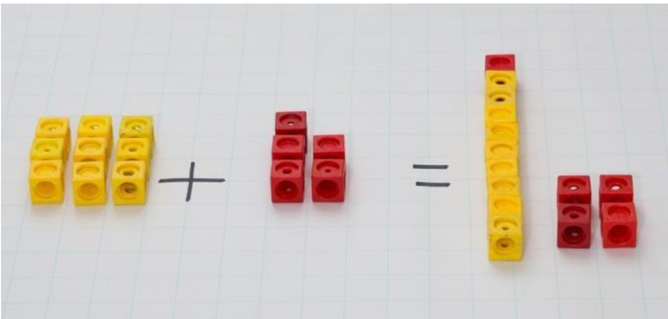
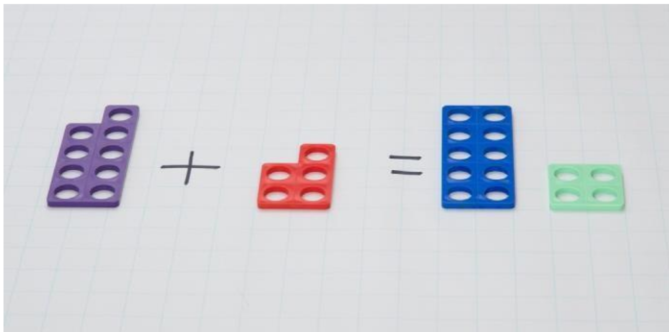
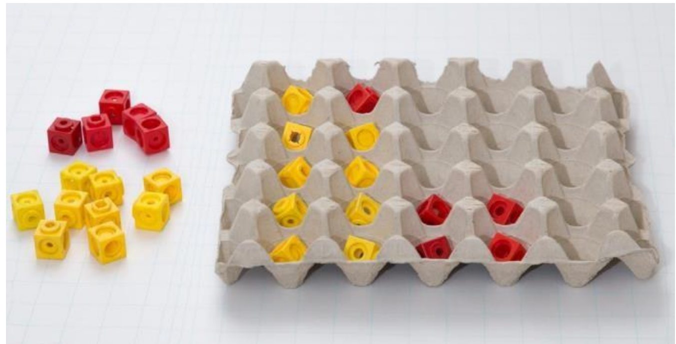
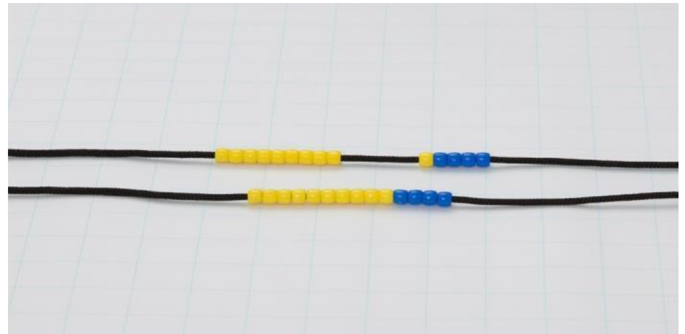
Forest Hill Partnership

Calculation Policy









Calculation Policy – Forest Hill Partnership

What is this Policy for?

This policy is intended to demonstrate how to teach different forms of calculation at Staple Hill Primary. It is organised by stages to show a progression through each of the four operations. This policy is designed to help teachers at the school ensure that calculation is taught consistently in all year groups and to aid them in helping children who may need support or further challenge.

The policy is also designed to help parents, carers and other family members support children's learning in line with the teaching at school.

How to use this policy?

Each page follows the same format to help find the information needed. At the Forest Hill Partnership schools, we teach mathematics using the CPA approach – concrete, pictorial, abstract. This three step way of learning is based on many years of research and educational success.When learning something new, we always move through the three steps:

- Step one: C = **concrete** - children start to learn by using real objects or manipulatives to perform the 'real' story.
- Step two: P = **pictorial -** children draw the objects as they are at first and then move to a representation. This supports children in embedding the 'real' story of what they are doing.
- Step three: A = **abstract** - this is the written sum or number sentence or algorithm we call this the 'maths' story.

Children will always work through the steps in the CPA order with the aim that the children can quickly move to using just the abstract 'Maths' story as soon as they are ready. Different children will move through this process at varied speeds. Some children may only need to use the Concrete and Pictorial a couple of times before they are secure enough to move to using only the Abstract. Other children may require all three steps for an extended period.

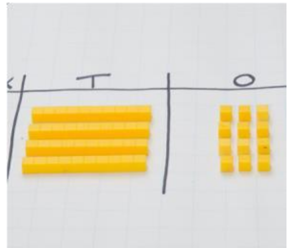
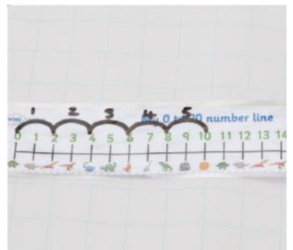
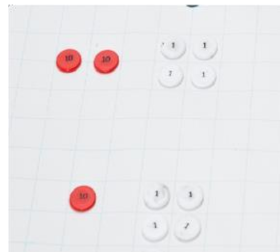
Our policy is set out to map each stage of calculation across the three steps of learning. It contains additional information as well as photographs. Key language is highlighted in red in the first column.

Equipment/resources:

We use a range of concrete manipulatives and pupils should use a range when exploring mathematics. In any of the examples shown the concrete resource can be replaced by a different resource of a child's choice.





Real life objects Unifix cubes Numicon counters beads Number/counting BaseTen/Dienes Number line Place value

Vocabulary

Children should be encouraged to use a wide range of mathematical vocabulary to discuss the 'maths' using high levels of oracy. This is supported by the NCETM mathematical glossary. Children will have these discussions modelled by the teacher and will be provided with a scaffold using sentence stems in every lesson. We also use certain consistent definitions that will ensure that we teach maths in a consistent way throughout the school.

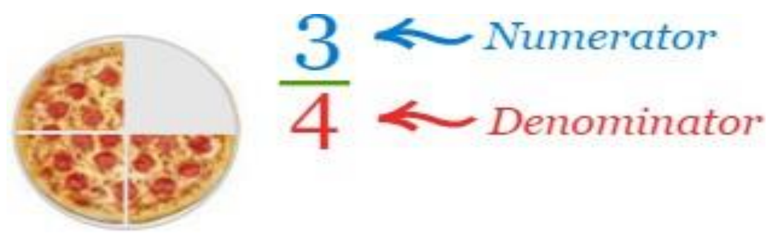
Addition: addend, sum/total. Part and Whole

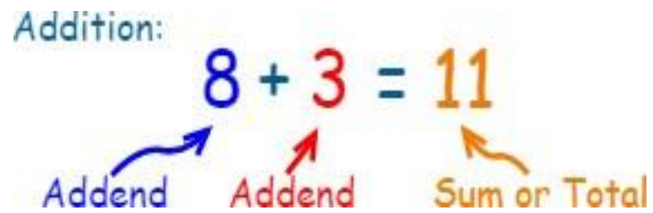
Subtraction: subtrahend, minuend,

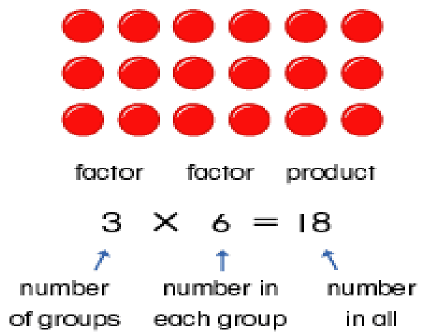
difference**Multiplication**:

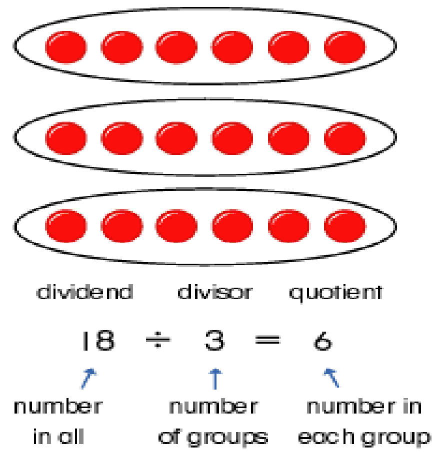
Division: dividend, divisor, quotient

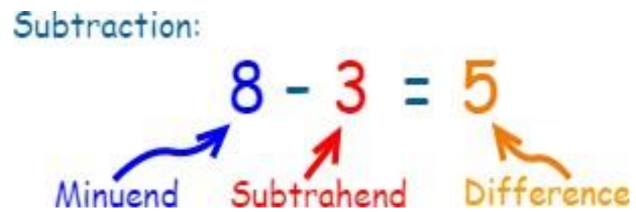
Fractions: whole and part. Denominator (written first) and numerator











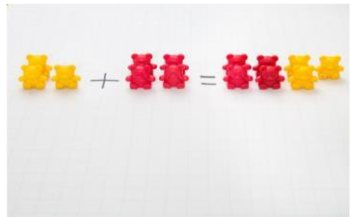
Addition

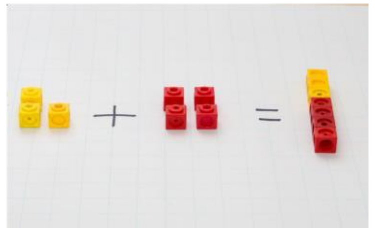
Objective

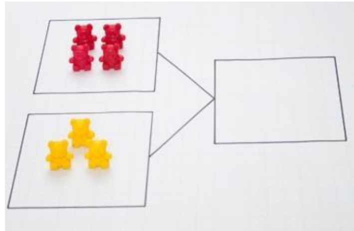
Stage 1: Combining two parts to make a whole.

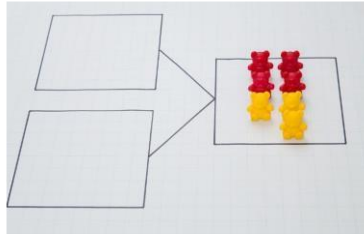
more
altogether
add
plus
equals
total
make

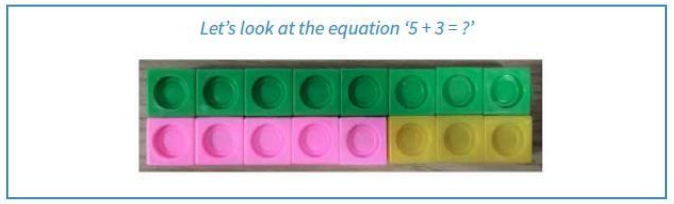
Concrete



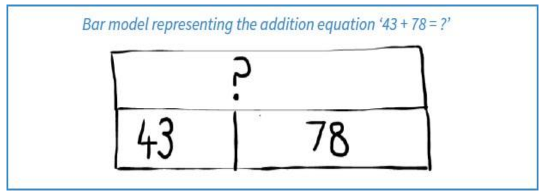


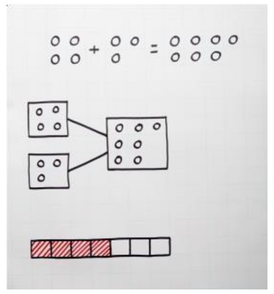


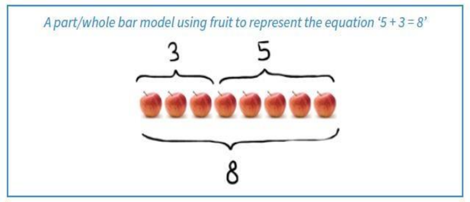


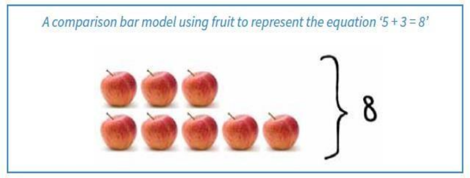


Pictorial





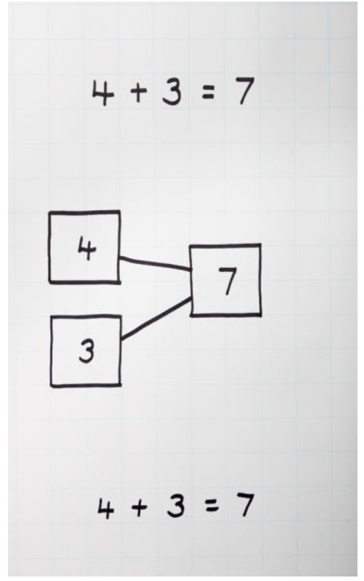




Children should begin by drawing the real life object then move to an abstract model to represent each item

e.g. a cube or counter

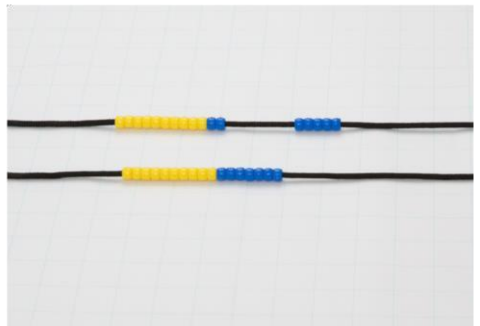
Abstract

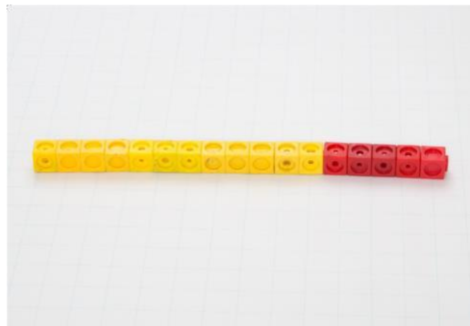


Use the part-whole diagram first then move to the abstract number sentence.

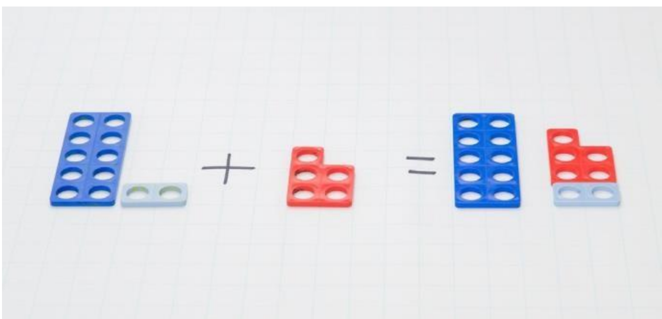
Stage 2: Start at the bigger number and count on.

