

Bar Modelling at Preston Street

What is a bar model?

A **bar model** is a pictorial representation of a maths problem.

A bar model is **not**, in itself, a way of solving a calculation. However, it can help children:

- Visualise a calculation more clearly;
- Understand which calculation to do in order to solve a word problem;
- Understand more clearly the processes involved in a particular calculation.

How are bar models used?

In maths, there are three ways of representing a number calculation:

- **Concrete materials**
- **Pictorial representation**
- **Abstract notation**

Concrete materials means that pupils use actual materials (for example, counters or rods) to show the numbers involved. For example, a pupil can perform the calculation $4 + 5$ by counting out four red counters and five blue counters, then adding them together.

Pictorial representation means that pupils use some kind of picture or diagram to represent the numbers involved. For example, a pupil might draw 4 red circles and 5 blue circles before adding them together.

Abstract notation is when pupils use mathematical symbols to represent a calculation. For example, a pupil might write ' $4 + 5 = 9$ '.

For more information on concrete, pictorial and abstract, please see the separate leaflet which will be issued shortly (November 2020).

Bar models are a form of **pictorial representation**. They are used widely by pupils across middle and upper primary to help:

- Solve number problems;
- Visualise calculations more clearly;
- Understand the concept of 'related calculations' and 'inverse operations'.

These will be explained in more detail in this leaflet.

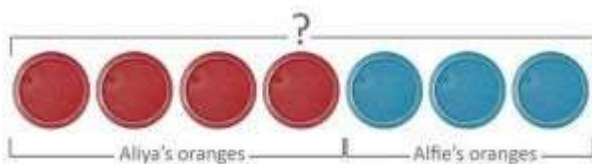
Moving from concrete materials to pictorial representation

Here is a simple question which might be answered by younger pupils:

Aliya has 4 oranges. Alfie has 3 oranges. How many oranges do Aliya and Alfie have altogether?

Step One: concrete materials

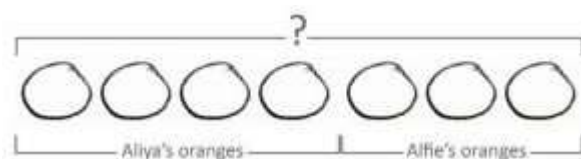
The first step in solving this problem for many pupils would be to **use concrete materials** such as counters to 'represent' the numbers involved.



This diagram shows how this could be laid out using counters. This very clearly shows the calculation $4 + 3 = 7$.

Step Two: simple pictorial representation

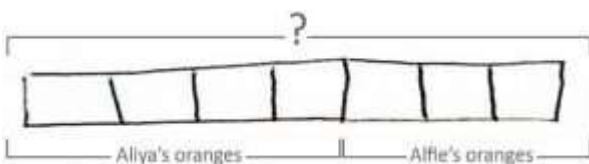
Instead of counters, pupils might use **pictorial representation**.



This pictorial representation is essentially the same as the one above with counters.

Step Three: 1:1 bar modelling

As pupils get more confident in using pictorial representation, an important next step is to represent the problem using a **1:1 bar model**.



This bar model shows the numbers (4 and 3) on a 1:1 basis (4 squares for 4 + 3 squares for 3).

Step Four: rough bar modelling



This next step shows the numbers as 'bars' without being split up into individual 1:1 squares.

Pupils using this model are able to represent both numbers approximately, without having to 'count out' both numbers. This is an important step, as it makes the process quicker and more efficient.

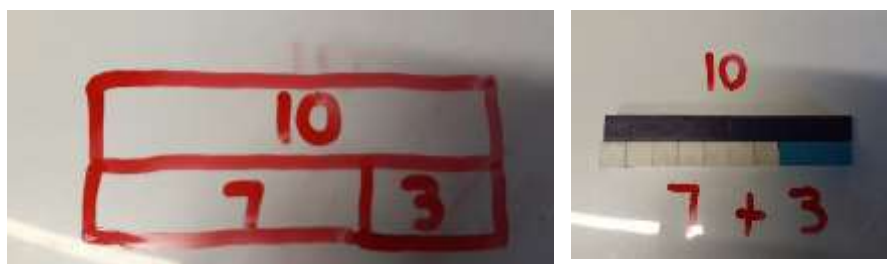
Solving Problems using different types of bar model

As pupils develop their understanding of bar modelling, they learn to use different types of bar model to represent different problems.

Part-Part-Whole model

A **part-part-whole model** represents a situation where two or more 'parts' are added together to make a 'whole'.

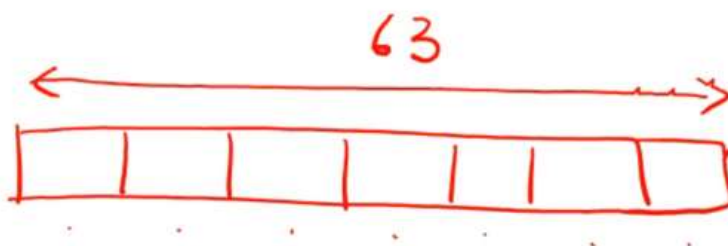
Here is a simple example of the part-part-whole model for the calculation $7 + 3$ using a pictorial bar model (left) and concrete materials (right).



