A guide for parents and teachers

Bond Blocks Out of the Box

Building Strong Mathematical Foundations

Linked to the Australian Curriculum

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Narelle Rice
& Dr Paul Swan

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Bond Blocks - Out of the Box

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Thank you to Daniel Swan for design.

Thank you for purchasing Bond Blocks.
We hope they help build

Curiosity,

Connections and

Confidence with maths.

- Narelle and Paul.

Contents

These activities can be completed with only **one set of Bond Blocks**.

Activities and Curriculum Links

Counting

Activity	Year	Australian Curriculum Links
Counting Forwards to 10	K	• (WA Kindergarten Curriculum – 4 year olds) • Recite number names in order, initially to 5, then to 10 consistently. • Recall what is missing ... 1 to 10. • Recognise numerals initially to 5,and then to 10 and begin to order them.
Counting Forwards to 20	F	• **ACMNA001:** Establish understanding of the language and processes of counting by naming numbers in sequences, initially to and from 20, moving from any starting point. • **ACMNA002:** Connect number names, numerals and quantities, including zero, initially up to 10 and then beyond • **ACMNA004:** Copy, continue and create patterns with objects and drawings.
Counting Backwards from 10	F	• **ACMNA001, ACMNA002, ACMNA004**
Counting Backwards from 20	F	• **ACMNA001, ACMNA002, ACMNA004**
Counting Forwards by two (even numbers)	1	• **ACMNA012:** Skip count by twos... starting from zero • **AMNA035:** Describe patterns with numbers and identify missing elements.
	2	• **ACMNA026:** Investigate number sequences, initially those increasing and decreasing by twos... from any starting point. • **ACMNA035:** Describe patterns with numbers and identify missing elements.
	3	• **ACMNA051:** Investigate the conditions for a number to be odd or even and identify odd and even numbers. • **ACMNA060:** Describe, continue, and create number patterns resulting from performing addition or subtraction.
Counting Backwards by two (even numbers) Counting Forwards by two (odd numbers) Counting Backwards by two (odd numbers)	2	• **ACMNA026:** Investigate number sequences, initially those increasing and decreasing by twos... from any starting point. • **ACMNA035**
	3	• **ACMNA051** • **ACMNA060**

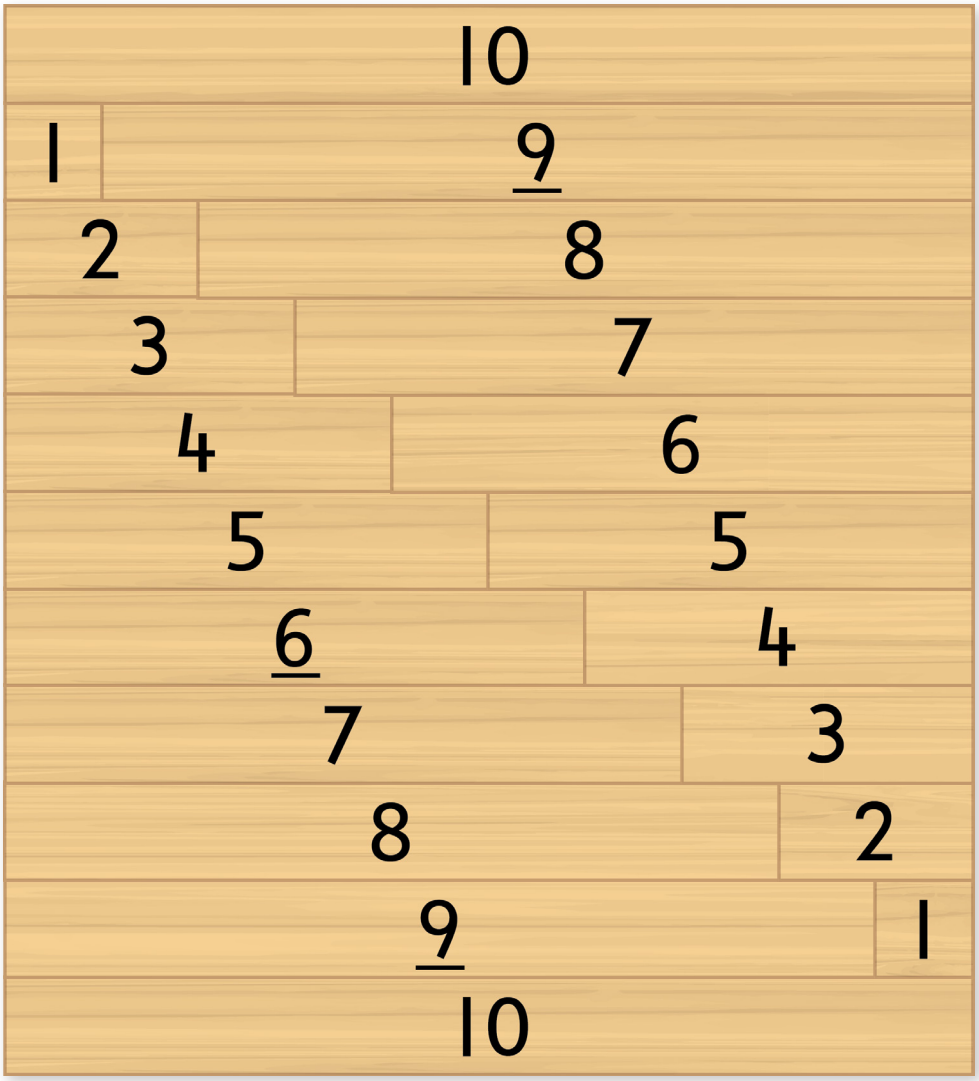
Addition and Subtraction

Activity	Year	Australian Curriculum Links
Linear Ten and Empty Ten Frame Blocks	1	• **ACMNA015:** Represent and solve simple addition and subtraction problems using a range of strategies including counting on, partitioning and rearranging parts.
Know Basic Facts	1	• **ACMNA015**
	2	• **ACMNA029:** Explore the connection between addition and subtraction.
	3	• **ACMNA055:** Recall addition facts for single-digit numbers and related subtraction facts to develop increasingly efficient mental strategies for computation.
Understand Addition and Subtraction Concepts and Relationships	2	• **ACMNA029** • **ACMNA030:** Solve simple addition and subtraction problems using a range of efficient mental and written strategies. • **ACMNA036:** Solve problems by using number sentences for addition or subtraction.
	3	• **ACMNA054:** Recognise and explain the connection between addition and subtraction.
Calculating Strategies	1	• **ACMNA015**
	2	• **ACMNA030.**
	3	• **ACMNA055:** Recall addition facts for single-digit numbers and related subtraction facts to develop increasingly efficient mental strategies for computation.

The Bond Block Set

Bond Blocks include two of each linear block 1 to 9, four linear 10 blocks, two blank five blocks and a marked and blank empty ten frame block.

Linear Bond Blocks



Linear Ten Blocks
(join to make twenty)

Blank Five Blocks
Use as a linear ten or empty ten frame.

Empty Ten Frame Blocks

Bond Block Features

Bond Blocks are a **representational manipulative** that have been designed to help students move **from counting to calculating** with numbers.

They are a **representational manipulative** because the quantity of the number is represented by:

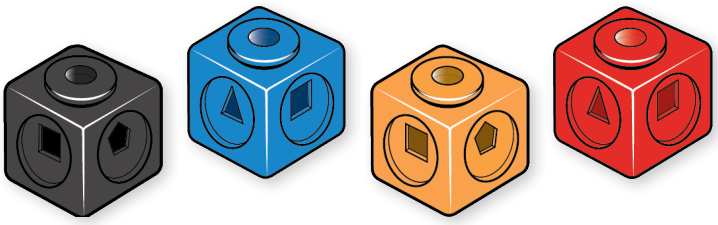
i. The length of the block and
ii. The written number on the block.

They are **not scored** with individual unit lines.

The **length** of the block helps develop the concept of a mental number line.

The **natural wood** (sustainably sourced from New Zealand pine) reduces the distraction of coloured plastic and focuses attention on the **written number**.

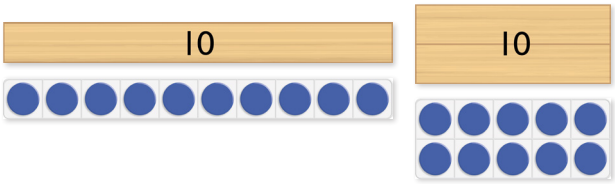
They can be used with other common manipulatives, such as 2 cm cubes because they match in size.



Bond Blocks are **self-checking**.

Linear Ten Block
Similar to ten strip.

Empty Ten Block
Similar to ten frame.

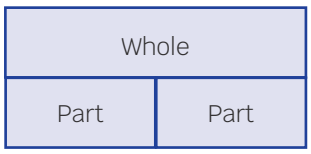


Number Bonds

The term bond refers to the parts that join to make a whole.

Number Bonds are also referred to as **Number Facts** and **Fact Families.**

This diagrammatic concept is known by a number of names including **'part-part-whole'**, **'bar model maths'** and **'Singapore maths'**.



Parts BOND together to make a whole.