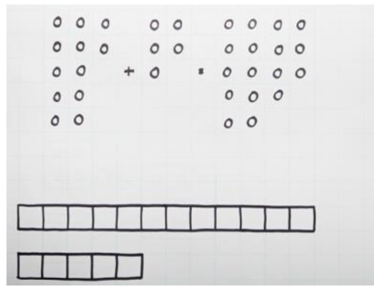
bigger
smaller
count-on
and
tens
ones

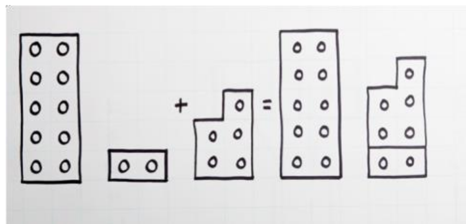


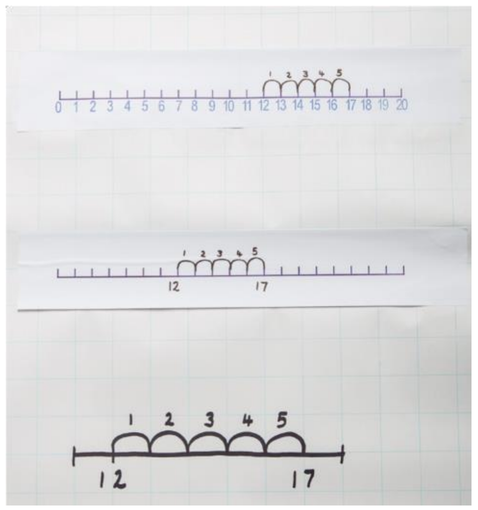


Start at the larger number and then count on the smaller number 1-by-1 to find the answer.

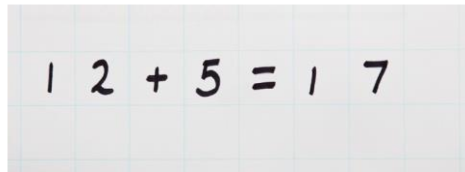








Number line: children should start with a line with all the numbers included, then move to a line without the numbers where children decide which numbers to include. Finally moving to children drawing their own.



Children should hold the larger number in their head and count on the smaller number to find the answer.

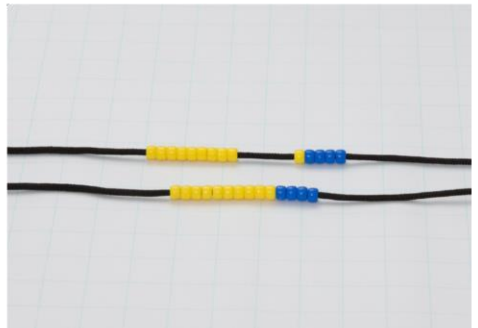
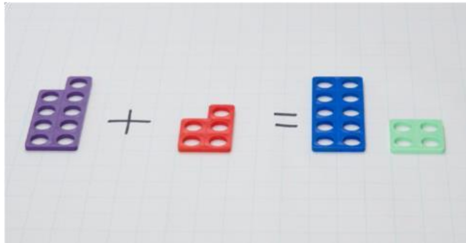
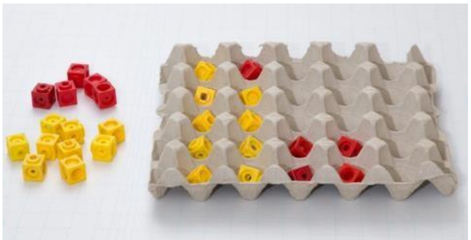
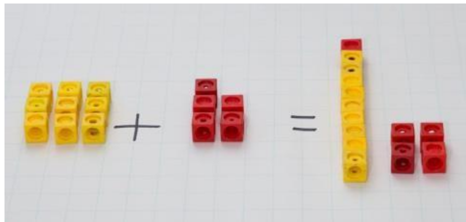
Addition

Objective	Concrete	Pictorial	Abstract

Stage 3: Regrouping to make 10

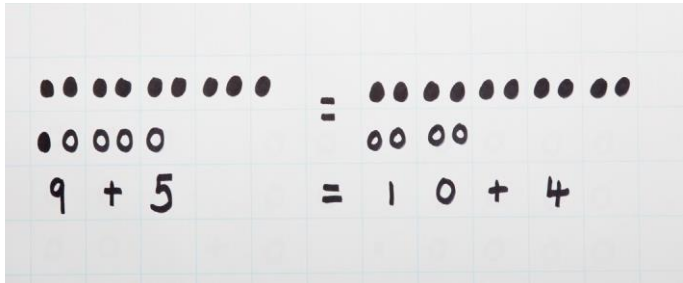
regroup
number bonds
number facts

Concrete

Start with the bigger number and use the smaller number to make a 10 first.

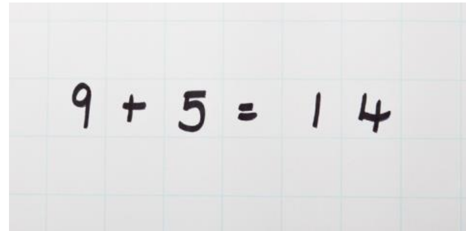
Pictorial



Use pictures of the object or a pictorial representation

e.g a circle or a square

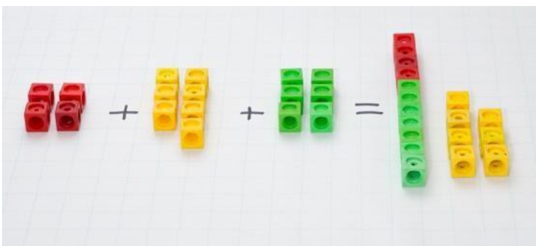
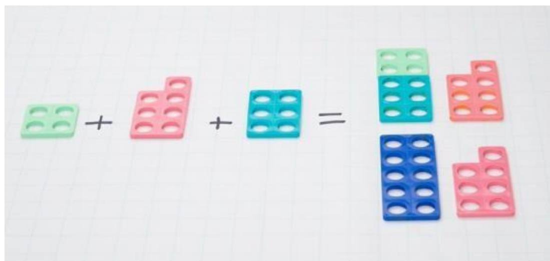
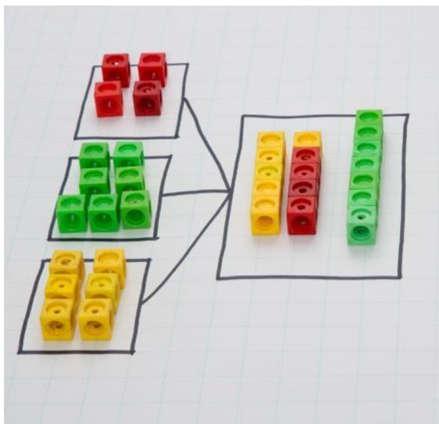
Abstract



Stage 4: Adding three single digits

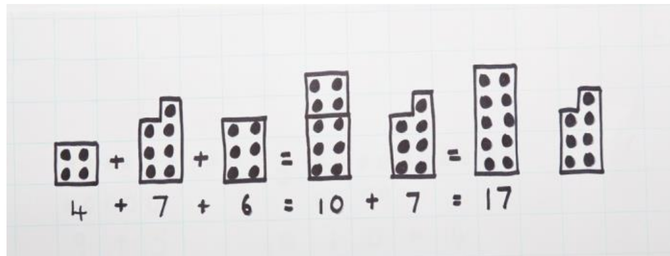
number bonds
number facts
hundreds
tens
ones

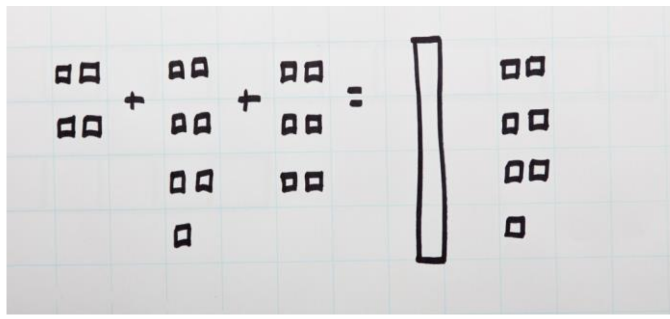
Concrete

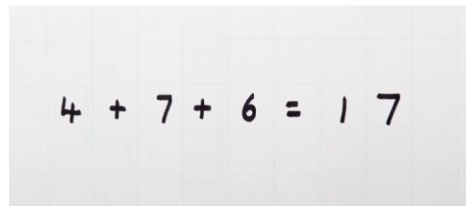
Start by making 10 where a pair of number bonds are included then add the third digit.

Pictorial





Abstract



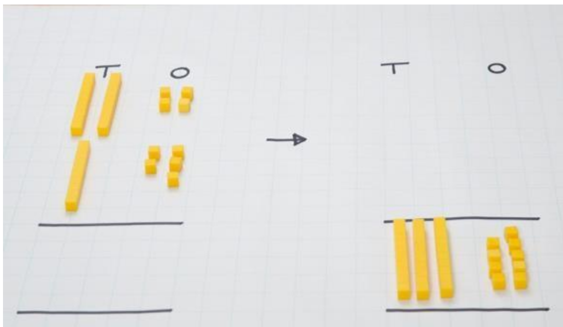
Addition

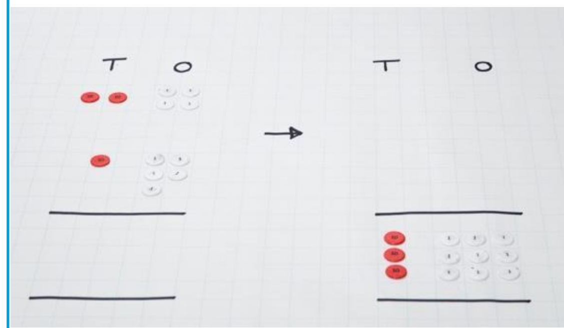
Objective	Concrete	Pictorial	Abstract

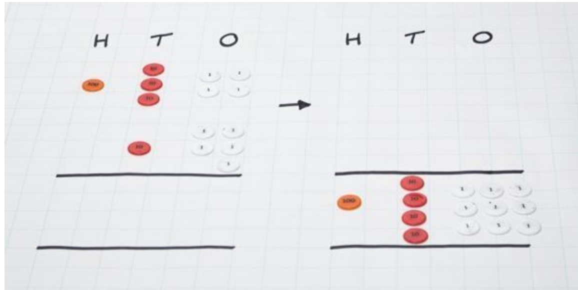
Stage 5: Column method - without regrouping

Place value
column
compact
partition

Concrete

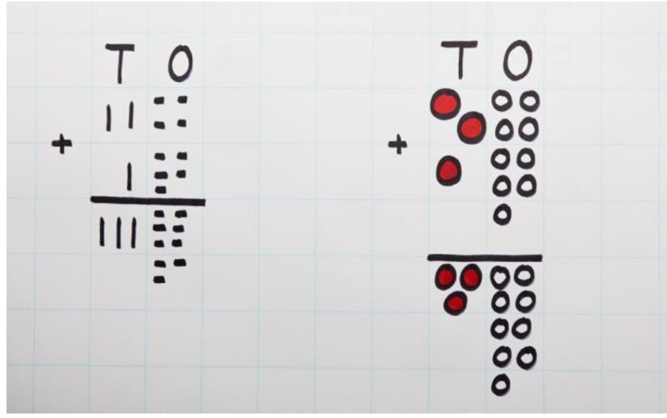




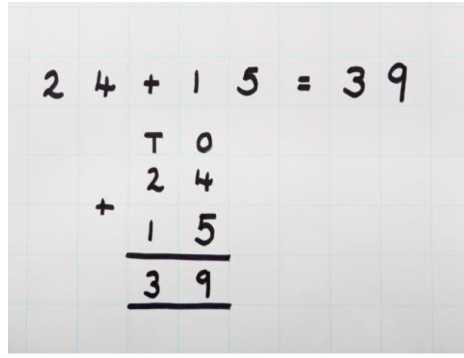


Start with the bigger number and use the smaller number to make a 10 first.
Start with the bigger number and use the smaller number to make a 10 first .

Pictorial



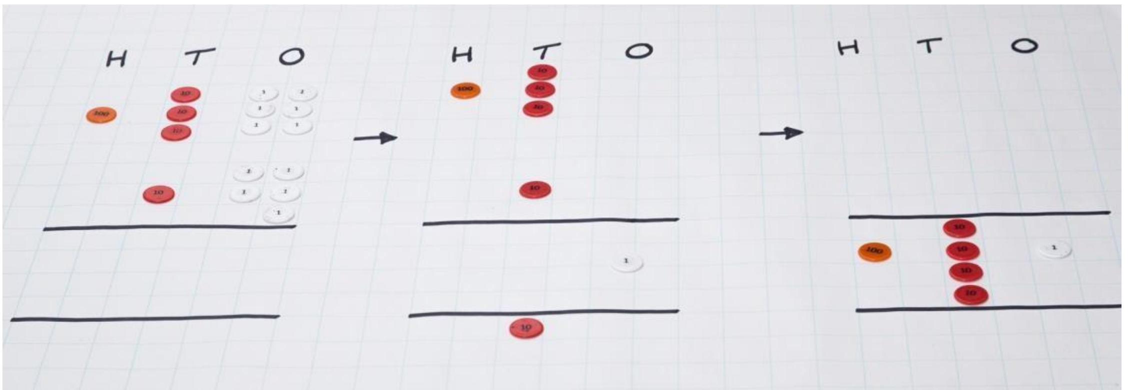
Abstract



Stage 6: Column method with regrouping

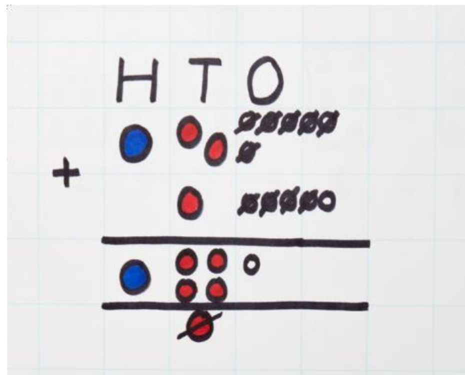
re-grouping
column
formal method
partition

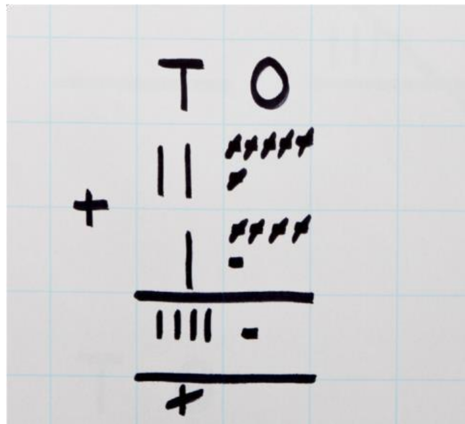
Concrete



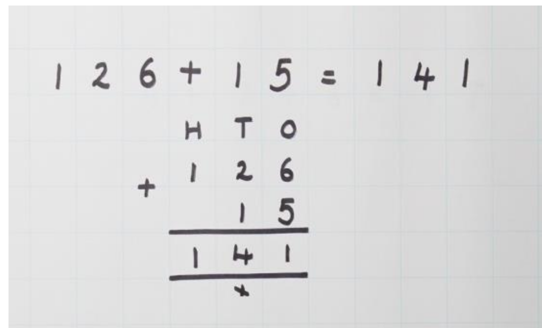
Add the ones first then the tens. Start with Base 10 before moving onto place value counters.

