equal steps to find the answer. Children recognise that multiplication can be done in any order and the same answer is found. This is called commutativity.

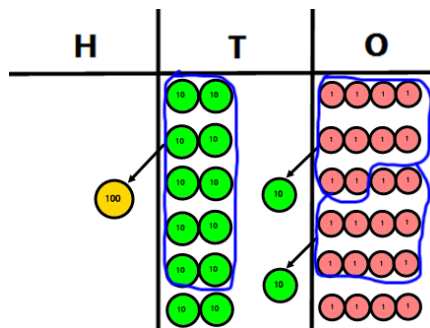


## Partitioning



Children can use other practical equipment to partition and multiply the numbers within the calculation and put back together to find the answer.

Or



Children begin by making the number the amount of times needed. They start with the ones and exchange 10 ones for 1 ten. They continue to work in the same way through each place value column.

$$24 \times 6 =$$

$$20 \times 6 = 120$$

$$4 \times 6 = 24$$

$$120 + 24 = 144$$



## Grid method

Children use a grid to partition the number into smaller parts. They find the answers to the multiplications and add the answers together to find the collective answer to the original calculation.

x	20	5
7	140	35

$$20 \times 7 = 140$$

$$5 \times 7 = 35$$

$$140 + 35 = 175$$

x	300	50	3
10	3000	500	30
4	1200	200	12

$$300 \times 10 = 3000$$

$$50 \times 10 = 500$$

$$3 \times 10 = 30$$

$$300 \times 4 = 1200$$

$$50 \times 4 = 200$$

$$3 \times 4 = 12$$

$$3000 + 500 + 30 = 3530$$

$$1200 + 200 + 12 = 1412$$

$$3530 + 1412 = 4942$$

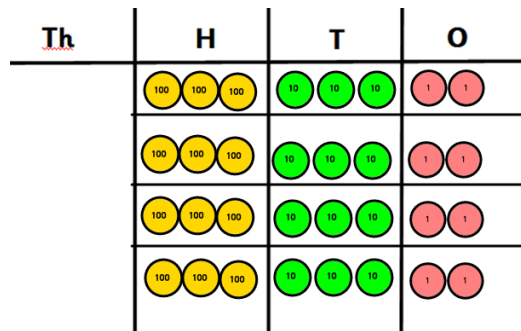
$$25 \times 7 = 175$$

$$353 \times 14 = 4942$$



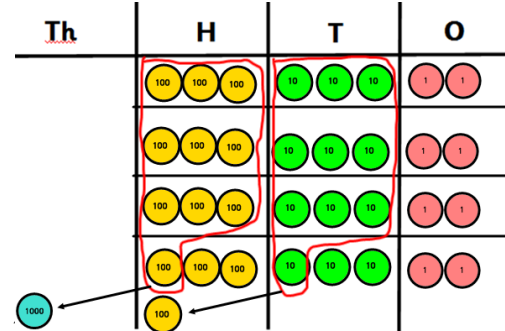
## Formal column method

## Expanded column method and column method



1

The children begin by building the number  
The correct amount of times needed.



The children then count the amount of  
place value coins in each column  
beginning with the ones and moving  
through each column and exchanging  
where needed.

Expanded column method  
 $253 \times 14 = 3542$

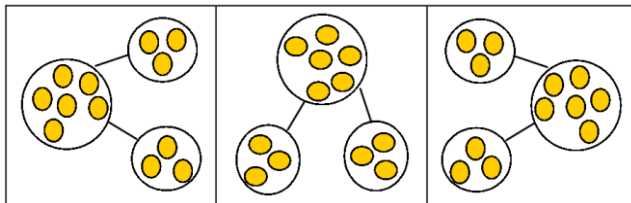
$$\begin{array}{r} 253 \\ \times 14 \\ \hline 1012 \\ + 2530 \\ \hline 3542 \end{array}$$

Formal column method  
 $332 \times 4 = 1328$

$$\begin{array}{r} 332 \\ \times 4 \\ \hline 1328 \end{array}$$

## Division

## Sharing practically

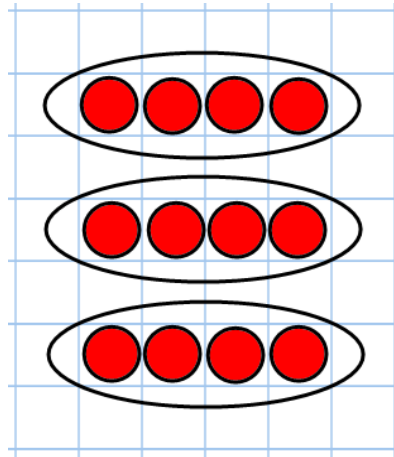


Children begin by counting the  
number of objects needed and share  
into the number of groups shown  
within the division  
calculation.