Concrete-Representational-Abstract

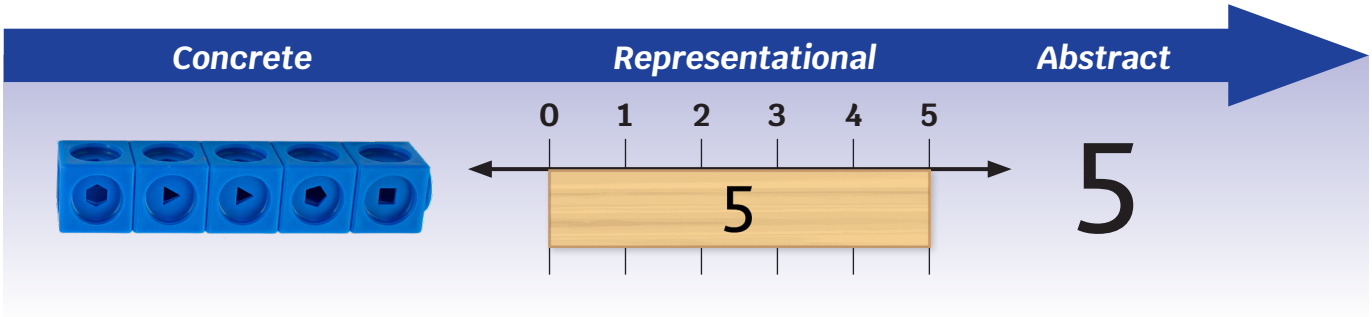
Bond Blocks are used within a **Concrete-Representational-Abstract** approach to teaching.

Counting

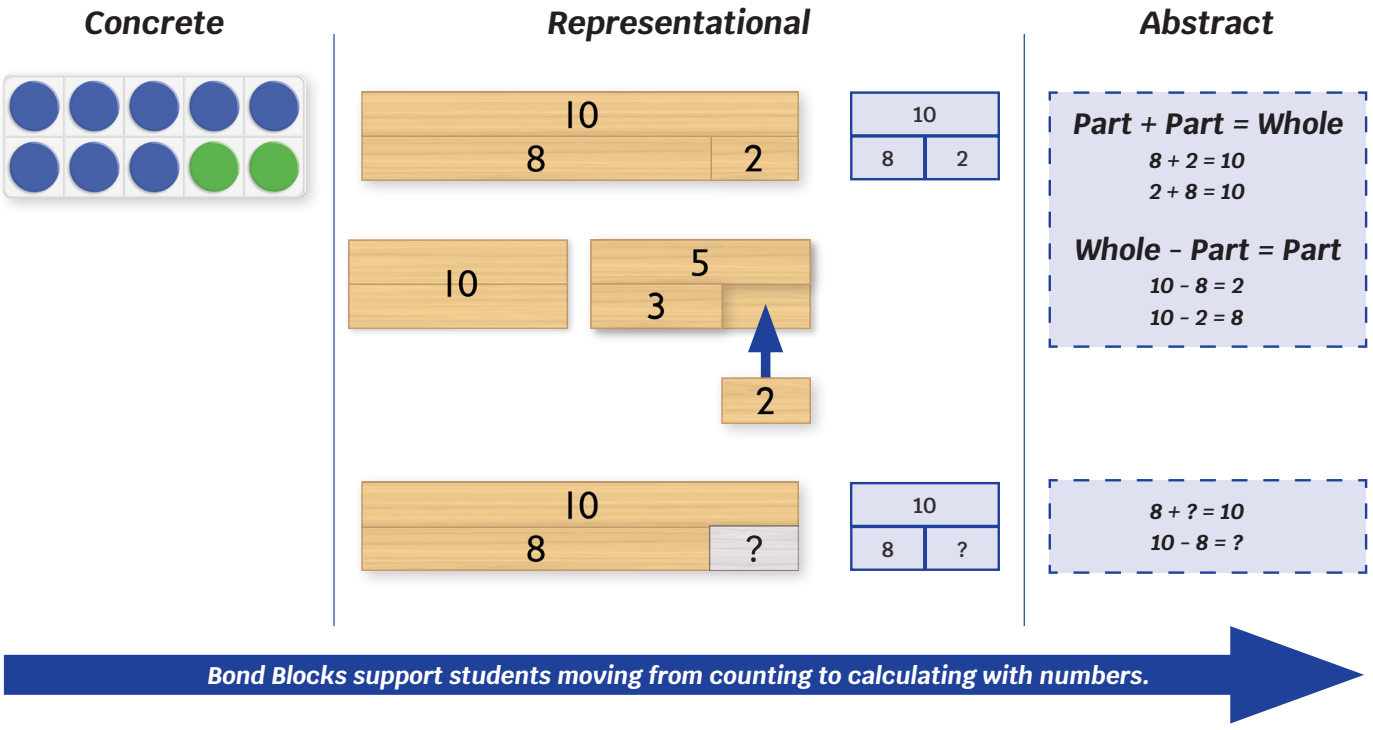
Before using Bond Blocks students need to be confident counting up to 10 discrete objects using the first three counting principles (Gelman & Gallistel, 1978).

i. **The stable order principle:** Number names are said in the conventional order.
ii. **The one-one principle:** Each item is counted once as the corresponding word is said.
iii. **The cardinal principle:** The last number said indicates the total for the group.

Begin using Bond Blocks in conjunction with discrete objects that can be counted with one-to-one correspondence. Bond Blocks were designed to be the **same size as standard 2 cm cubes** for this reason. This follows Bruner's (1966) pedagogical principle of moving from Concrete to Representational to Abstract.



Adding and Subtracting



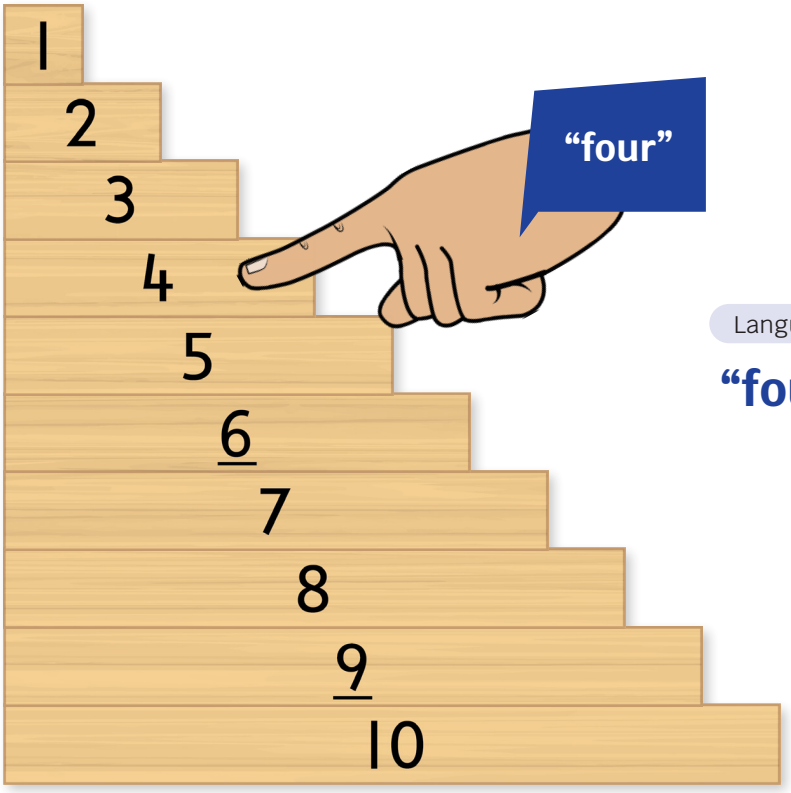
Bond Blocks support students moving from counting to calculating with numbers.

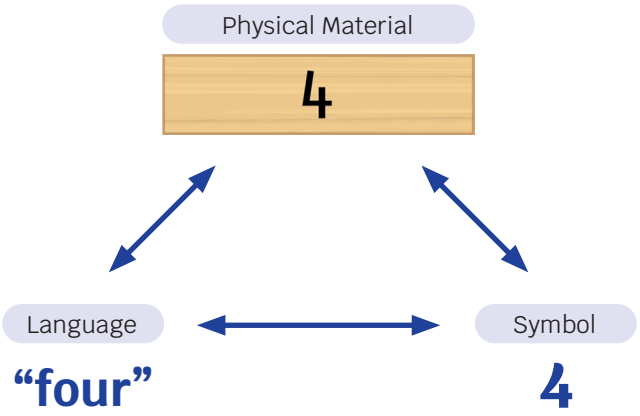
Gelman, R. & Gallistel, C. (1978) The Child's Understanding of Number. Cambridge, MA. Harvard University Press.

Bruner, J. S. (1966). Toward a theory of instruction. Cambridge: Harvard University Press.