Pictorial





Abstract

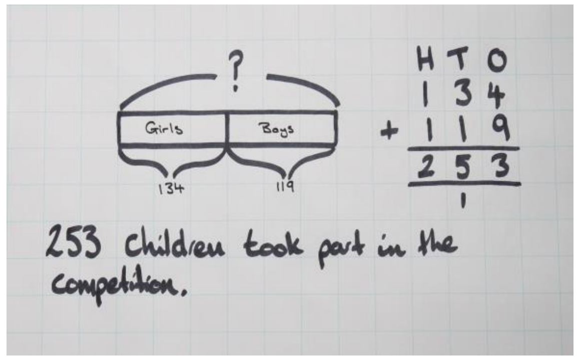


Addition - Bar Modelling

Part-Part-Whole Model

134 girls and 119 boys took part in an art competition.
How many children took part in the competition?

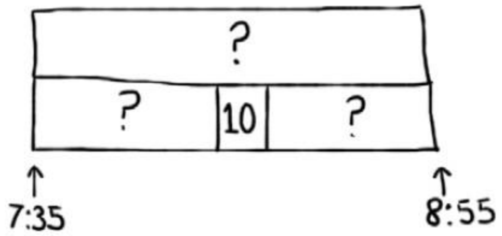
We know the 2 parts. To find the whole, we add 134 + 119.



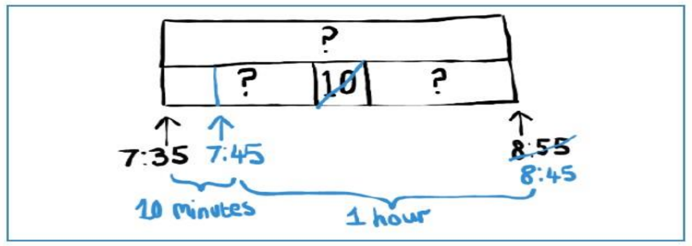
Time problems

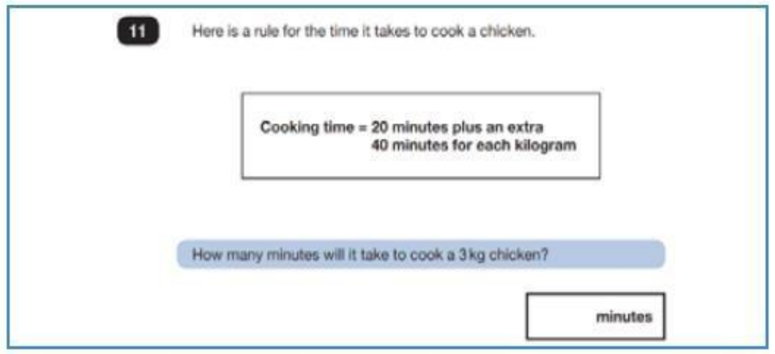
Time can be a tricky thing for children to visualise as their go-to pictorial model is a clock which goes round and round. As far as we know time doesn't go round, it moves forward in a line so bar models can represent some time problems quite well. Here's an example:

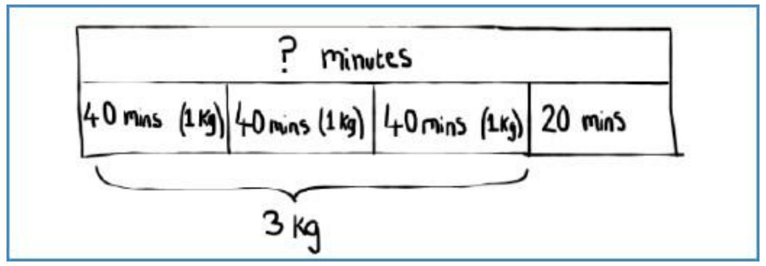
A film starts at 7:35 pm and ends at 8:55 pm. There is an ice cream break of 10 minutes halfway through. How long is the film?



Children can use bar models like this as a working document, changing parts of it as they work out their answers:



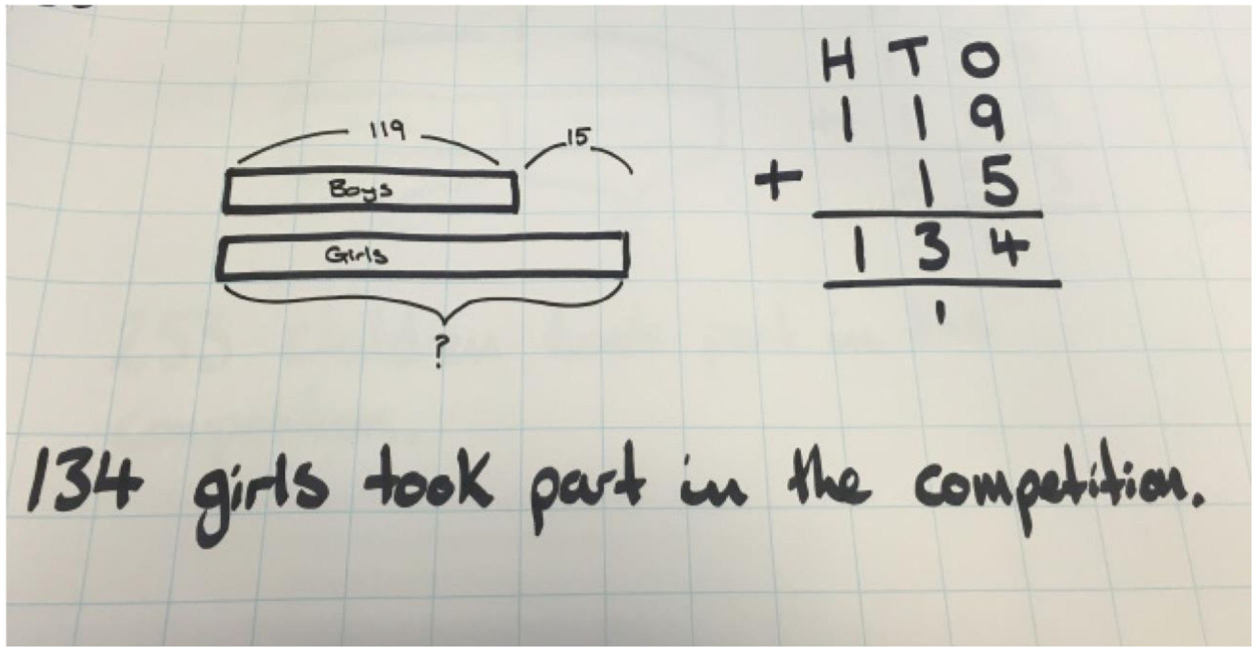




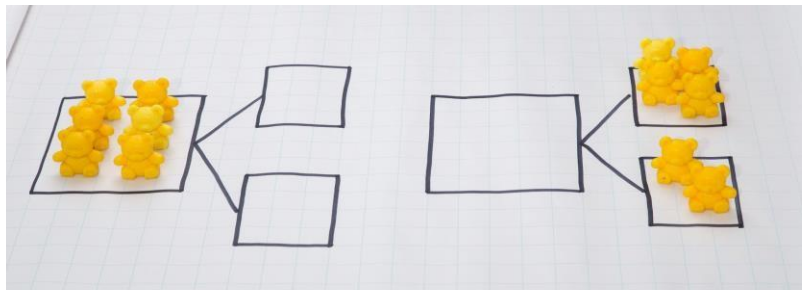
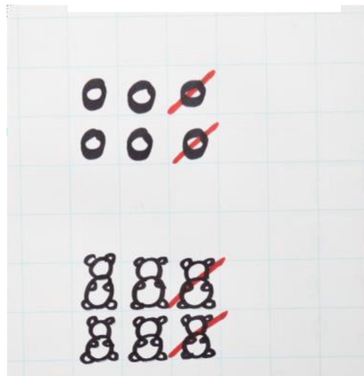
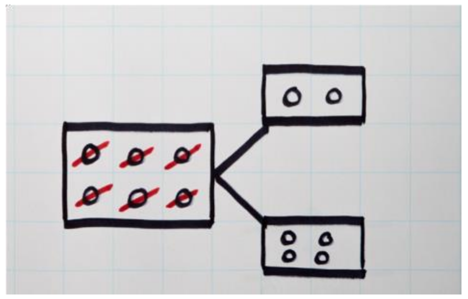
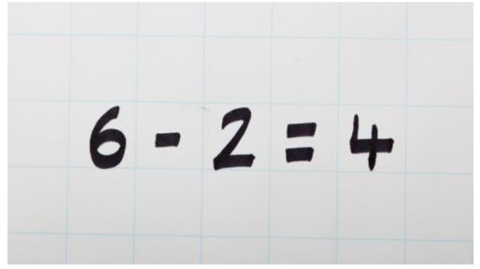
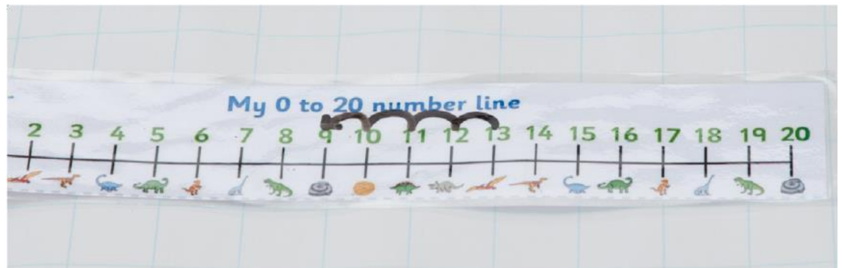
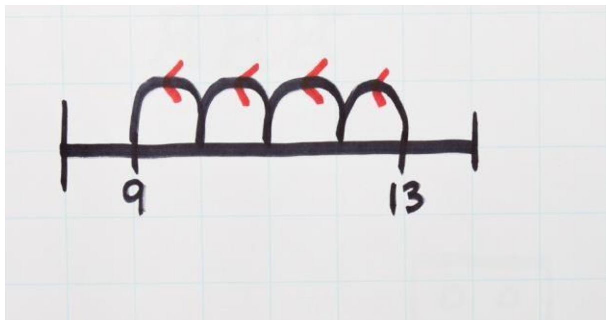
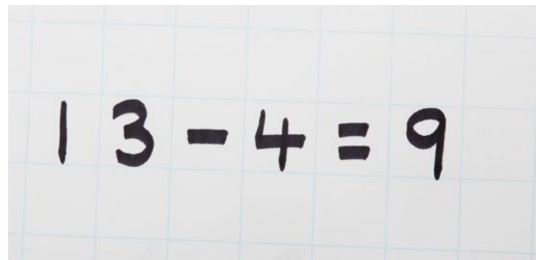
Comparison Model

119 boys took part in an art competition. 15 more girls than boys took part. How many girls took part in the competition?

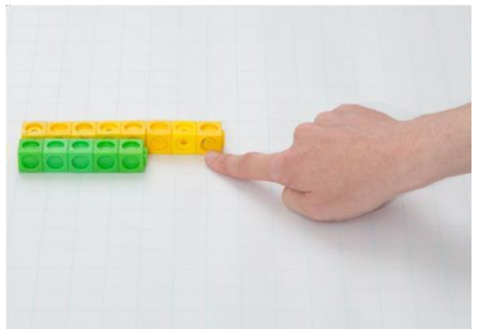
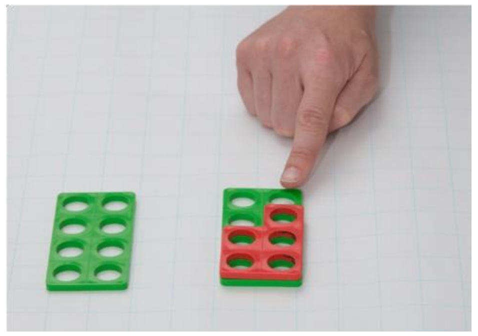
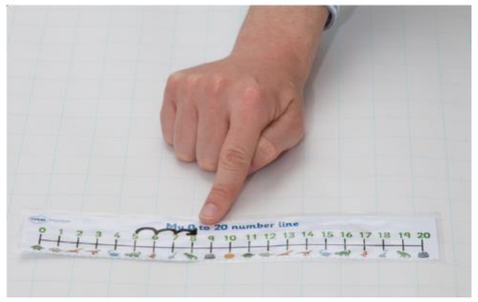
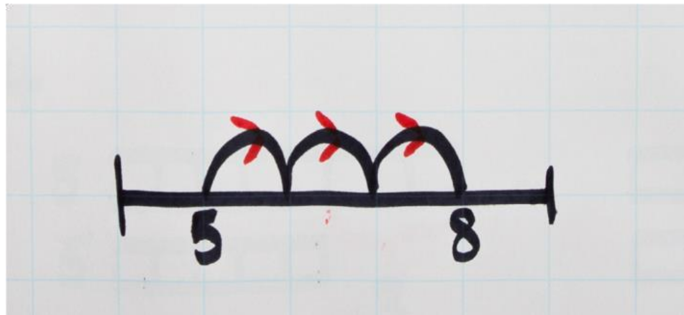
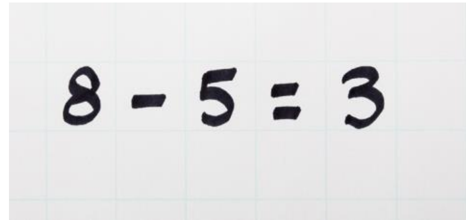
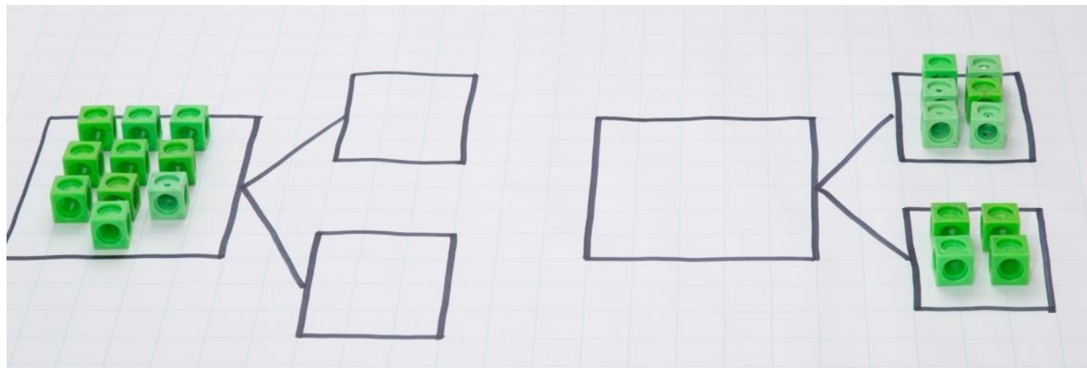
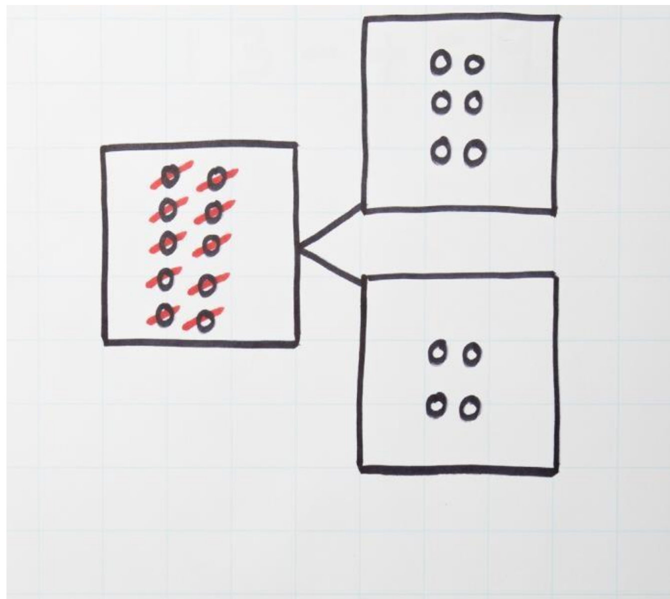
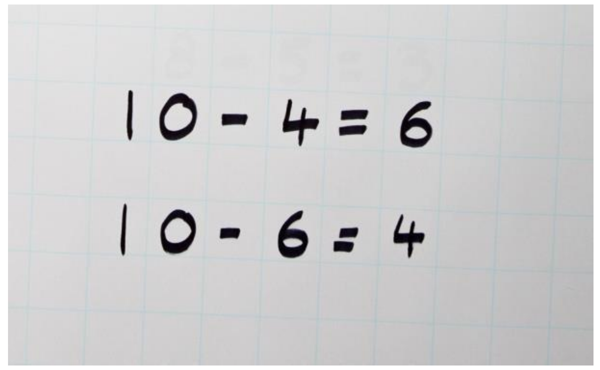
We are comparing the boys to the girls. We know the smaller quantity. To find the bigger quantity we add 119 + 15



Subtraction

Objective	Concrete	Pictorial	Abstract
Stage 1: Taking away ones subtract take away left over less	 	  Cross out drawn objects to show what has been taken away.	
Stage 2: Counting Backwards minus tens ones fewer than backwards larger smaller	   Make the larger number then move backwards as you count in ones.	 	