This bar model could be used to answer various questions, including:

- *I have 7 cars. My brother has 3 cars. How many do we have altogether?*
- *I have 7 cars. My brother and I have 10 cars altogether. How many does my brother have?*

Equal Parts Model



The above bar model shows how an older pupil might represent problems such as:

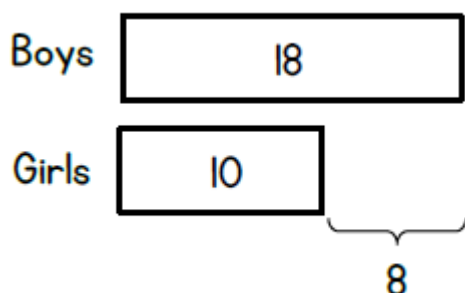
I have £63 and share it equally between 7 people. How much does everyone receive?

I share £63 equally between 7 people. How much do 3 people get?

This second problem is quite challenging when it is read as a 'word problem'. However, the use of a bar model makes it much easier to understand the calculations involved in solving the problem.

Comparison model

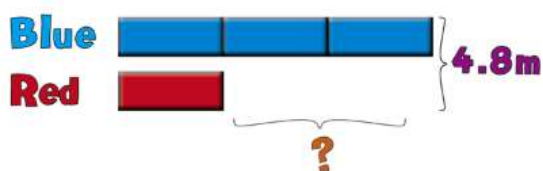
A comparison model compares two or more amounts.



Additive comparison model

There are 18 boys and 10 girls in a class. How many more boys are there than girls?

This **additive comparison** model allows pupils to visualise the difference between the two amounts.

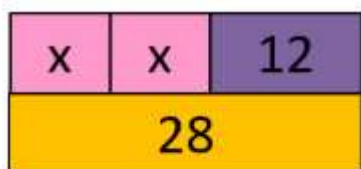


Multiplicative comparison model

I have 4.8 metres of blue ribbon. I have a piece of red ribbon which is one third of the length of the blue ribbon.

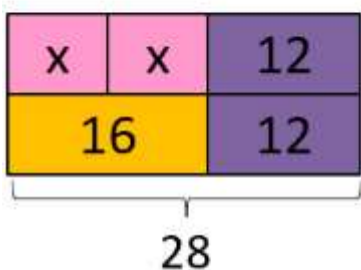
This **multiplicative comparison model** allows pupils to clearly visualise the length of the red ribbon in comparison to the blue.

Combinations of different models to solve more complex problems

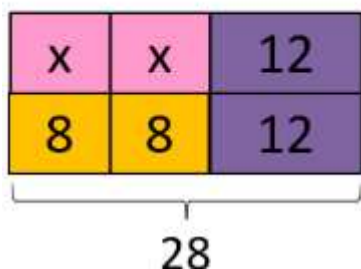


This bar model (left) is a combination of the 'part-part-whole' and 'equal parts' model.

It shows how a bar model could be used to help a pupil understand the equation $2x + 12 = 28$



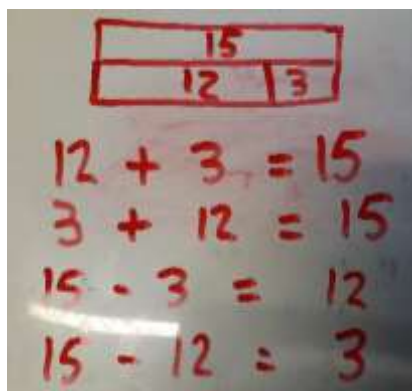
This is an example of how once pupils understand how to use the main types of bar model, they can use this knowledge to develop their understanding of more complex and challenging maths.



It is important to understand that bar modelling strategies can help all pupils, not just those who are younger or less able.

Understanding the concept of related calculations / inverse operations

The 'Part-part-whole' and 'equal parts' bar models can be used to help pupils understand the concept of related calculations.

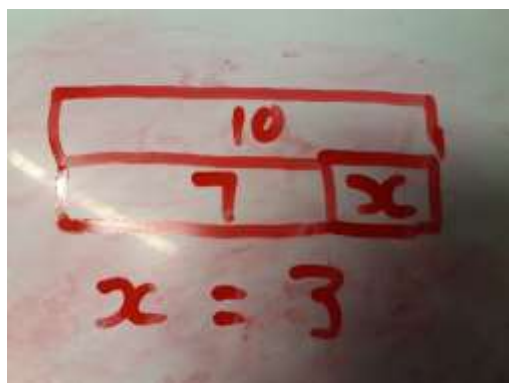


For example, this diagram on the left shows how a pupil can use one bar model to show four related calculations:

Addition	Subtraction
$12 + 3 = 15$	$15 - 3 = 12$
$3 + 12 = 15$	$15 - 12 = 3$

Understanding that these four calculations are all part of the same 'fact family' is a very important step in pupils' mathematical development.

This also helps pupils to understand the concept of **inverse operations**. This means that if $12 + 3 = 15$, then $15 - 3 = 12$.



This bar model shows how this idea can be extended to encompass 'missing number' calculations:

Addition	Subtraction
$7 + x = 10$	$10 - x = 7$
$x + 7 = 10$	$10 - 7 = x$

The 'equal parts' model allows pupils to develop a similar understanding of the link between multiplication and division, as can be seen in this diagram:



Multiplication	Division
$4 \times 6 = 24$	$24 \div 6 = 4$
$6 \times 4 = 24$	$24 \div 4 = 6$