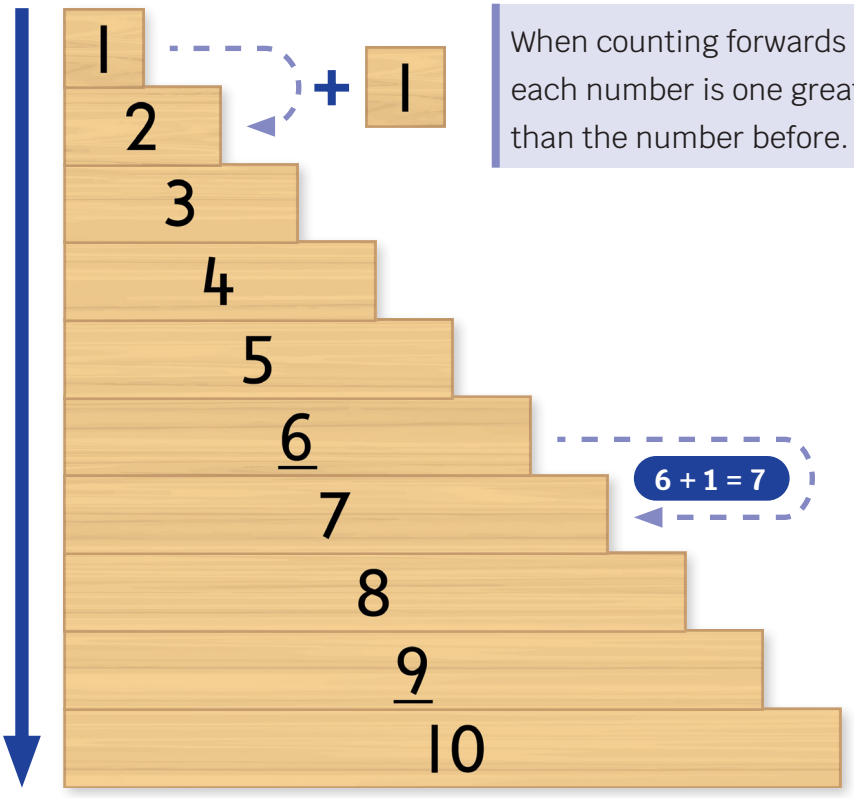
Counting Forwards

Build a set of steps from 1 to 10.
Count forwards.
Make sure students **touch the block**, next to the number, **as they count**.



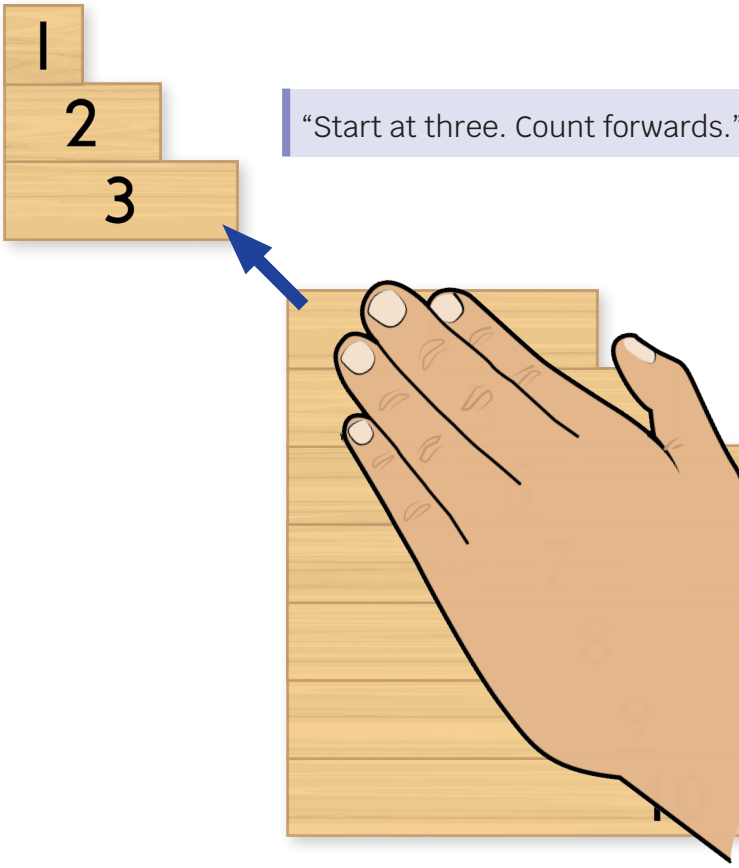


Doing this helps students connect the physical material with the language and symbols.



When counting forwards by one each number is one greater than the number before.

It is important to start counting at numbers other than 1.
Split the steps and count forwards starting at different numbers.

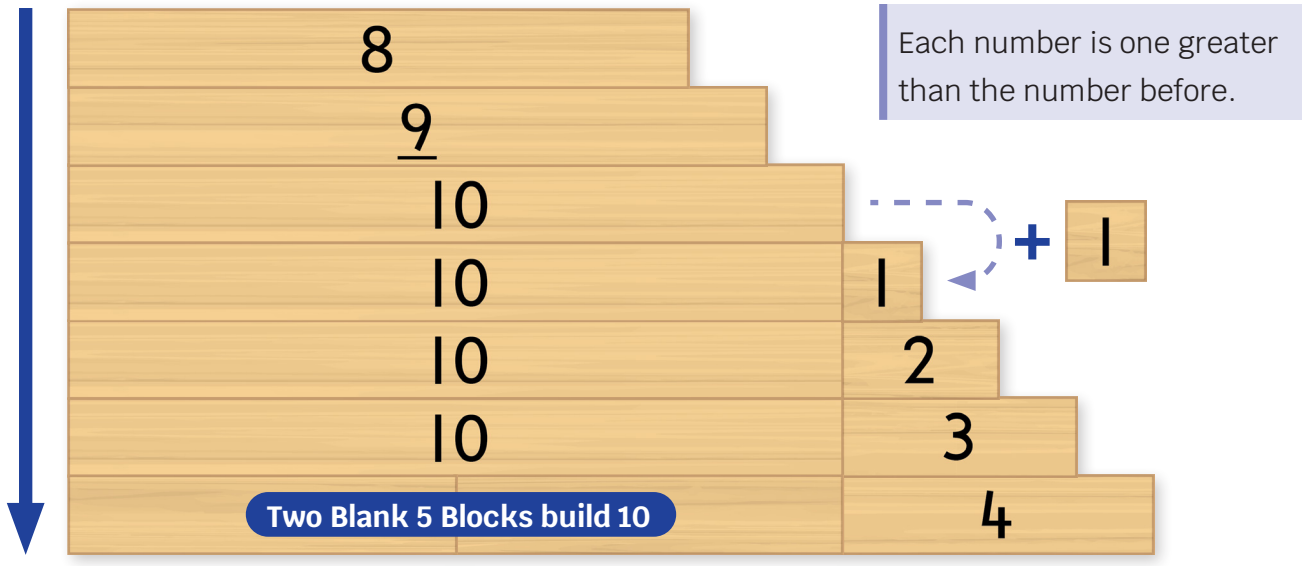


"Start at three. Count forwards."

The teacher covers the blocks to be counted.
The teacher returns each block to the steps, **immediately AFTER** the child has said the missing number.

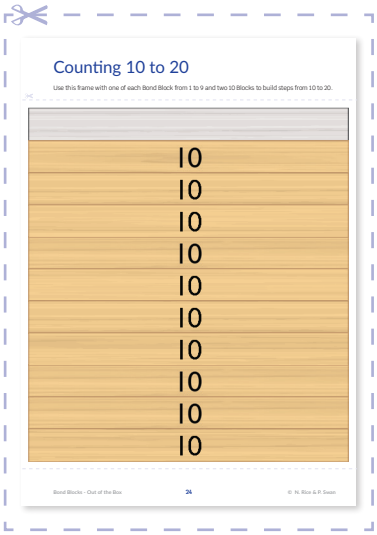
Counting, without seeing the number on the block, like this is different to the previous activity and harder.