Subtraction

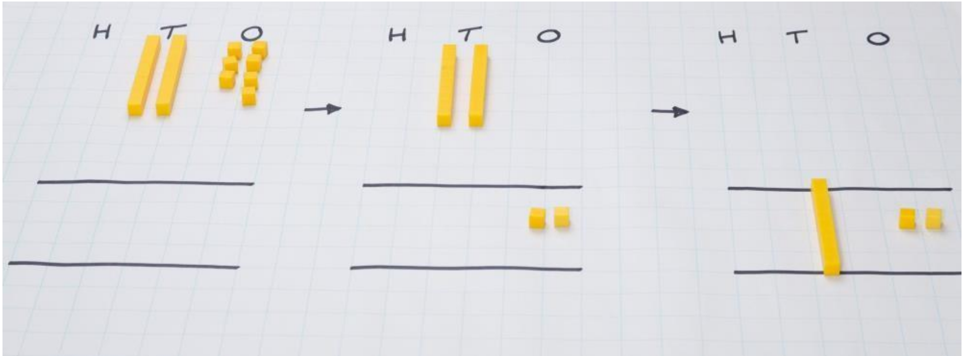
Objective	Concrete	Pictorial	Abstract
Stage 3: Finding the difference difference decrease less than	   Finding the difference is a comparison. Pupils should be taught to compare the two numbers to find the difference.	 Pupils can also draw cubes to show the difference.	
Stage 4: Part Part Whole model inverse number bonds number facts	 Link to addition to help explain the inverse.	 Cross out drawn amounts to show subtraction.	

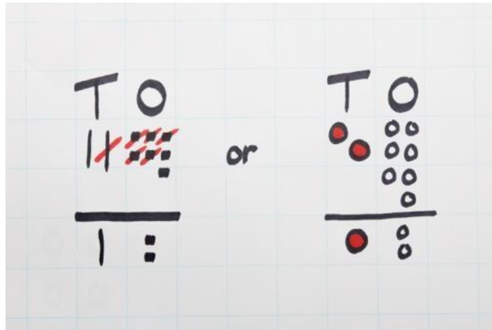
Subtraction

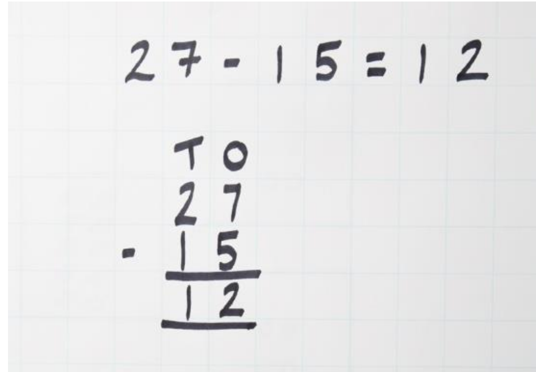
Objective	Concrete	Pictorial	Abstract

Stage 5: Column method - without regrouping

hundreds
tens
ones
partition
palce value
column

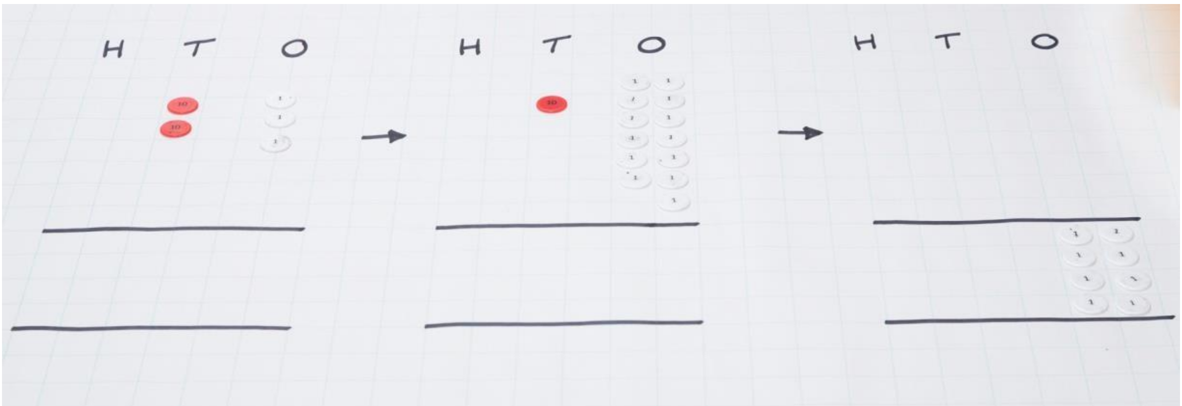


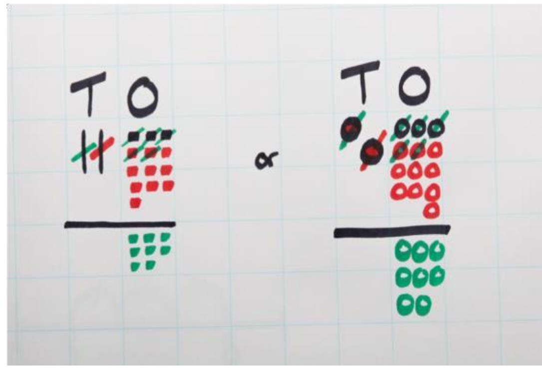


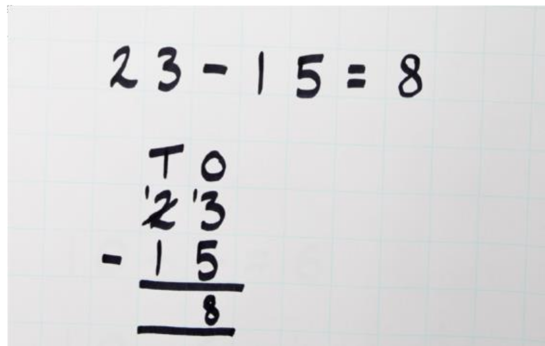


Stage 6: Column method with regrouping

re-grouping
column
partition





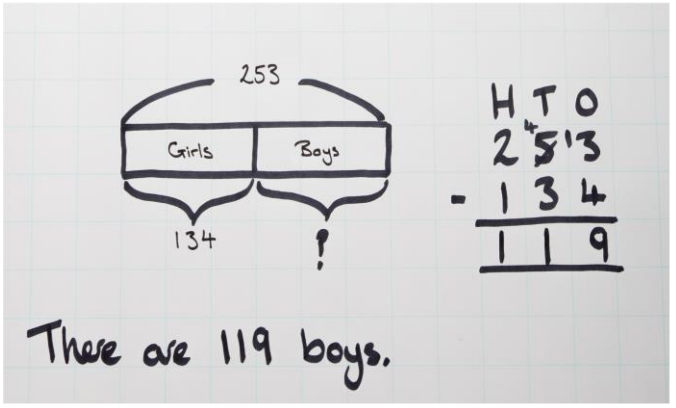


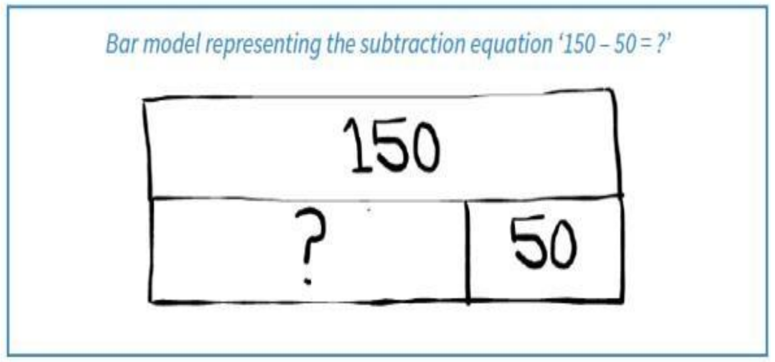
Subtraction - Bar Modelling

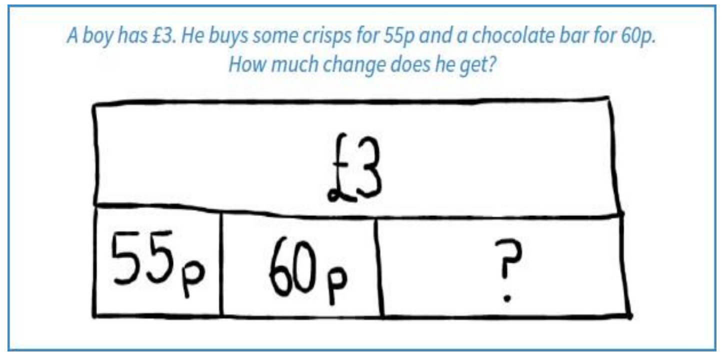
Part-Part-Whole Model

253 children took part in an art competition. There are 134 girls. How many boys are there?

We know the whole and 1 part.
To find the missing part, we subtract 253 – 134.



