# How to help your child... solve problems using bar models

One of the aims of the National Curriculum for Maths is that pupils can solve problems by applying their knowledge to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions. Pupils in Singapore are fantastic at problem-solving and much of this is down to their use of the bar model method.

Bar modelling allows pupils to draw and visualize mathematical concepts to solve problems.

## Bar modeling at a glance:

- A versatile maths model strategy that can be used across a wide range of concepts and topics.

- Gives pupils a powerful and adaptable strategy for solving increasingly difficult problems.

- Allows pupils to understand on a conceptual level what occurs when using complex formulas (for example, algebra).

- Draws on the concrete, pictorial, and abstract approach.

## Bar modeling and the CPA approach

The bar model method draws on the concrete, pictorial, and abstract (CPA) approach — an essential maths mastery concept. The process begins with pupils exploring problems via concrete objects. Pupils then progress to drawing pictorial diagrams, and then to abstract algorithms

### Concrete – modelling with real objects

There are 8 flowers in the vase. I am holding 2 flowers.

Should we add or subtract to find the total number of flowers?

There are 8 flowers in the vase.
There are 2 flowers in Hannah's hand.
How many flowers are there in total?

8
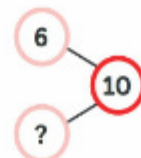
2

$8 + 2 = 10$

There are 10 flowers in total.

8    2

10

Why do we add?

### Concrete – handling real objects

How many more cubes do they need to make a stack of 10 cubes?

There are 6 cubes now.

How many more to make 10?

$6 + \boxed{\phantom{0}} = 10$

$6 + 1 = \boxed{\phantom{0}}$

$6 + 2 = \boxed{\phantom{0}}$

$6 + 3 = \boxed{\phantom{0}}$

$6 + \boxed{\phantom{0}} = 10$

6

10

?

and notations (such as the +, -, x and / symbols).

The example below explains how bar modelling moves from concrete maths models to pictorial representations.

As shown, the bar method is primarily pictorial. Pupils will naturally develop from handling **concrete** objects, to drawing **pictorial** representations to creating **abstract** rectangles to illustrate a problem. With time and practice, pupils will no longer need to draw individual boxes/units. Instead, they will label one long rectangle/bar with a number. At this stage, the bars will be somewhat proportional. So, in the example below, the purple bar representing 12 cookies is longer than the orange bar representing 8 cookies.

## The lasting advantages of bar modelling

The lasting power of bar modelling is that once pupils master the approach, they can easily use bar models year after year across many maths topics. For example, bar modelling is an excellent technique for tackling ratio problems, volume problems, fractions, and more.

Importantly, bar modelling leads pupils down the path towards mathematical fluency and number sense. Maths models using concrete or pictorial rectangles allow pupils to understand complex formulas (for example, algebra) on an intuitive, conceptual level. Instead of simply following the steps of any given formula, students will possess a strong understanding of what is actually happening when applying or working with formulas.
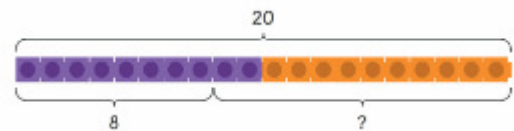
The result? A stable, transferable, and solid

### Concrete – modelling with other objects and pictures

Let's use 🟪 🟧 to help us.

20

8    ?

Sam bakes 20 cookies.
What if he gives some away?

What if Sam gives away 8 cookies?

20 − 8 = ▢

Then, Sam would have ▢ cookies left.

### Concrete to pictorial – drawing

*With thanks to Maths No Problem!*
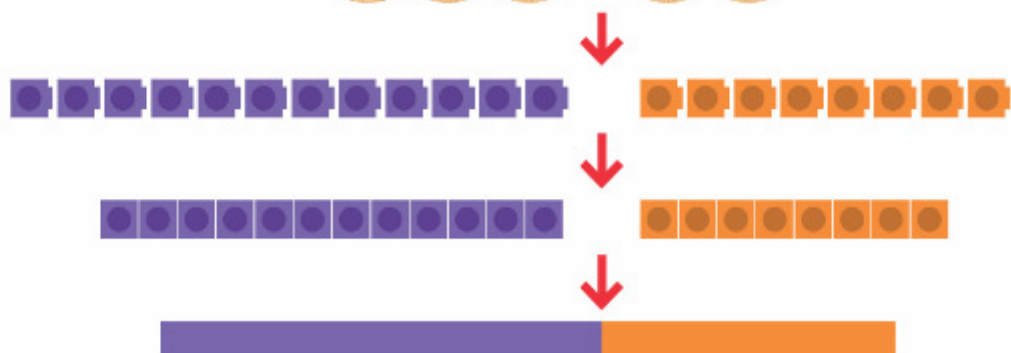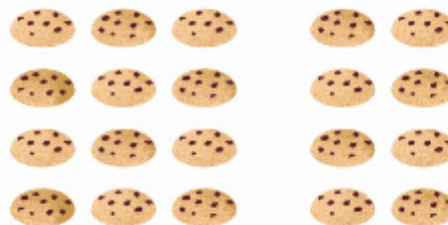
**Examples of bar models being used to solve problems**

Whole unknown...

| ? |
|---|
| 15 | 15 | 15 | 15 |

4 children go to the cinema. They each pay £15. How much do they spend altogether?