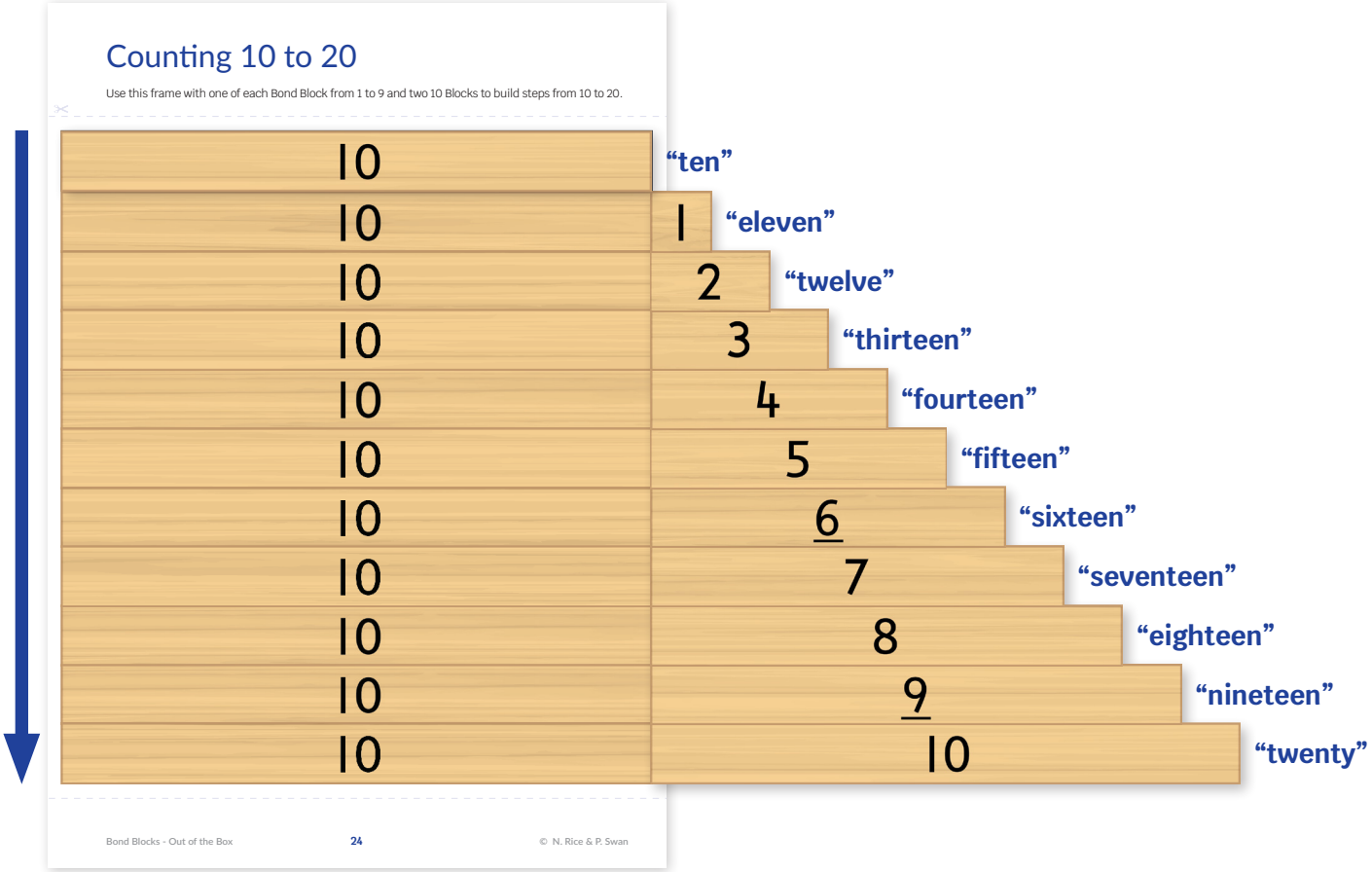
After students can confidently count to 10 from any number use one set of Bond Blocks to extend counting forwards to 14.



Each number is one greater than the number before.

Bond Blocks can be used to count from 10 to 20.
Cut out this template at the end of the guide.



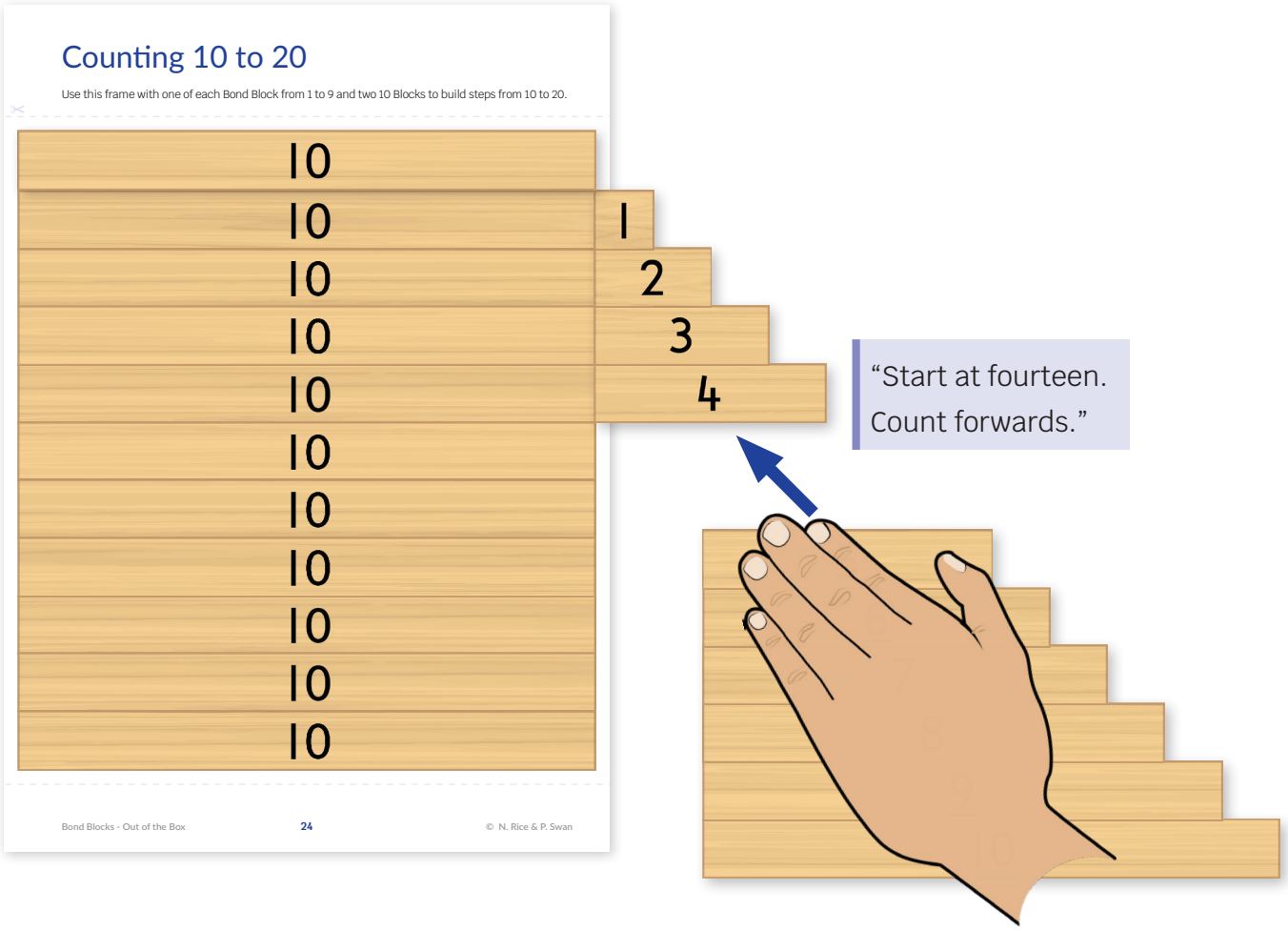


Make sure students touch the block, next to the number, as they count.

When using Bond Blocks to count from 10 to 20 students have to place the block to the right of the printed tens. This highlights how these two-digit numbers are made up of 10 add another amount (the Bond Block placed).

Note: The teen numbers, 14, 15, ... 19 are said "right to left". This is different to all other numbers. For example, 34 is said "left to right" according to place value. However, when reading 13, the three is said first. Hand gestures can support students to say teen numbers.

After students can count confidently forwards from 10 to 20, it is important that they learn to count to 20 ***starting from different numbers*** between 10 and 20.



The teacher covers the blocks to be counted. The teacher returns each block to the steps, **immediately AFTER** the child has said the missing number.

Counting Backwards

Repeat the sequence of counting forwards activities with counting backwards.

Count backwards orally pointing to the matching Bond Blocks:

i. From 10 to 1.

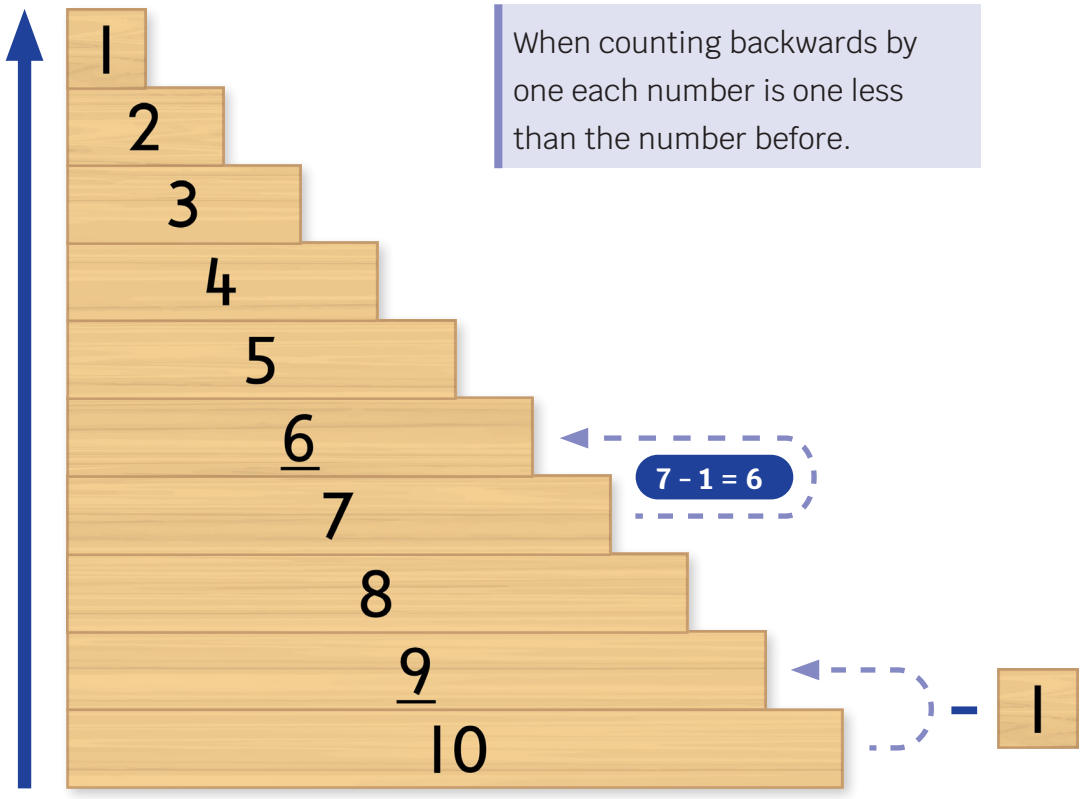
ii. Starting at any number less than 10, to 1.

iii. From 14 to 1.

iv. From 20 to 10.

v. From 20 to 10 starting at any number between 10 and 20.