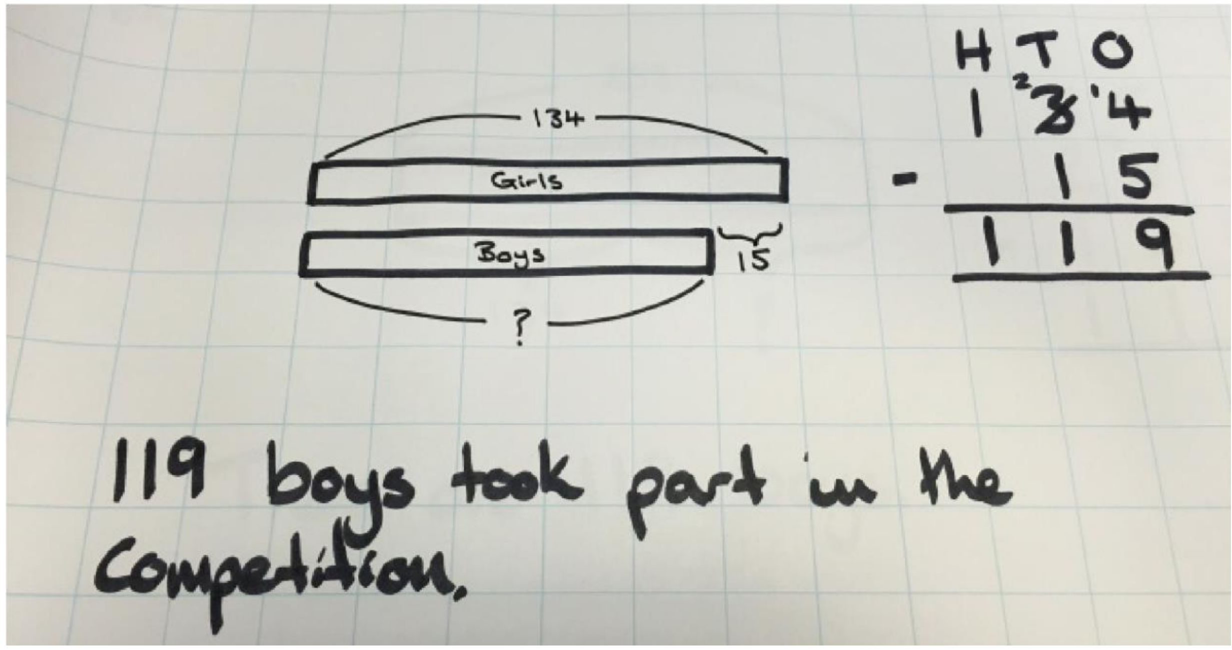


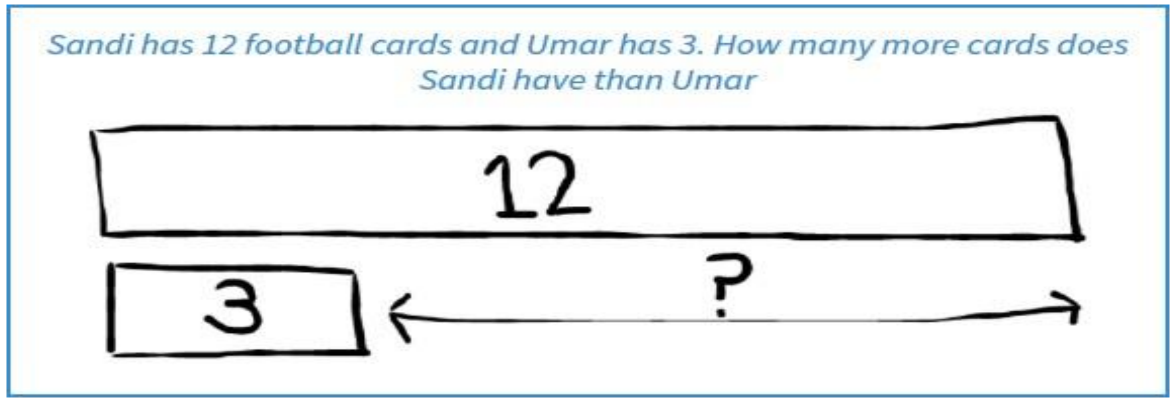


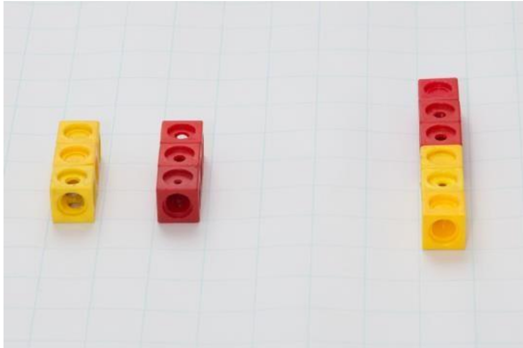
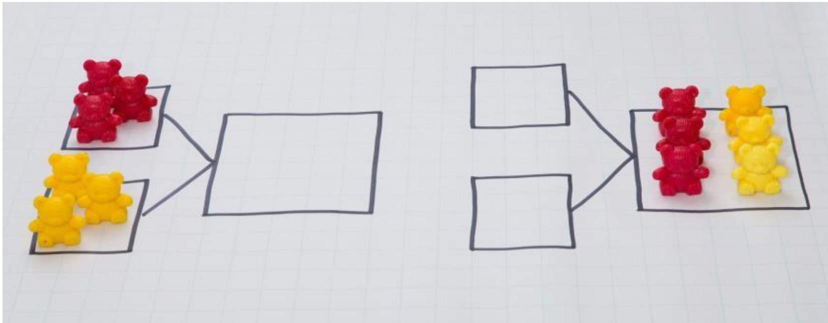
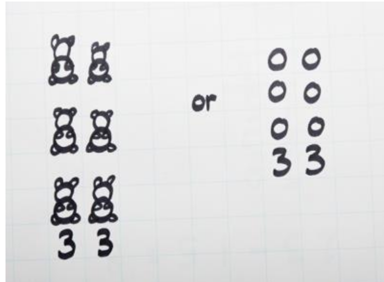
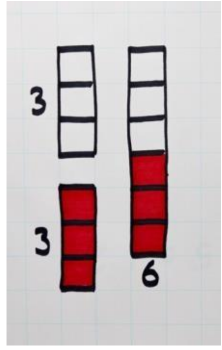
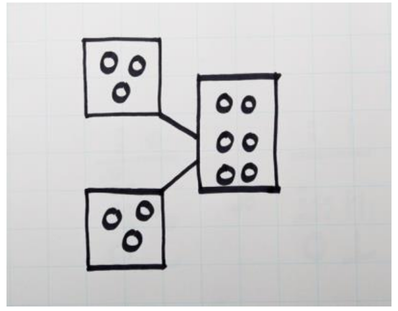
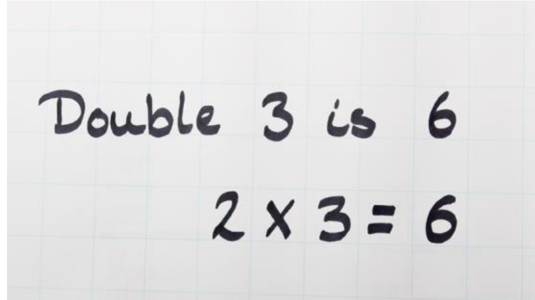
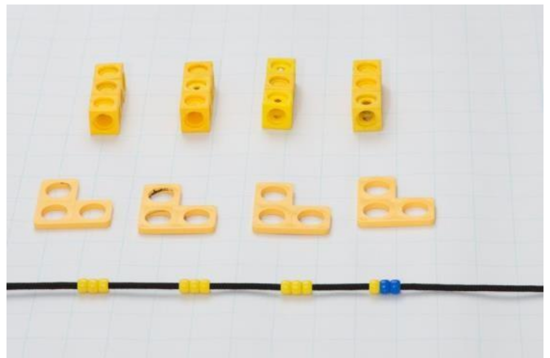
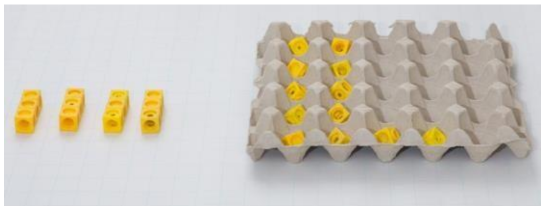
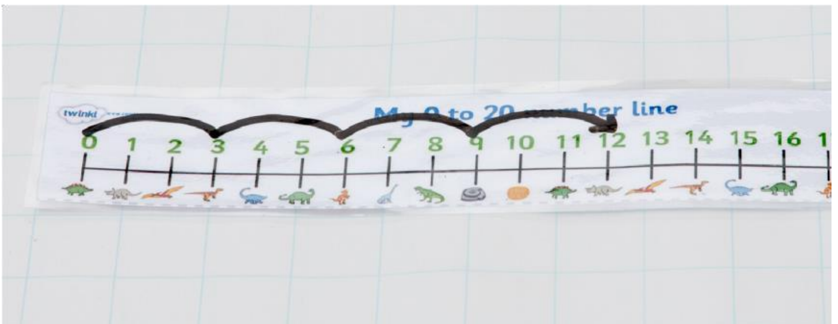
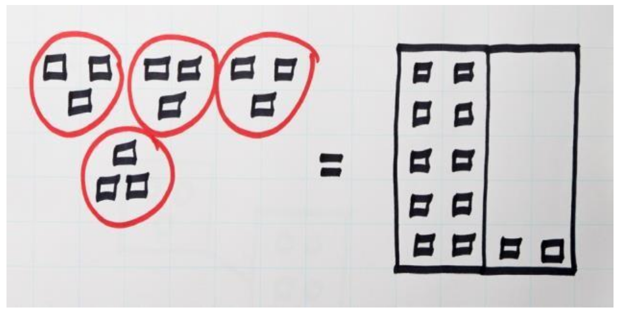
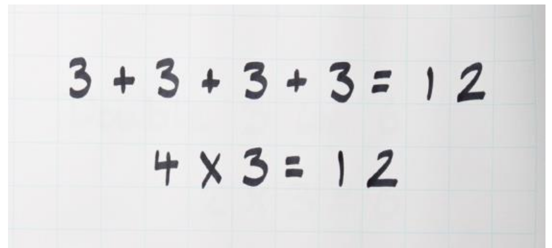
Comparison Model

134 girls took part in an art competition. 15 fewer boys than girls took part. How many boys took part in the competition?

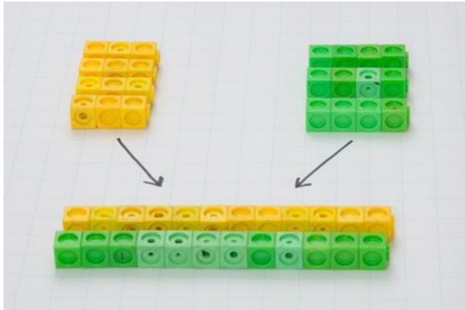
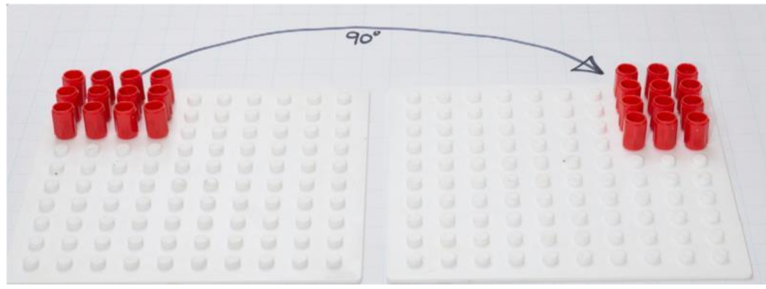
We are comparing the girls to the boys. We know the bigger quantity. To find the smaller quantity we subtract 134 – 15.

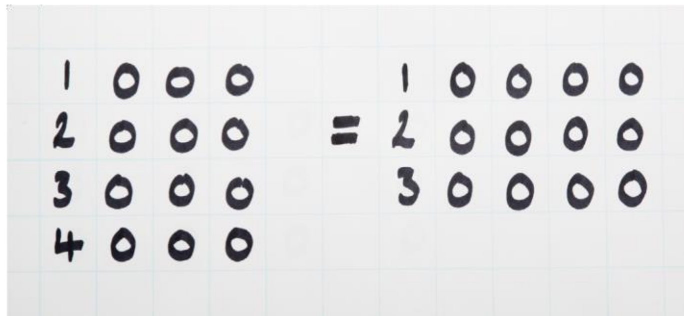


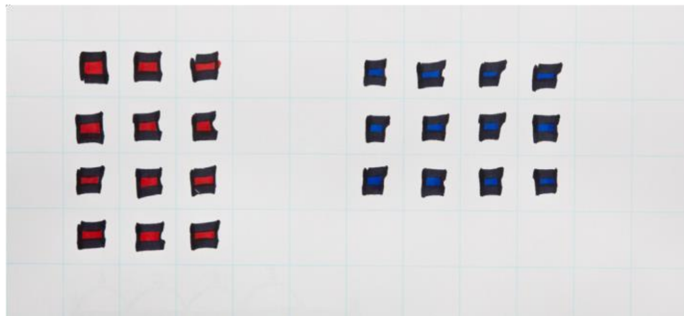


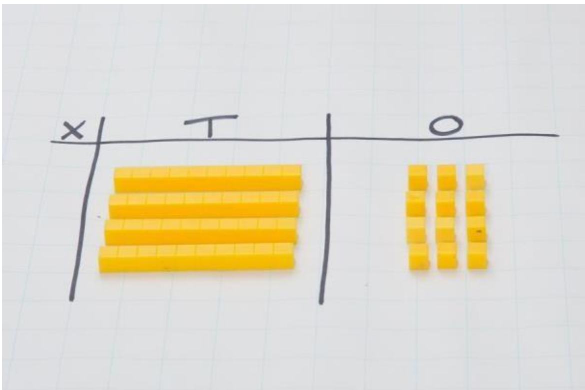
Objective	Concrete	Pictorial	Abstract
Stage 1: Doubling double goups of total	  	  	
Stage 2: Repeated addition then counting in multiples	   Pupils need to see repeated addition in a range of resources.		

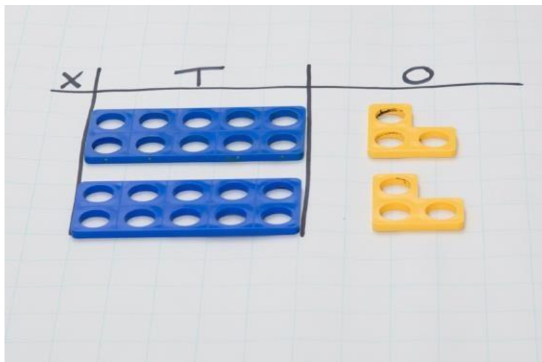
<table>
<tr><th>Objective</th><th>Concrete</th><th>Pictorial</th><th>Abstract</th></tr>
<tr>
<td>Stage 3: Arrays - showing commutative law

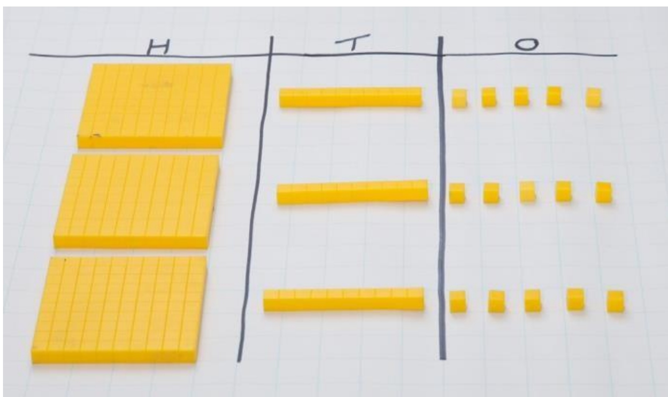
array
commutative law
times
multiply
row
column</td>
<td>



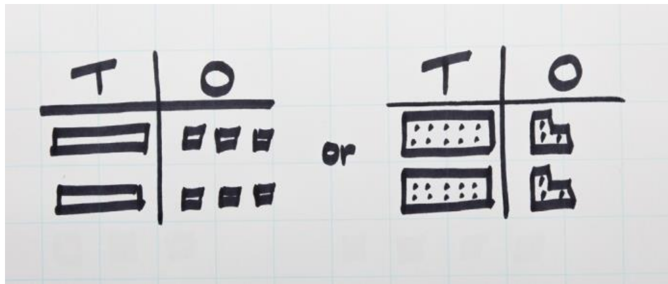
Demonstrate the commutative law by making an array and turning it 90’ as in the example shown above where 3 rows of4 becomes 4 rows of three after the quarter turn.</td>
<td>

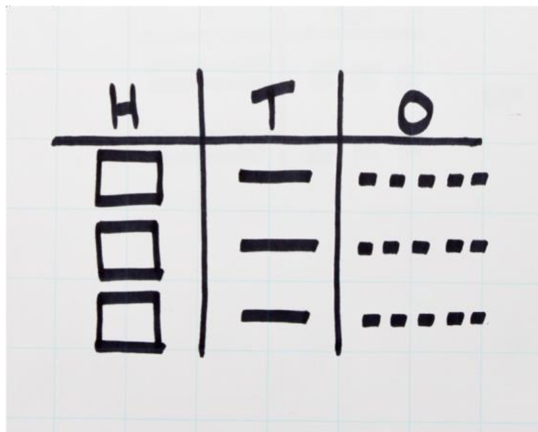
</td>
<td>$4 \times 3 = 12$
$3 \times 4 = 12$</td>
</tr>
<tr>
<td>Stage 4: Column Method

column
lots
groups
product
array
hundreds
tens
ones</td>
<td>





By representing tens horizontally it makes the group clearer and keeps the calculation more compact.</td>
<td>


</td>
<td>$\begin{array}{rrr} & T & O \\ & 1 & 3 \\ \times & & 4 \\ \hline & 5 & 2 \\ & 1 & \end{array}$

$\begin{array}{rrrr} & H & T & O \\ & 1 & 1 & 5 \\ \times & & & 3 \\ \hline & 3 & 4 & 5 \\ & & 1 & \end{array}$</td>
</tr>
</table>