$$6 \div 2 = 3$$



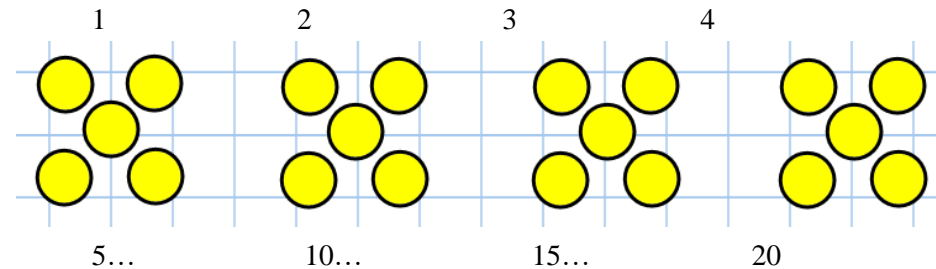
## Grouping practically



Children begin by counting out the number of objects needed. They organise these into equal sized groups using the number shown within the division calculation.

$$12 \div 4 = 3$$

## Counting in equal steps

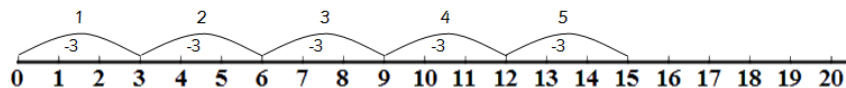


$$20 \div 5 = 4$$

## Chunking using repeated subtraction

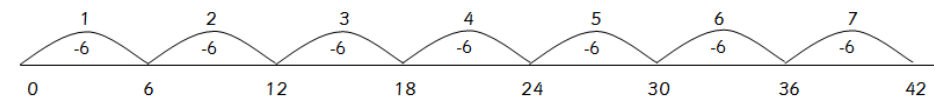
### On a number line (used for smaller numbers)

Children can either do this method using a number line or an empty number line. They start at the number given in the division calculation and jump in equal steps (subtracting) given by the divisor until they reach zero. They count the number of jumps they have taken to give them the answer.



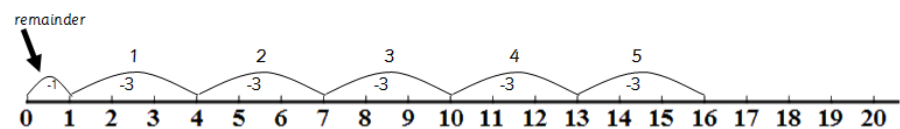
$$15 \div 3 = 5$$



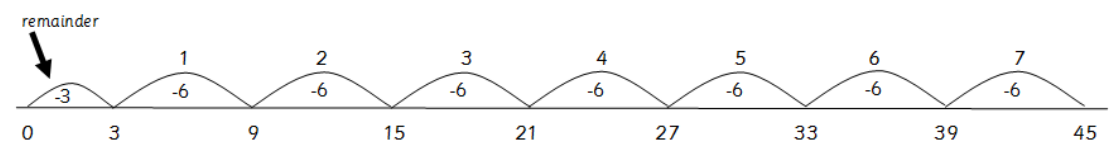


$$42 \div 6 = 7$$

If the number has a remainder, the children will jump in equal steps (subtracting) given by the divisor until they can't subtract that number anymore without going into negative numbers. They count the number of jumps they have taken and count the remaining to get to zero to give them the remainders.



$$16 \div 3 = 5 \text{ r } 1$$



$$45 \div 6 = 7 \text{ r } 3$$

**In a column** (used for larger numbers)

$$\begin{array}{r} 5273 \\ -200 \\ \hline 73 \\ -50 \\ \hline 23 \\ -20 \\ \hline 3 \end{array}$$

$$40 + 10 + 4 = 54$$

$$54 \text{ r } 3$$

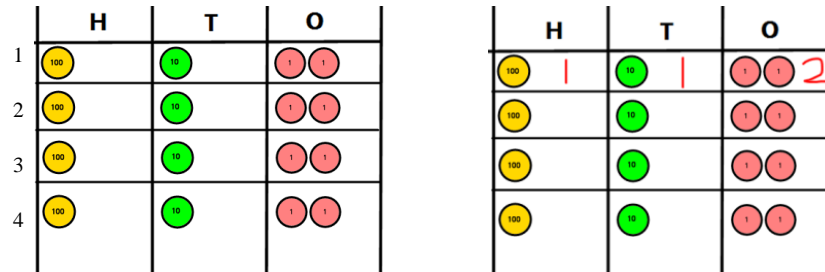
$$273 \div 5 = 54 \text{ r } 3$$



## Sharing using place value coins

### No remainders

Children split their place value grid into the number of the divisor given in the division calculation and use place value coins to share the hundreds, tens and then ones. To find the answer children count how many is in a group.