Counting Backwards from 10 to 1



When we change the activity from counting forward to counting backwards we do things in the reverse order. Mathematicians call this the “inverse”.

Counting backwards is harder for students than counting forwards so we need to give them more time to practise counting backwards.

Bond Blocks can be used flat on a table to count backwards.
However, when Bond Blocks are used to build up like a tower, students are forced to find a shorter block for each step. In doing so they create a counting backwards sequence!

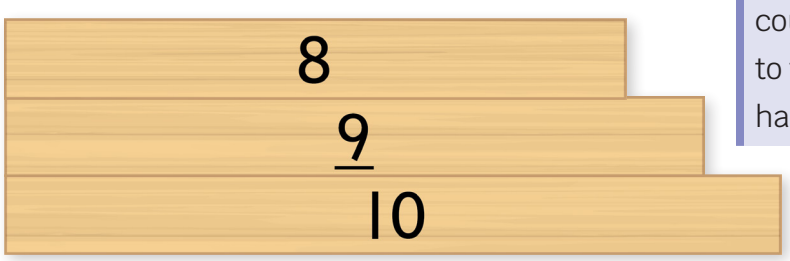
Steps (horizontal)

Tower (vertical)

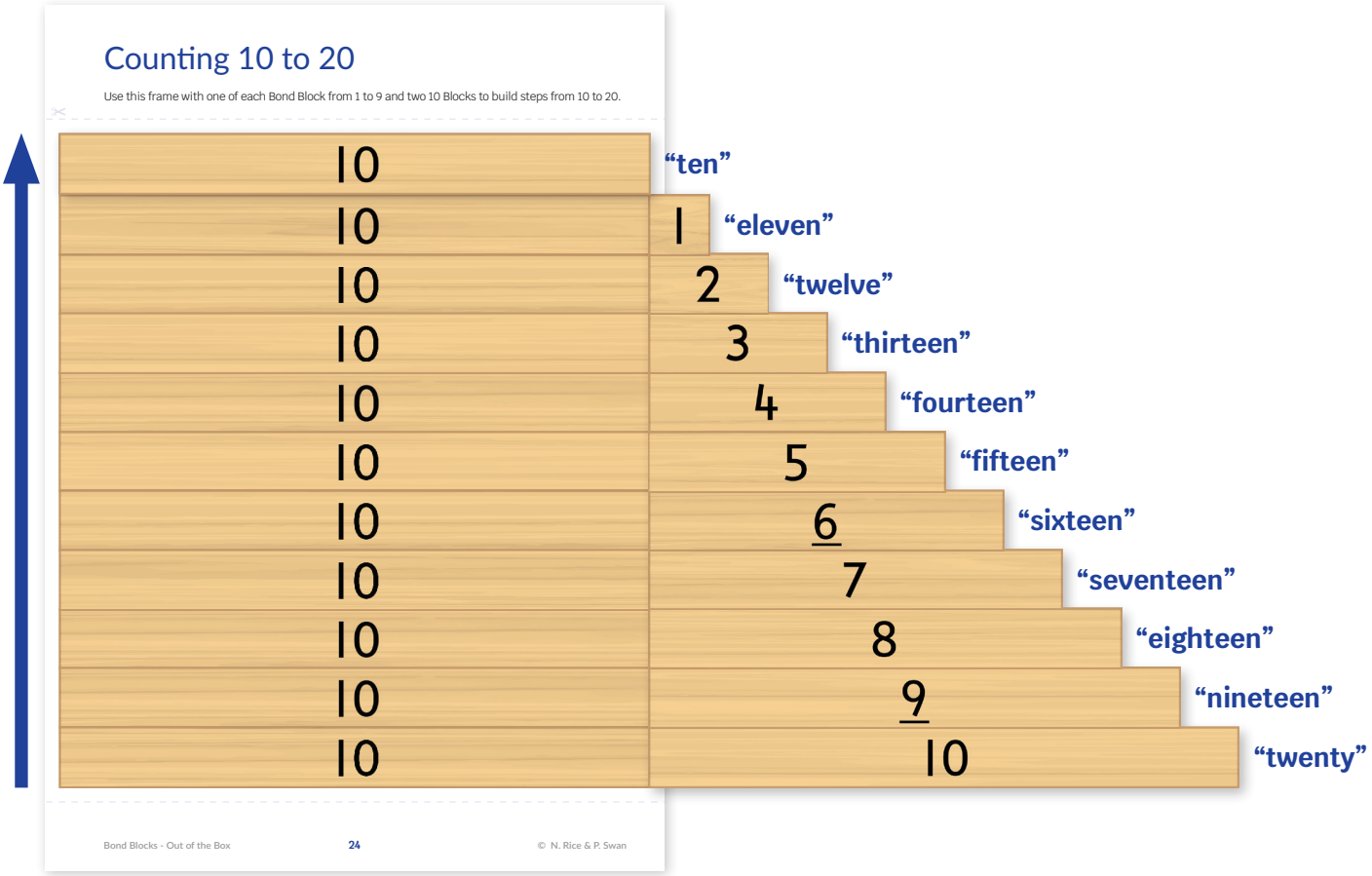
Counting Backwards Starting at any number less than 10, to 1

"Start at eight. Count backwards by one."

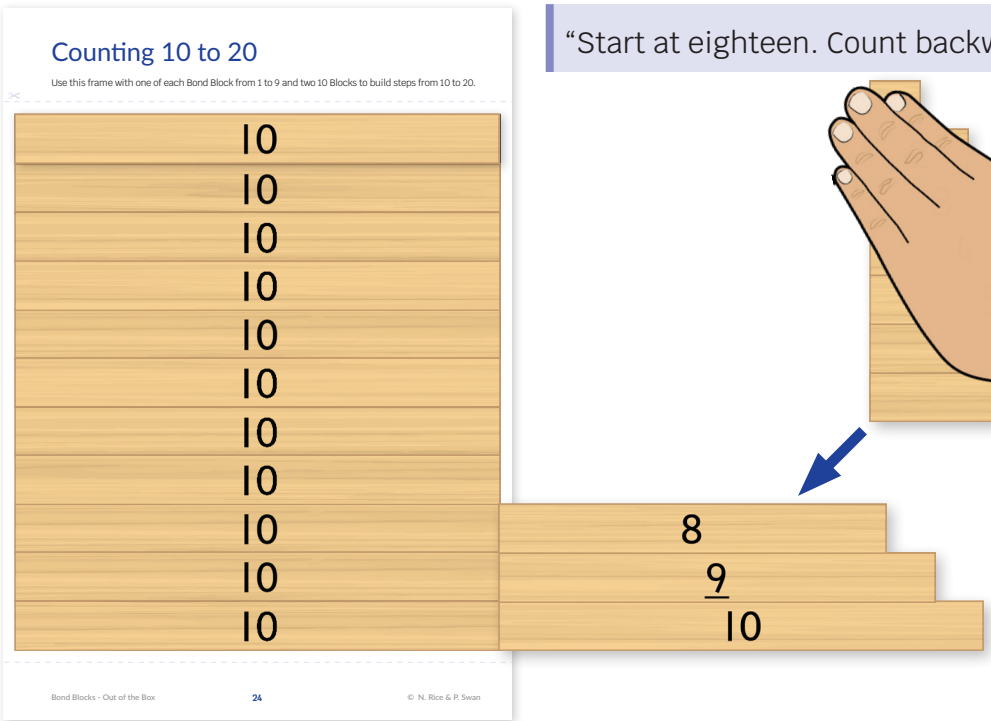
The teacher covers the blocks to be counted. The teacher returns each block to the steps, **immediately AFTER** the child has said the missing number.



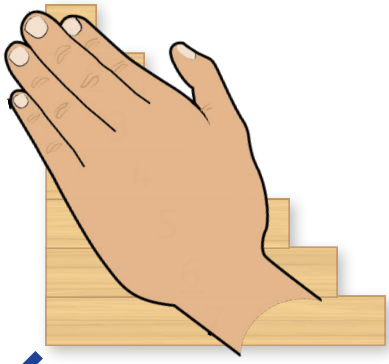
Counting Backwards from 20 to 10



Counting Backwards from 20 to 10, starting at any number between 10 and 20



"Start at eighteen. Count backwards by one."