Objective

Stage 4: Column Method

partition
expanded
compact efficient
formal

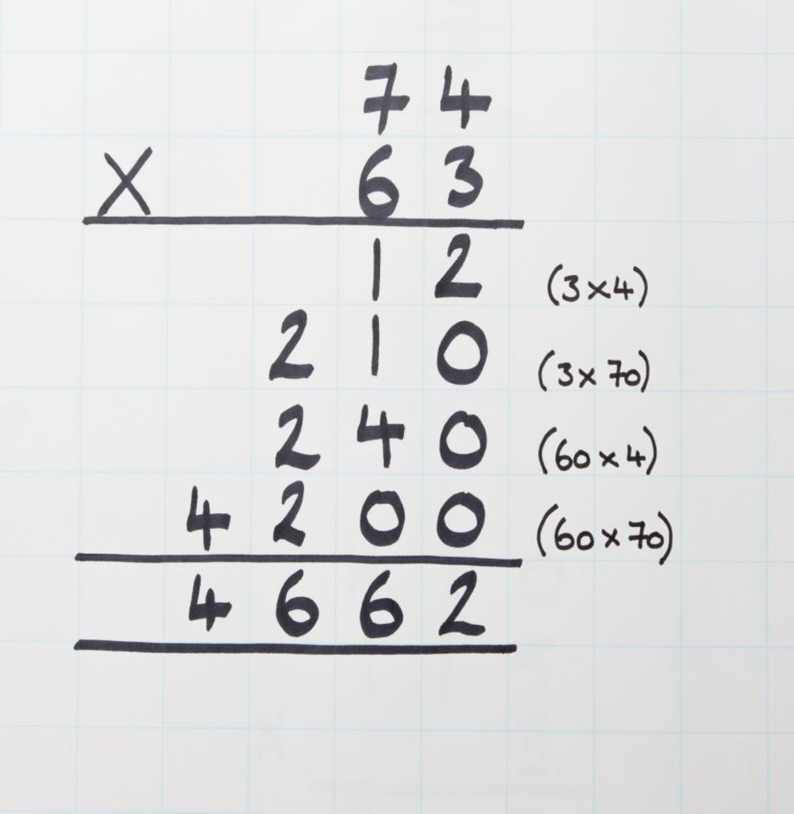
Concrete

Pictorial

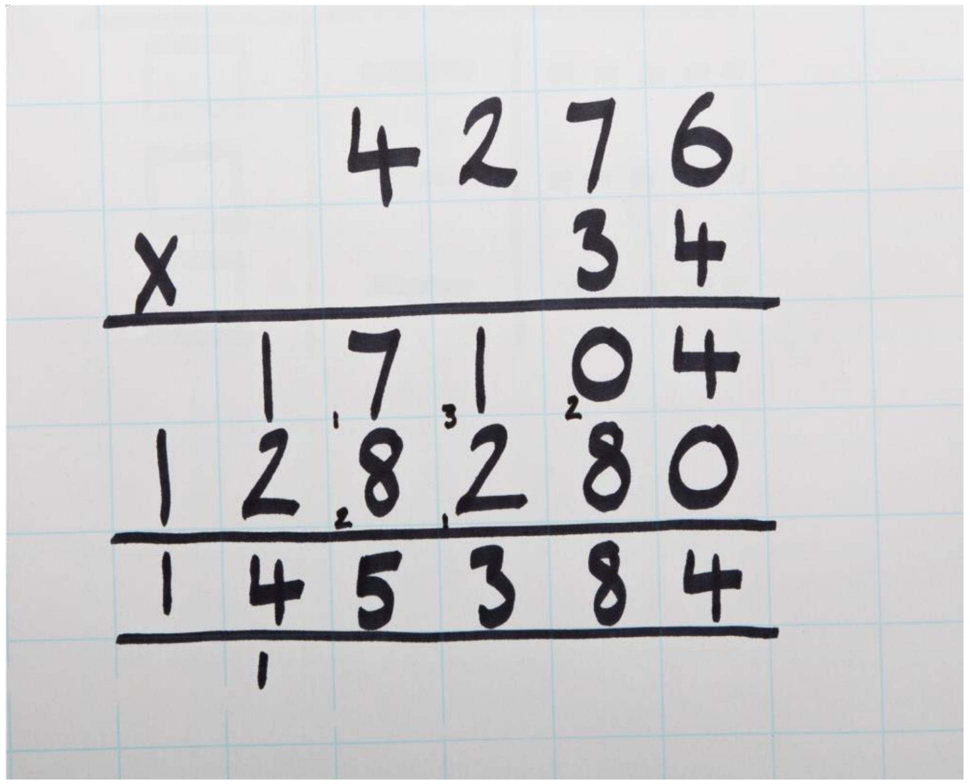
Abstract

Once pupils are secure and move to digit X 2 digit they should just be using the formal abstract method:

Expanded method:



Compact (efficient) method:

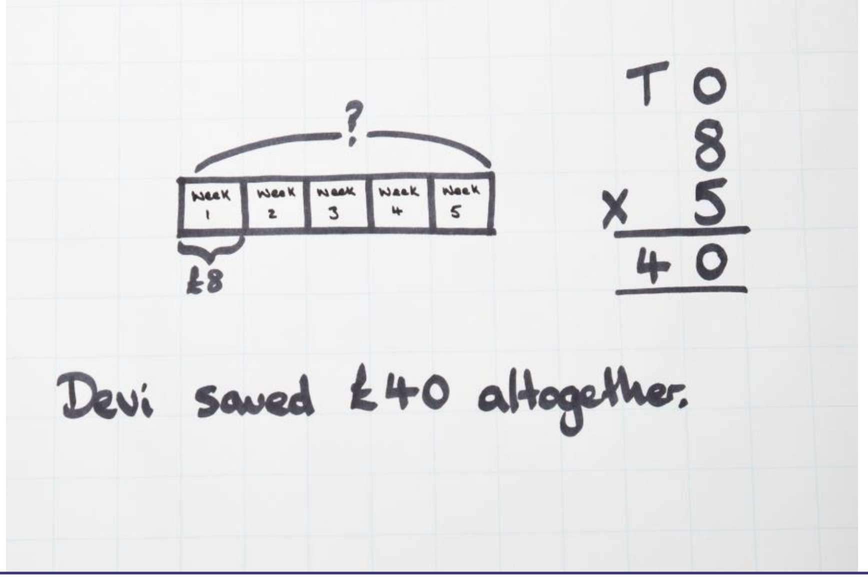


Mulitplication - Bar Modelling

Part-Part-Whole Model

Devi saved £8 a week for 5 weeks.
How much did she save altogether?

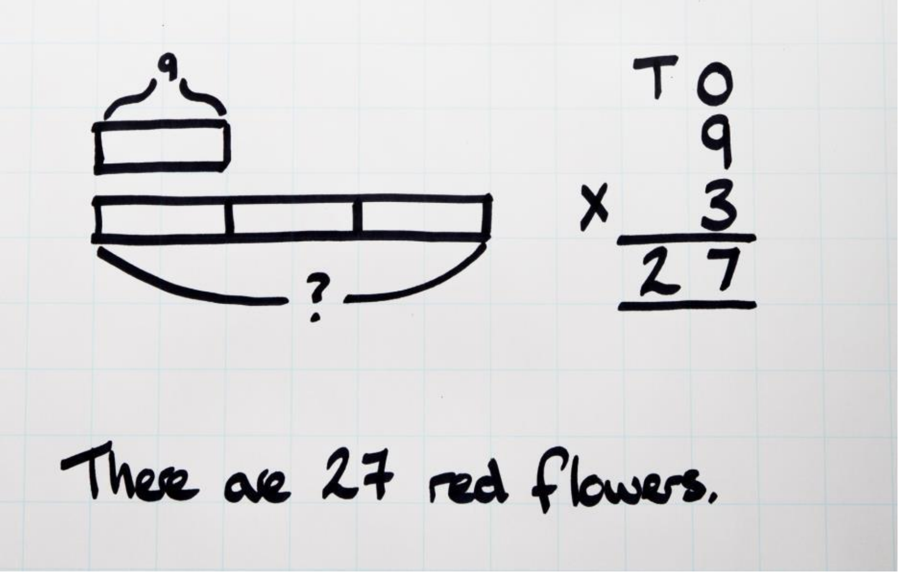
We know 1 part and the number of parts. To find the whole we multiply 8 x 5.

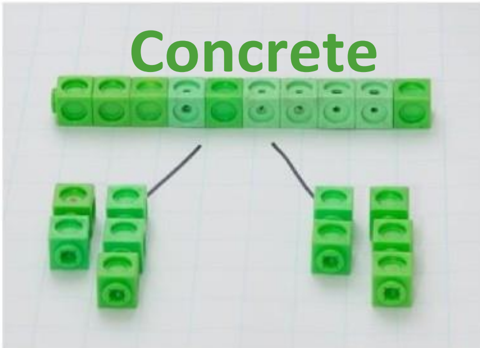
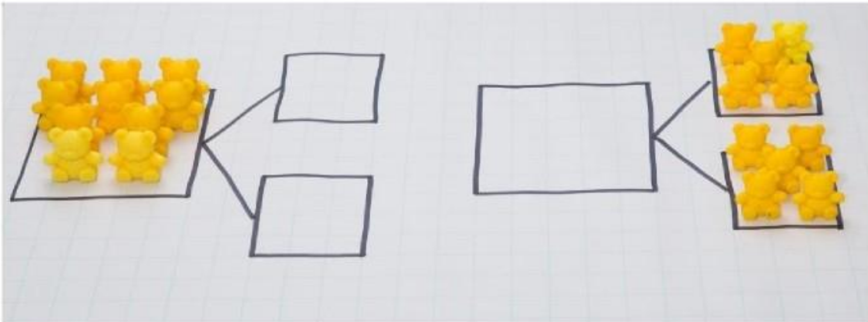
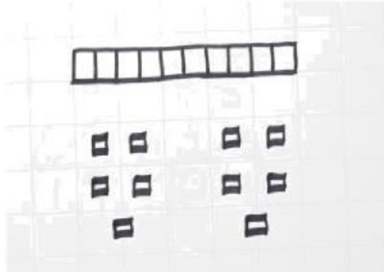
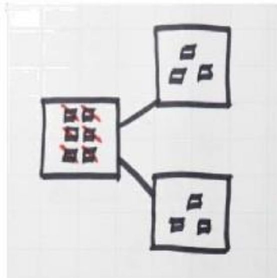
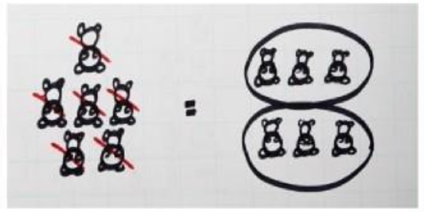
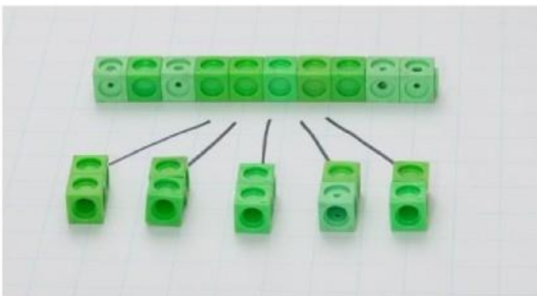
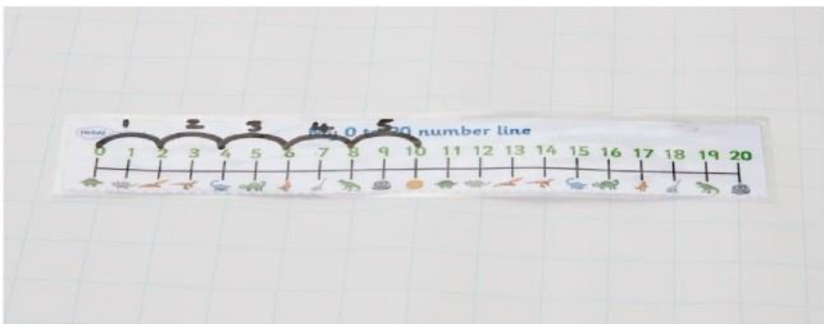
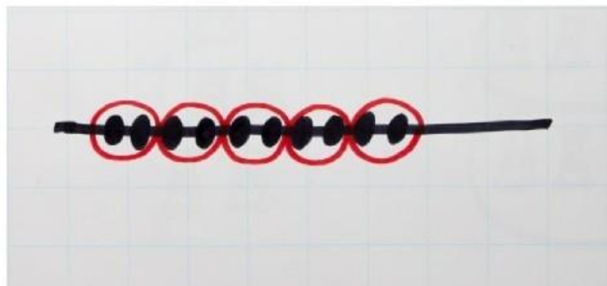
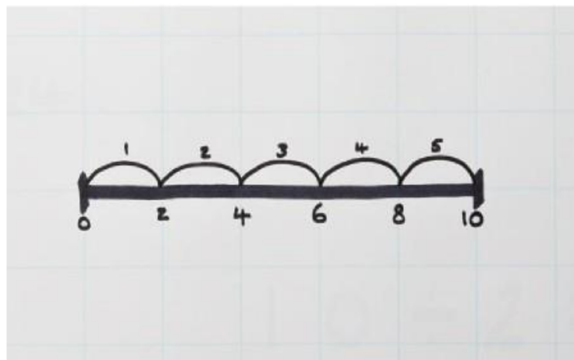


Comparison Model

There are 9 white flowers. There are 3 times as many red flowers as white flowers.
How many red flowers are there?