$$448 \div 4 = 112$$

$$400 \div 4 = 100$$

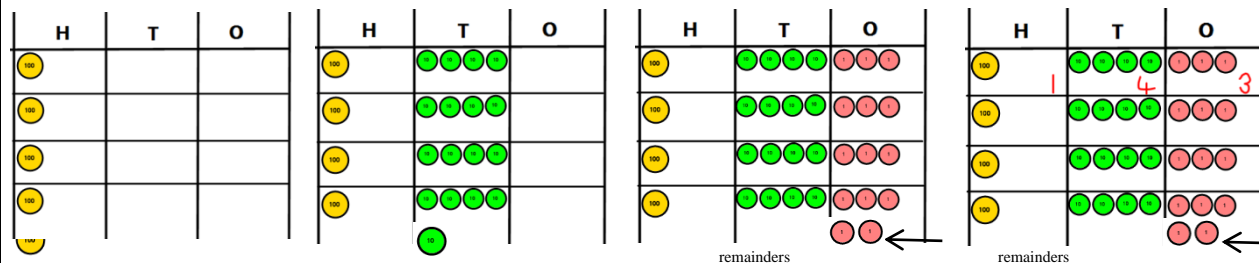
$$40 \div 4 = 10$$

$$8 \div 4 = 2$$

$$100 + 10 + 2 = 112$$

### With remainders

Children split their place value grid into the number of the divisor given in the division calculation and use place value coins to share the hundreds, tens and then ones. Where children are unable to share equally, they exchange into the next lower place value column. They continue this process until they have reached the ones. If any remain within the ones, these are the remainders. To find the answer children count how many is in a group.



$$574 \div 4 = 143 \text{ r } 2$$

$$400 \div 4 = 100$$

$$160 \div 4 = 40$$

$$14 \div 4 = 3 \text{ r } 2$$

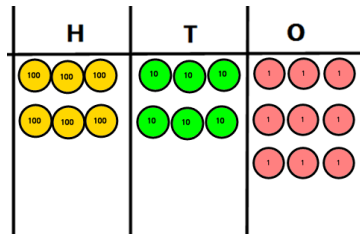
$$100 + 40 + 3 \text{ r } 2 = 143 \text{ r } 2$$



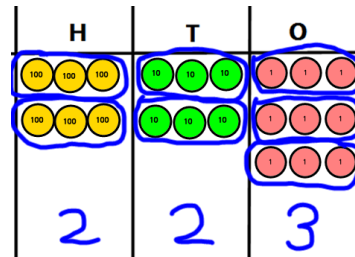
## Bus stop method including partitioning with grouping

### No remainders

Children begin by building their number.



They then start with the largest place value digit and group using the divisor in the division calculation. To find the answer, children count the number of groups they have made within each place value column.

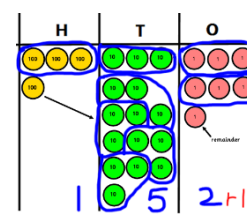
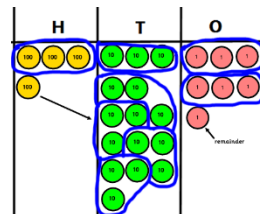
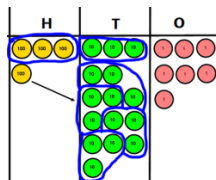
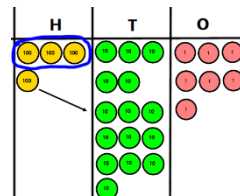
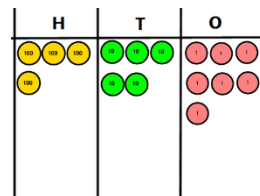


$$669 \div 3 = 223$$

$$\begin{array}{r} 223 \\ 3 \overline{) 669} \end{array}$$

### With remainders

Children begin by building their number. They then start with the large place value digit and group using the divisor in the division calculation. If they have remainders in a place value column they exchange into the next lower place value column. They continue this process until they have reached the ones. If any remain within the ones, these are the remainders. To find the answer children count how many is in a group.



$$457 \div 3 = 152 \text{ r } 1$$

$$\begin{array}{r} 152 \text{ r } 1 \\ 3 \overline{) 457} \end{array}$$



## Long division

$$\begin{array}{r} 0 \ 3 \ 2 \ r \ 4 \\ 1 \ 2 \ 3 \ 8 \ 28 \\ 3 \times 12 \quad - \underline{3 \ 6} \quad \downarrow \text{move down} \\ \quad \quad \quad 2 \ 8 \\ 2 \times 12 \quad - \underline{2 \ 4} \\ \quad \quad \quad 0 \ 4 \end{array}$$

Step 1: exchange 3 hundreds for 30 tens, now we have 38 tens.

Step 2: how many groups of 12 can I make with 38 tens? The 36 shows the tens we have grouped. The 2 is how many tens we have left.

Step 3: move the ones down to continue working.

Step 4: exchange 2 tens for 20 ones, now we have 28 ones.

Step 5: how many groups of 12 can I make with 28 ones? The 24 shows the ones we have grouped. The 4 is how many ones we have left, these become the remainders.

Step 6: record the number of groups as you work.

$$388 \div 12 = 32 \ r \ 4$$