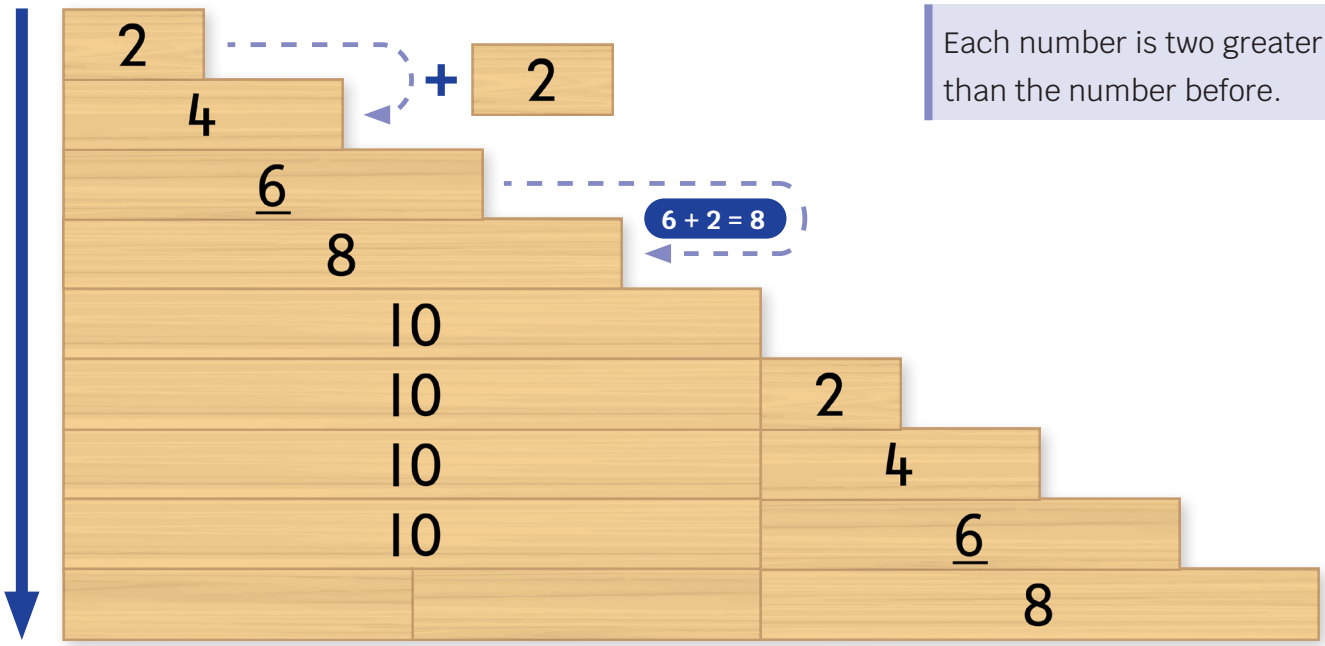
The teacher covers the blocks to be counted. The teacher returns each block to the steps, **immediately AFTER** the child has said the missing number.

Counting by Two with Even Numbers

We can count forwards by numbers other than one.

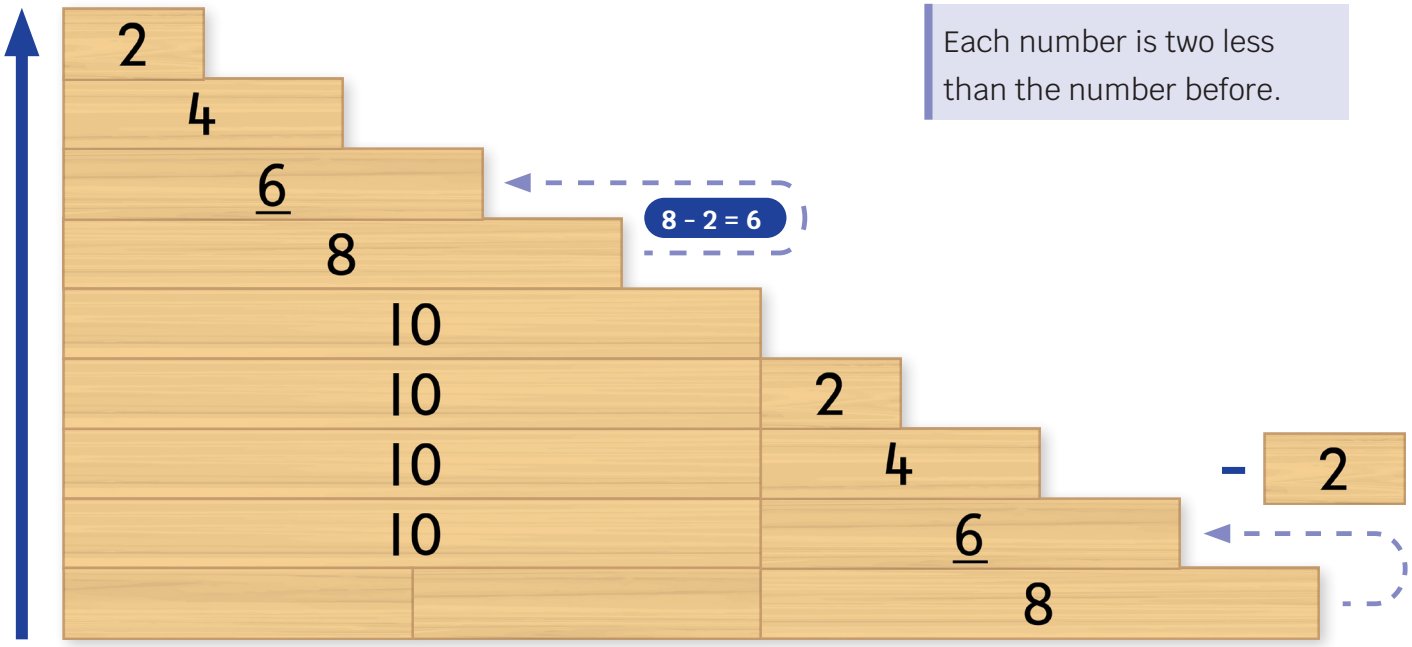
By adding two each time, starting at two, we make even numbers.

When we keep counting past 10 we can see a pattern in the last block added of 2, 4, 6, 8, 0 repeating.



Each number is two greater than the number before.

Once students can count confidently forwards by two with even numbers, extend the sequence to counting backwards.



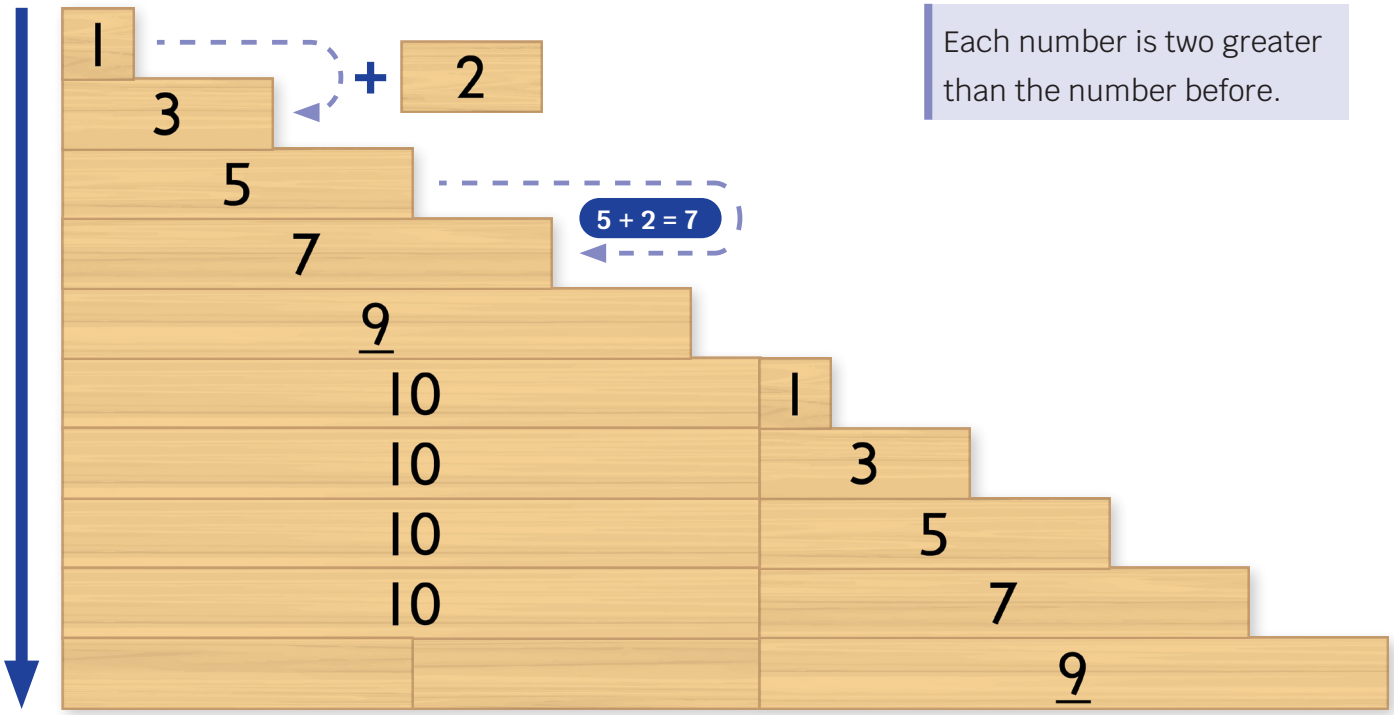
Each number is two less than the number before.

Counting by Two with Odd Numbers

We can count by two with a different set of numbers.