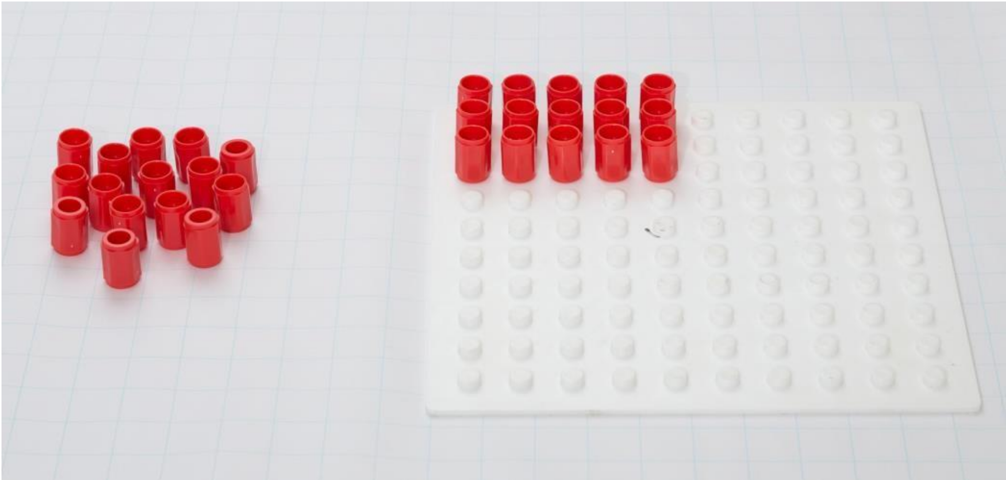
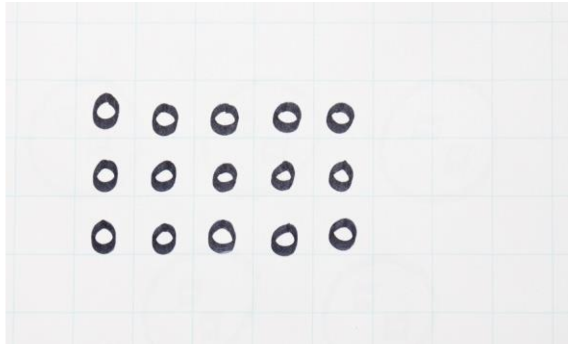
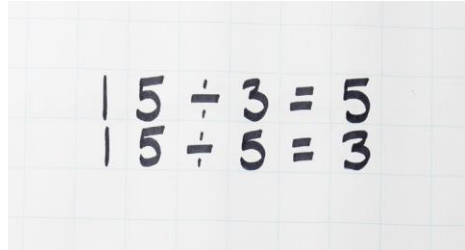
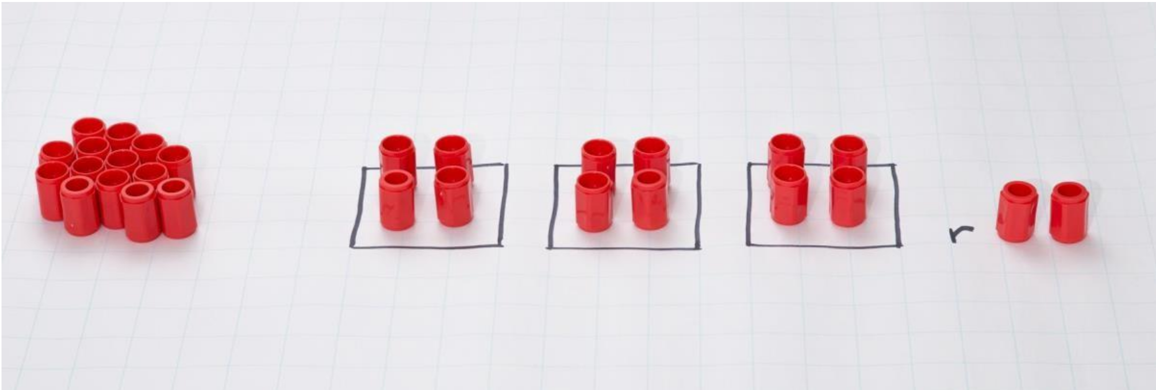
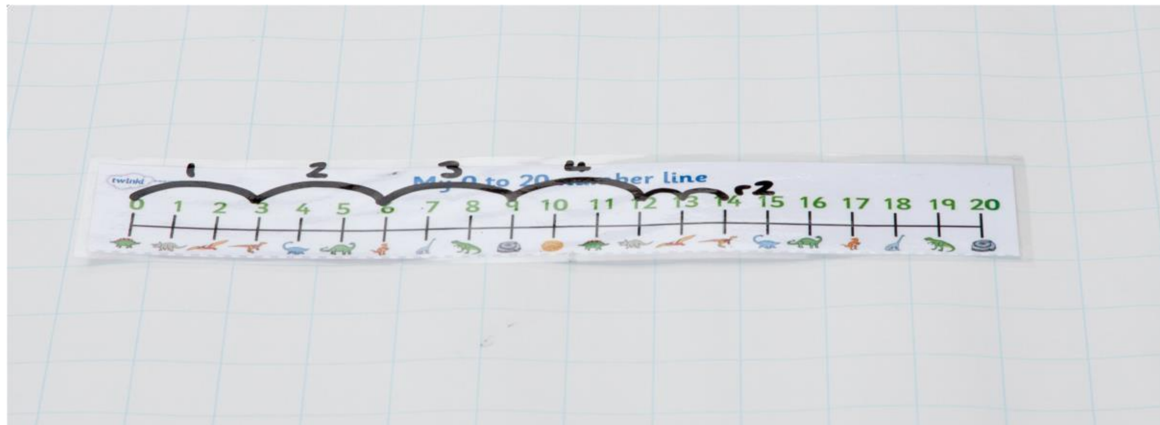
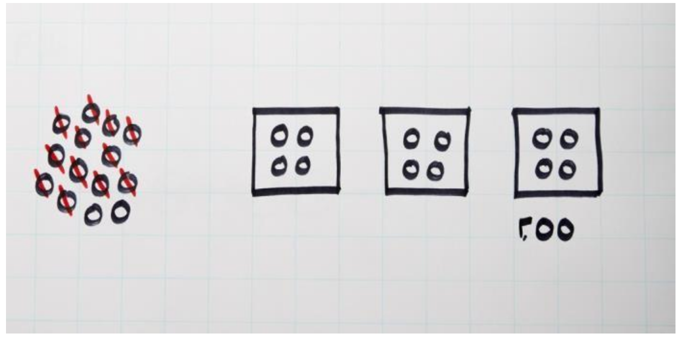
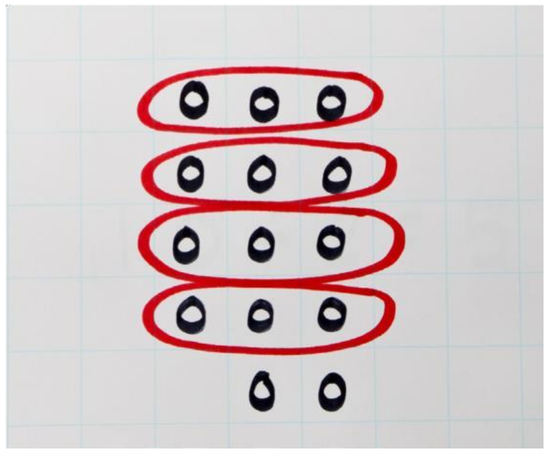
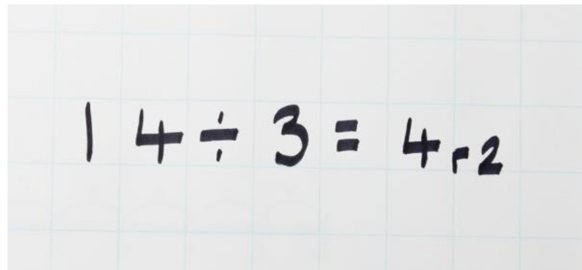
Two quantities are compared. One is a multiple of the other.
We know the smaller quantity.
To find the bigger quantity we multiply 9 x 3.



Objective	Concrete	Pictorial	Abstract
Stage 1: Sharing objects into two groups: halving share halve equal sharing into groups	 	  	$10 \div 2 = 5$ $6 \div 2 = 3$
Stage 2: Division as grouping sharing equal sharing into groups divide number line	  	  	$10 \div 2 = 5$

Divide quantities into equal groups then count the number of groups to find the answer.

Division

Objective	Concrete	Pictorial	Abstract
Stage 3: Arrays — showing Division arrays fairly share equally inverse division	 Link to multiplication		
Stage 4:Division with remainders	  Can also be shown with an array.	 	

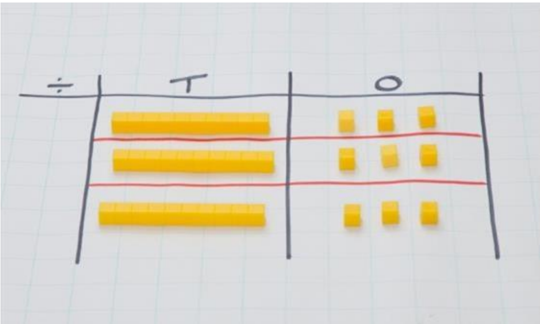
Division

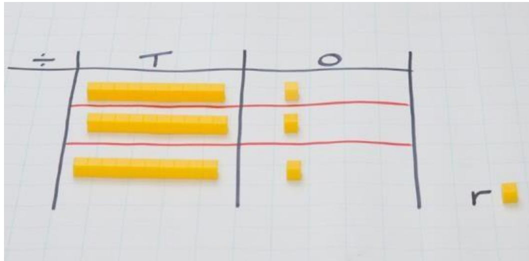
Objective

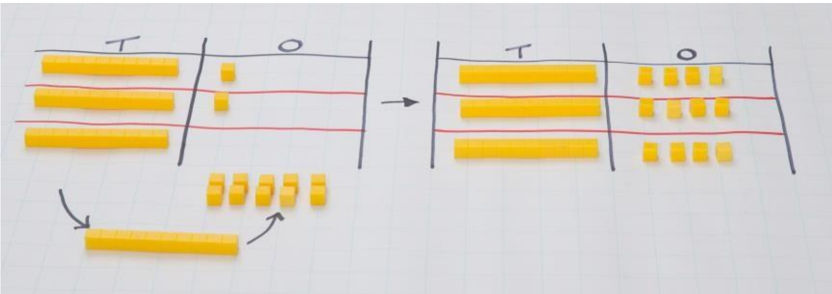
Stage 5: Short division

remainders
factor
distributive law
associative law
partition
quotient
divisible by

Concrete

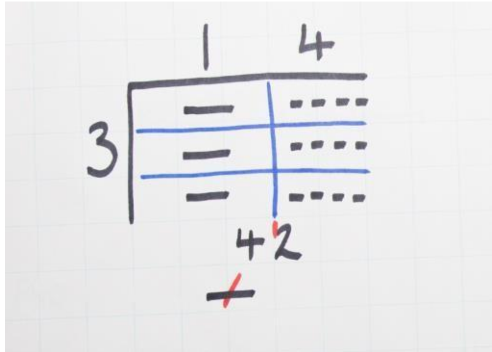


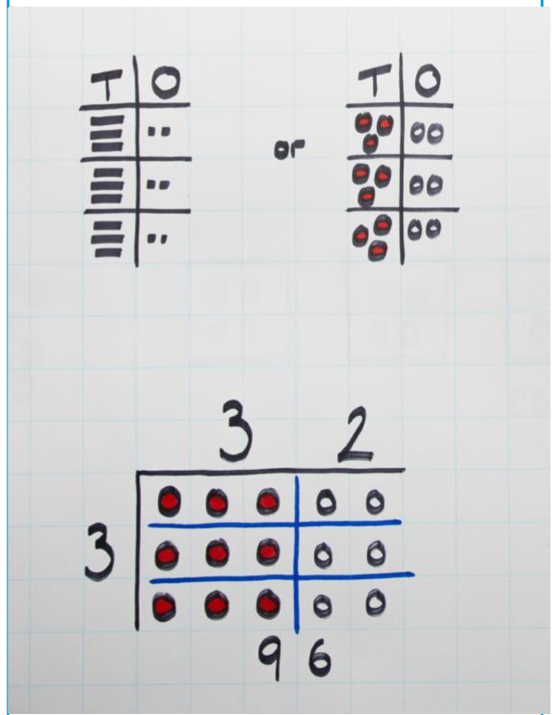


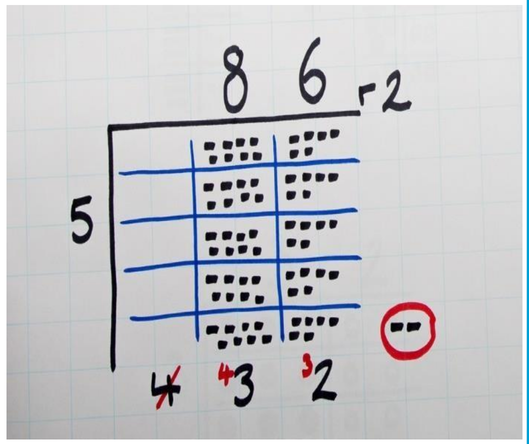


First with remainders then with re-grouping

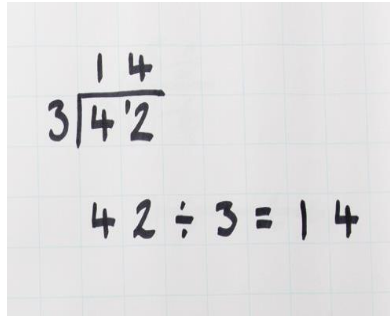
Pictorial

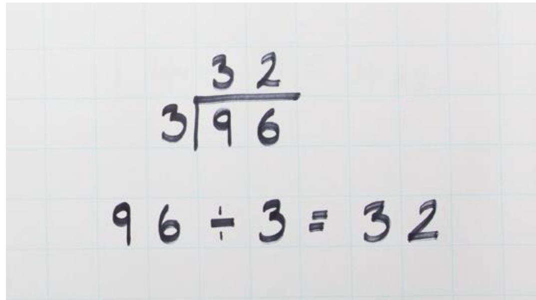


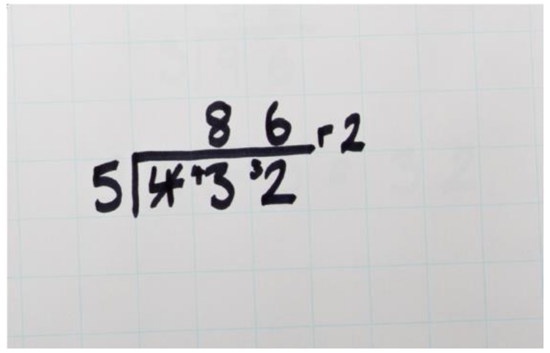




Abstract







Objective

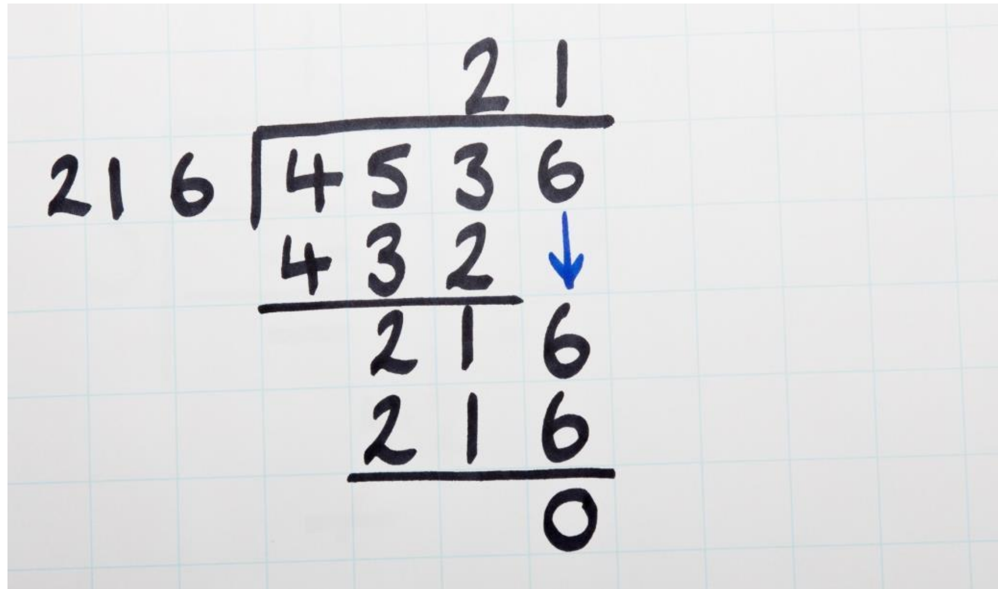
Stage 6: Long division

remainders
grid method
divisible by
factor
place value

Concrete

Pictorial

Abstract



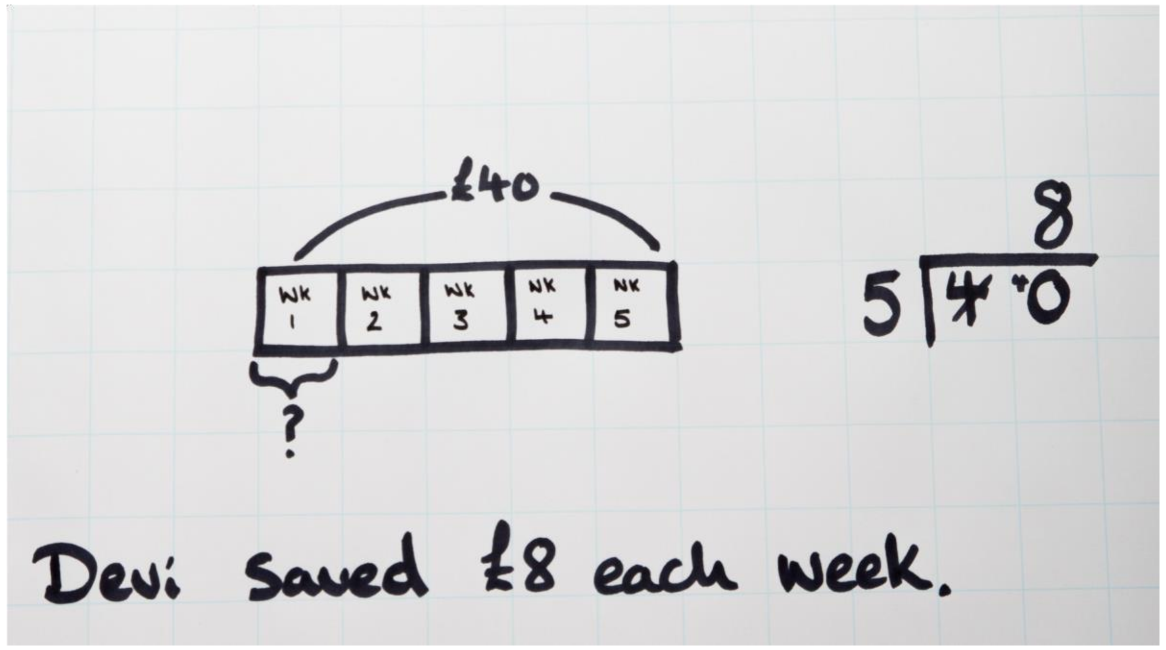
Once pupils are secure they can move to the abstract only long division.