Size of groups unknown...

| 60 |
|---|
| ? | ? | ? | ? |

4 children go to the cinema. They each pay £60 altogether. How much do they spend each?

Number of groups unknown...

| 60 |
|---|
| 15 |
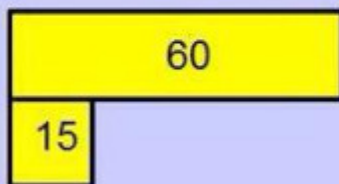
Tickets to the cinema are £15. Some children buy tickets that cost £60. How many children bought tickets?
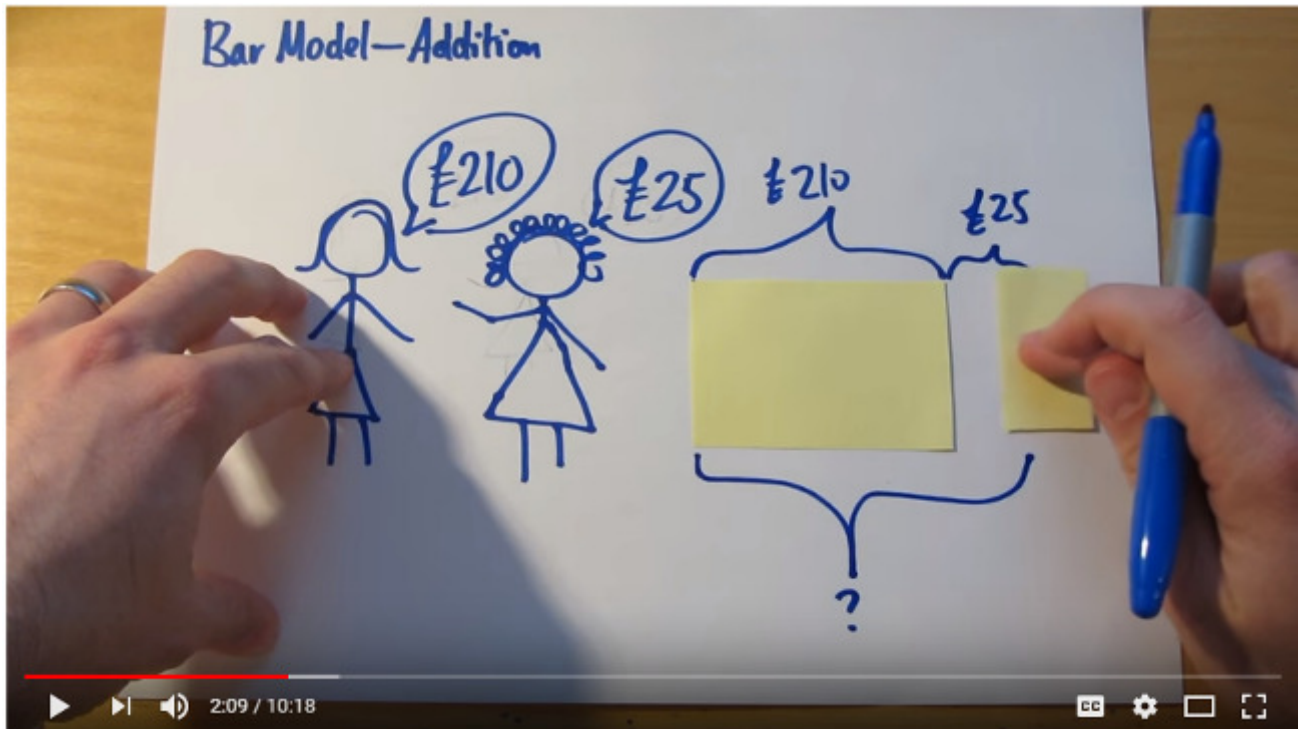
# Ratio

Tim and Sally share marbles in the ratio of 2:3
If Sally has 36 marbles, how many are there altogether?

**Bar Model Videos**

For a simple video introduction on solving word problems using a bar model, please see:

https://www.youtube.com/watch?v=4pfvel6TtEY



For a more complex example of how bar models are used higher up the school, please see the video:

https://www.youtube.com/watch?v=PEAoJUYELtk