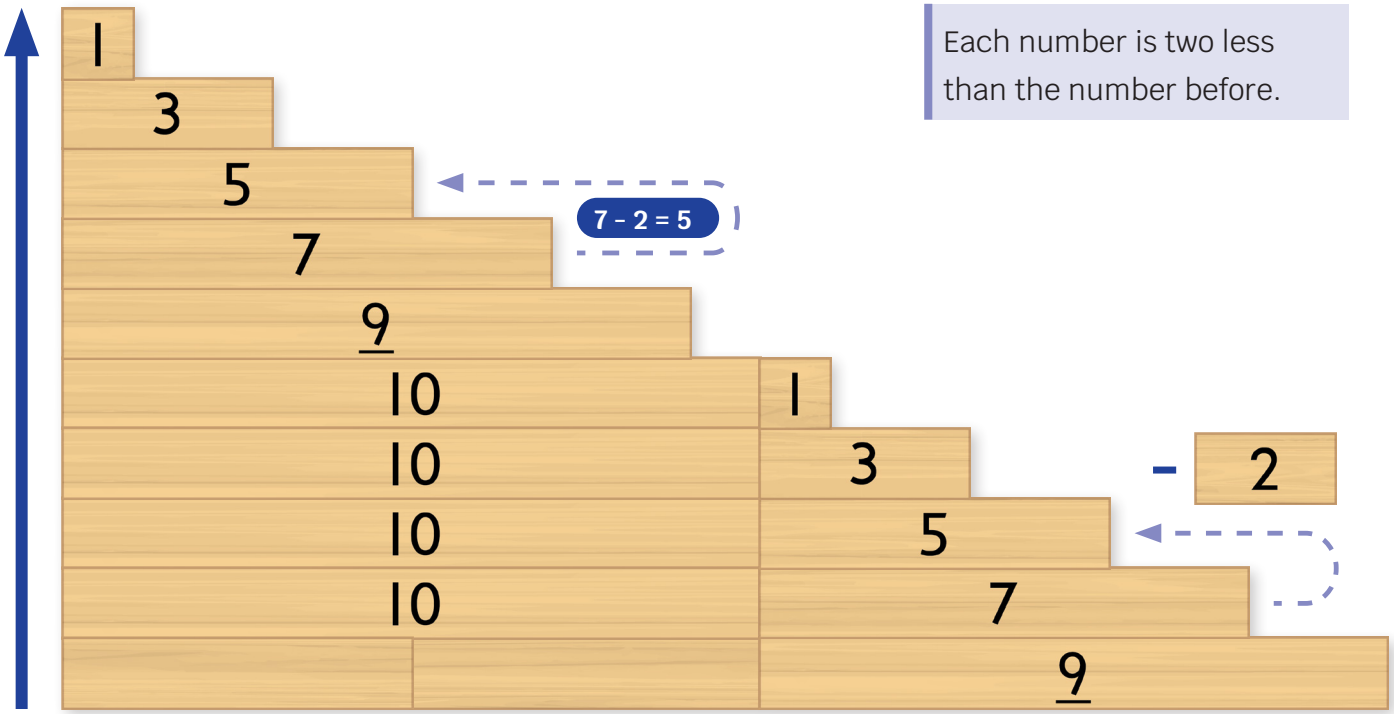
By starting at one and adding two repeatedly we make odd numbers.

The repeating pattern of the last block added is 1, 3, 5, 7, 9.



Each number is two greater than the number before.

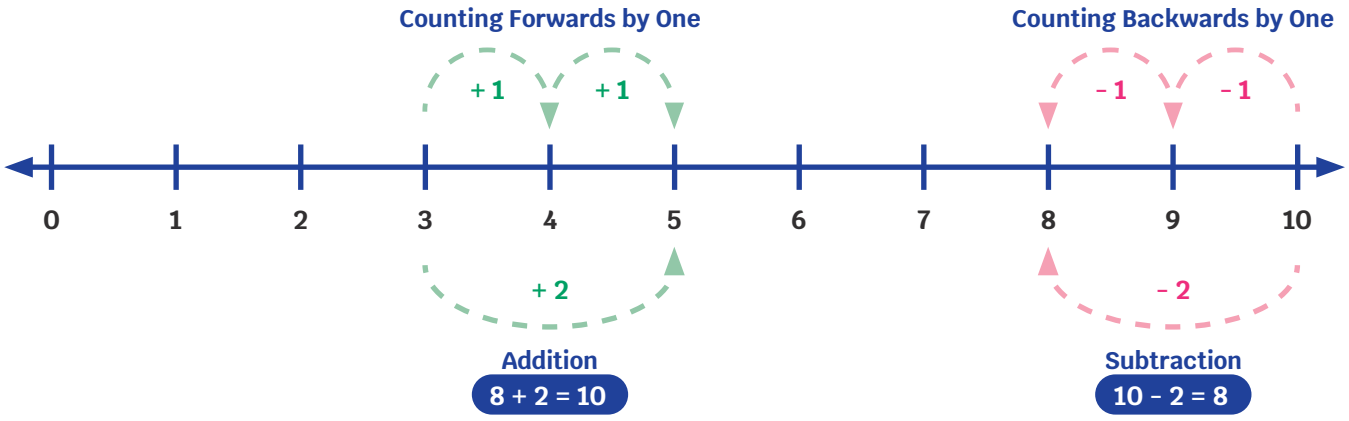
Once students can count confidently forwards by two with odd numbers, extend the sequence to counting backwards.



Each number is two less than the number before.

Linear Ten and Empty Ten Frame Blocks

Bond Blocks are a linear (length) design based on our number system. For example,

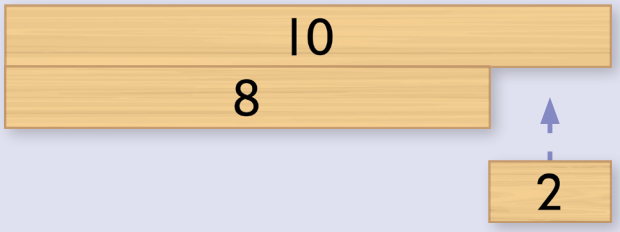


In the Bond Blocks set there are two different blocks that are used to represent ten. One is a Linear Ten. The other is different. It is called an Empty Ten Frame.

Linear Ten (similar to a ten strip)

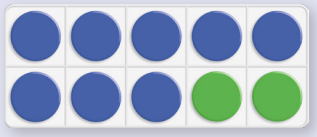
Ten strip showing 8 and 2.

For example, ***"8 add 2 equals 10."***

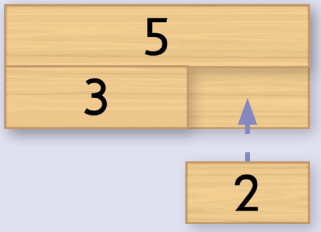


Empty Ten Frame (similar to a ten frame)

Ten frame showing 8 and 2.



For example, ***"8 add 2 equals 10."***



* 8 shown as 5 and 3.

The Blank (non-numbered) fives can be used to show how the Linear Ten and Empty Ten Frame blocks are related.

Two Blank Five Blocks make a **Linear Ten Block**

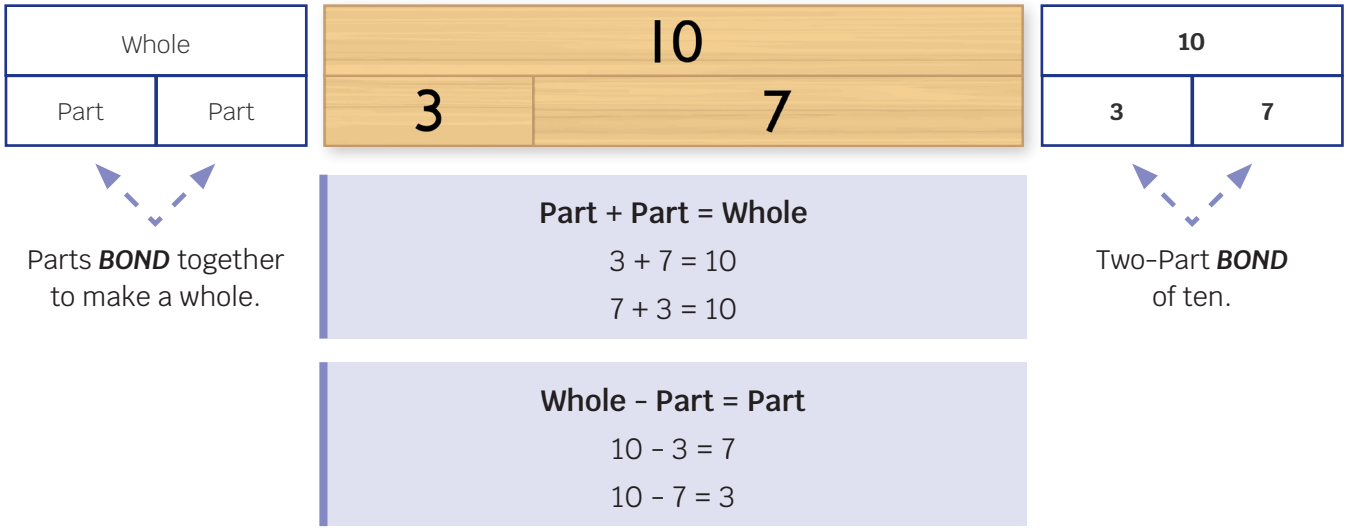
Two Blank Five Blocks make an **Empty Ten Frame Block**