Division - Bar Modelling

Part-Part-Whole Model

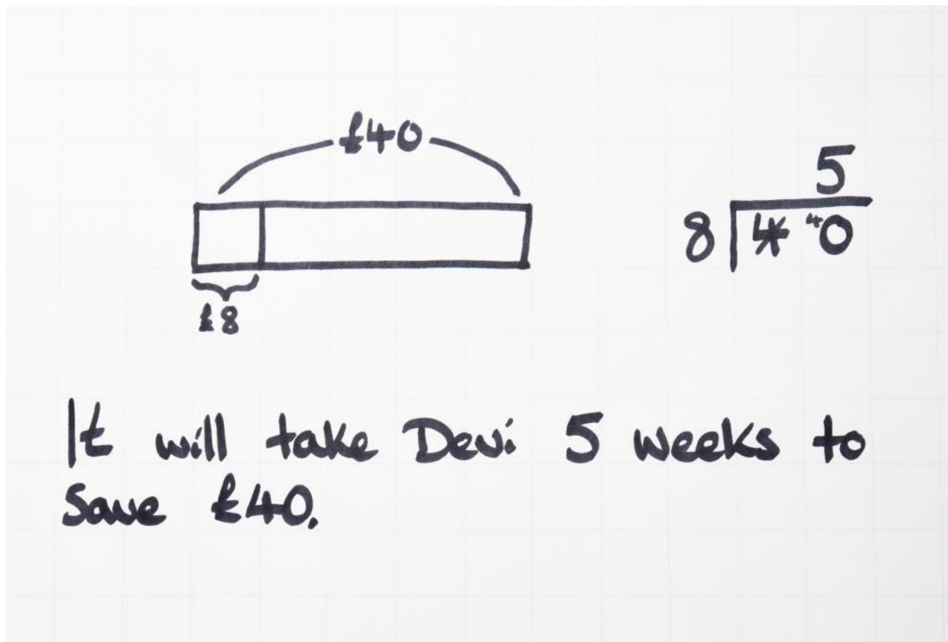
Devi saved £40 in 5 weeks. How much did she save each week?

We know the whole and the number of parts. To find one part we divide 40 ÷ 5.



Devi saves £8 each week, How many weeks will it take her to save £40?

We know the whole and one part. To find the number of parts we divide 40 ÷ 8.

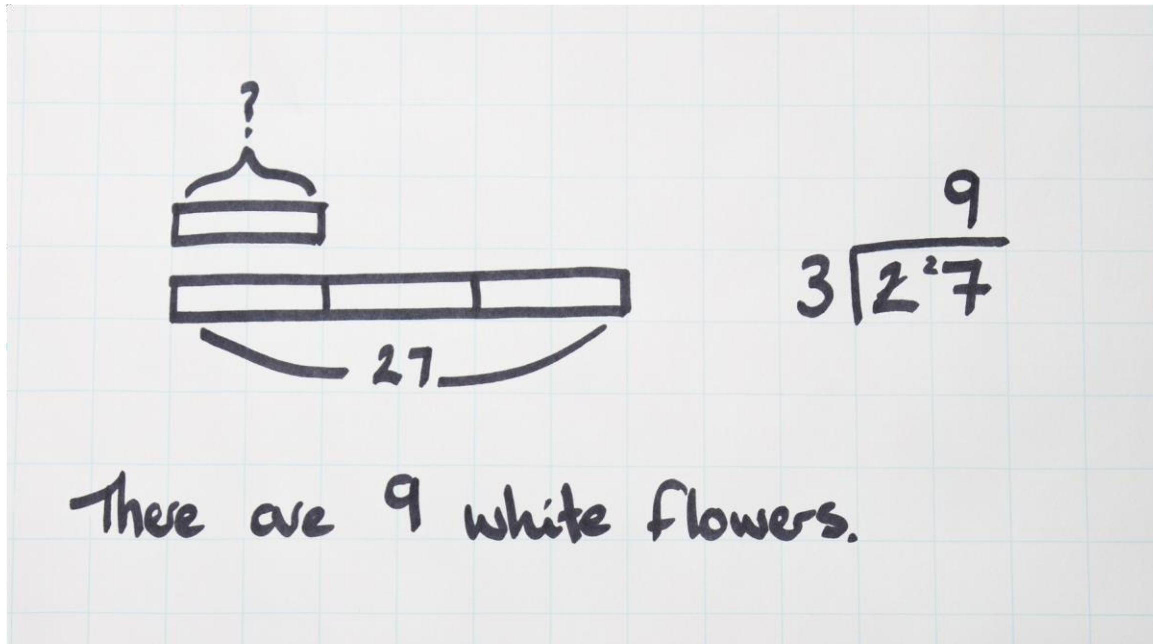


Division - Bar Modelling

Comparison Model

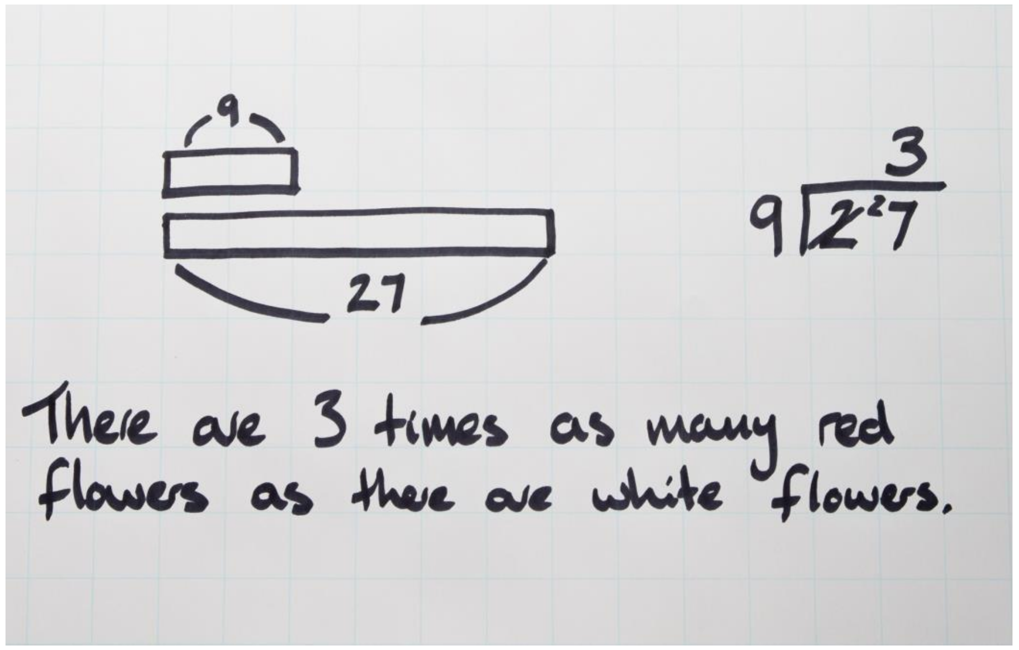
There are 27 red flowers. There are 3 times as many red flowers as white flowers. How many white flowers are there?

Two quantities are compared. One is a multiple of the other. We know the bigger quantity. To find the smaller quantity we divide 27 ÷ 3.



There are 27 red flowers and 9 white flowers. How many times as many red flowers as white flowers are there?

Two quantities are compared. One is a multiple of the other. We know both quantities. To find the multiplier we divide 27 ÷ 9.



Fractions - Bar Modelling

Fractions problems

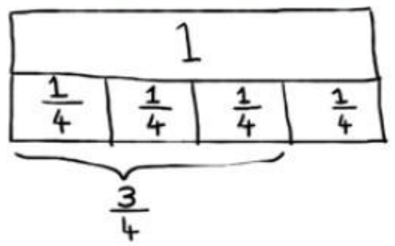
Fractions are mentioned 104 times in the National Curriculum so they're quite a big deal.

Modelling fractions using bar models is one of the most intuitive ways of showing fractions pictorially. It might even be that children will gain a greater understanding of bar modelling in general, giving them skills which are transferable to other areas of the Maths curriculum.

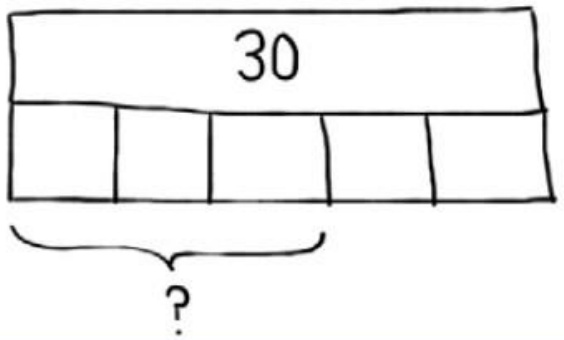
As such, there are a wide range of contexts that a bar model can be used to represent fractions problems.

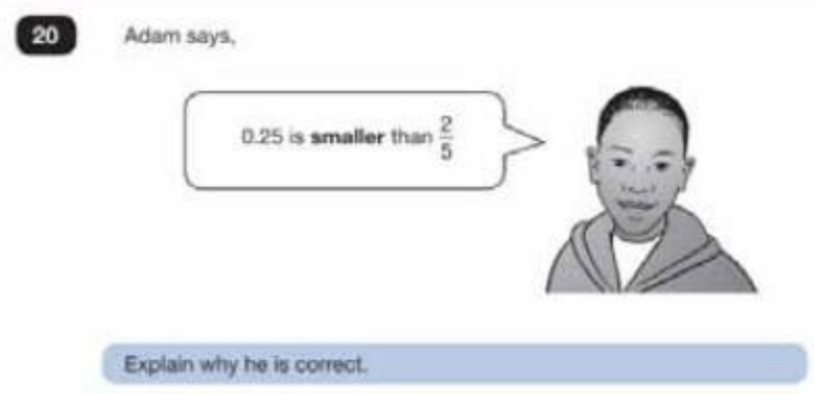
In Year 2 children have to recognise, find, name and write fractions, such as $\frac{3}{4}$ which can be represented as below:

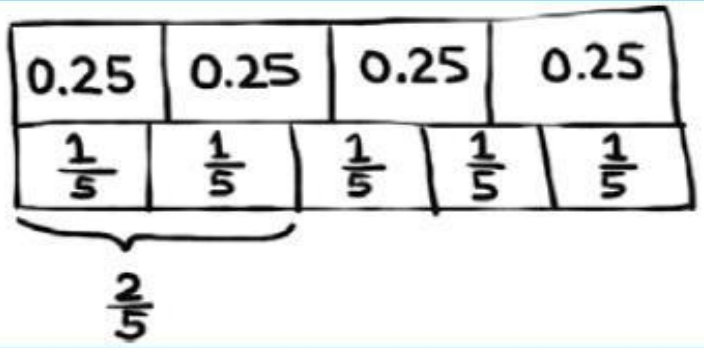
A bar model representing three quarters



A bar model representing the equation: What is $\frac{3}{5}$ of 30?





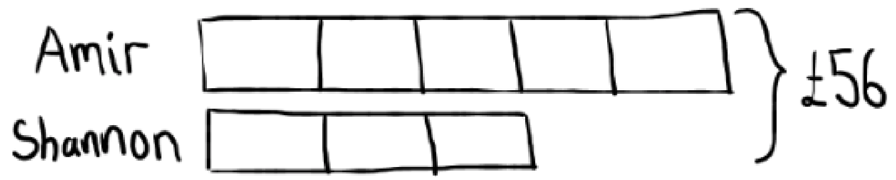


Ratio and algebra - Bar Modelling

Ratio problems

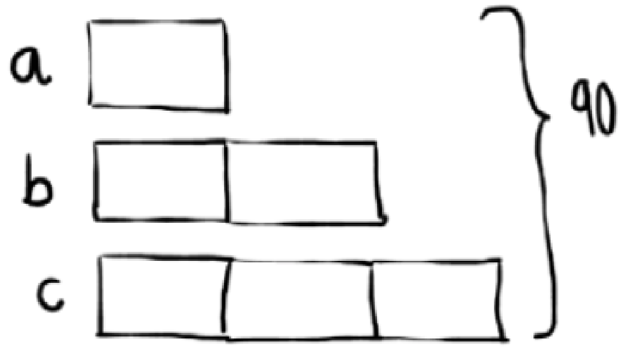
The comparison bar model is a gift when it comes to ratio problems, which is particularly significant given that in the 2017 KS2 tests the ratio question was one of the most poorly answered.

Shannon and Amir share £56 in the ratio of 3:5.
How much money does each person get?



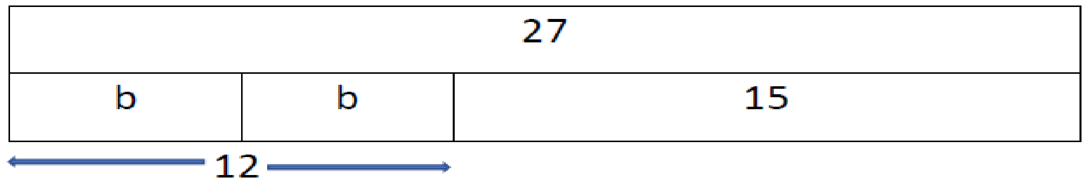
90 sweets are shared between bowls a, b and c. Bowl b contains twice the amount that bowl a contains. Bowl c contains three times the amount that bowl a contains. How many more sweets does bowl b have than bowl a?

Both these versions of the problem can be represented using the bar model below:



How to teach equations with the bar model:

2b + 15 = 27   What is the value of b?



From this we can see that 27 – 15 = 2b

So, we can see b = 6

2a + 7 = a + 11

So, what do we know?