Number Bonds

Bond Blocks were designed to help students develop efficient addition and subtraction.
Research shows that students need three things to be able to add and subtract efficiently:

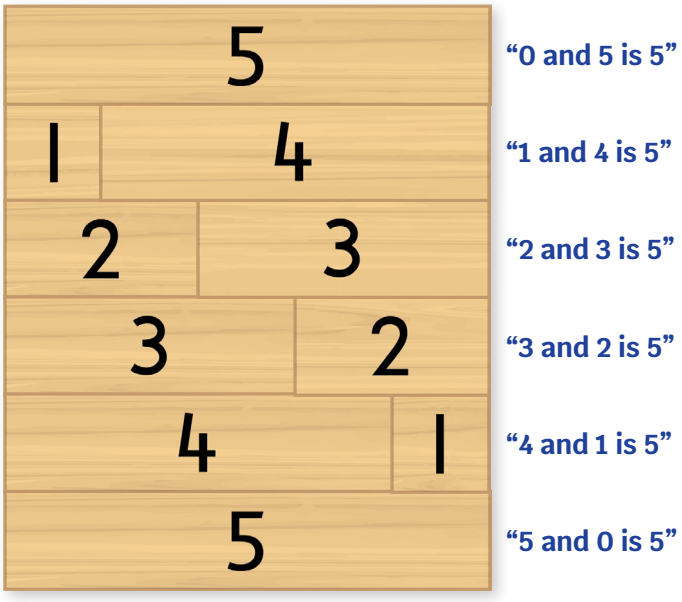
1. Know basic facts

Basic facts are made by adding two, single-digit numbers.
Basic facts are related to subtraction.
Bond Blocks can be used to represent every basic fact, organised in a part-part whole diagram.



The term 'number bond' refers to the parts that join or 'bond' together to make a whole.

Bond Blocks can be organised in a Bond Wall to systematically find every two-part bond of a whole.
For example, the whole of 5.

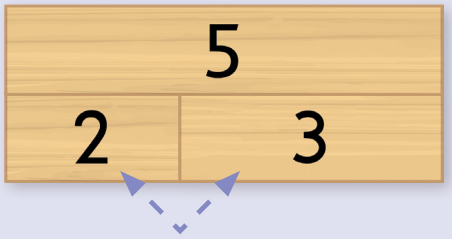


Two-Part Bonds of 5.

2. Understand addition and subtraction concepts and relationships

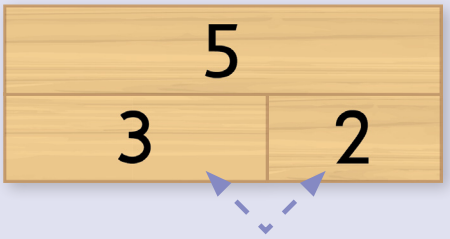
Concepts and relationships about addition and subtraction are taught through how Bond Blocks are placed and moved.

Blocks representing parts are rearranged to show the **Commutative Property of Addition**: swapping the order of the parts does not alter the size of the whole.



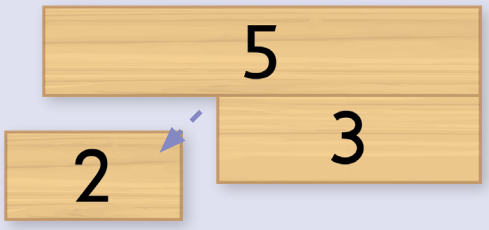
Swap to make 3 and 2.

Part + Part = Whole
so *2 + 3 = 5*
and *3 + 2 = 5*

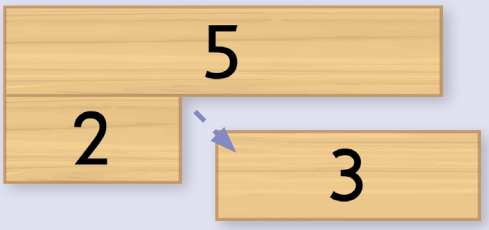


Swap to make 2 and 3.

Subtraction is not commutative. However, it is related to addition.
Mathematicians call this the inverse.

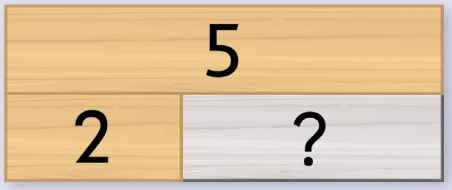


Whole - Part = Part
so *5 - 2 = 3*
and *5 - 3 = 2*



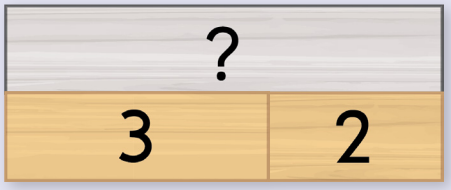
We use the relationship between addition and subtraction to find **missing numbers**.

To solve 2 + ? = 5



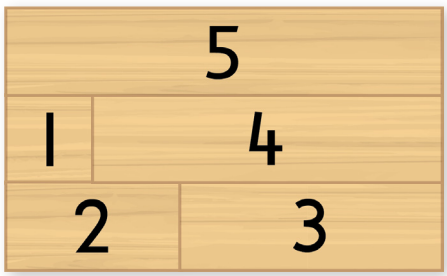
Whole - Part = Part
so *5 - 2 = ?*

To solve ? - 2 = 3



Part + Part = Whole
so *2 + 3 = ?*

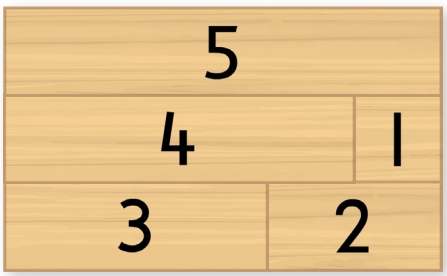
The Bond Wall is split and rearranged to show that knowing the Commutative Property of Addition almost halves the number of two-part bonds we need to remember used for addition and subtraction.



"0 and 5 is equal to 5 and 0"

"1 and 3 is equal to 4 and 1"

"2 and 3 is equal to 3 and 2"



3. Calculating strategies

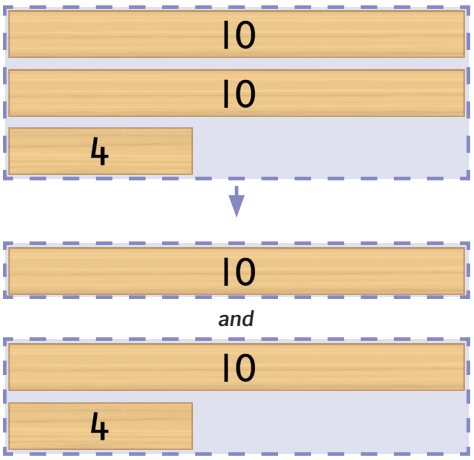
Students combine (i) knowledge of basic facts with (ii) understandings about addition and subtraction relationships, to develop efficient strategies to add and subtract with numbers larger than basic facts.

Partitioning: Splitting up numbers to make adding and subtracting easier.

7 + 5 partitioned as ***5 + 5 + 2***

Blocks rearranged to build ***10 + 2***

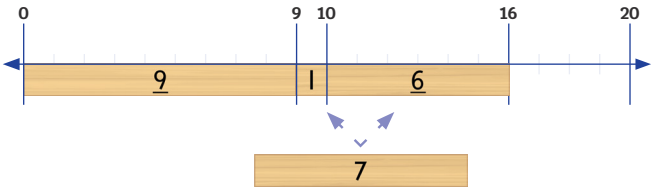
24 – 10, partition the whole of **24** into **10** and **14.**

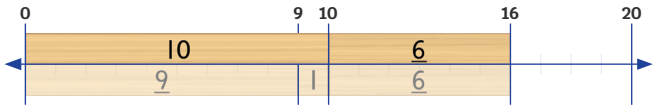


Bridging Ten: Partition one part to build a bond of 10. Organise Bond Blocks using part-part-whole.

Addition

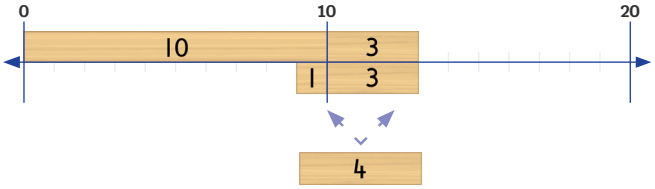
9 + 7, partition the 7 as 1 and 6, to add on bridging ten.

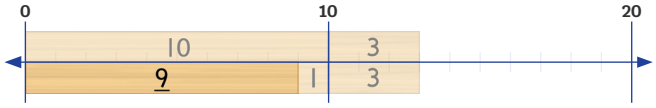




Subtraction (solved by *taking away*)

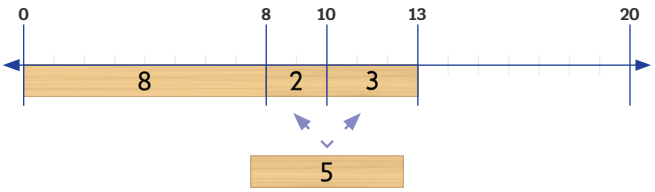
13 – 4, partition the 4 as 3 and 1, to take away bridging ten.

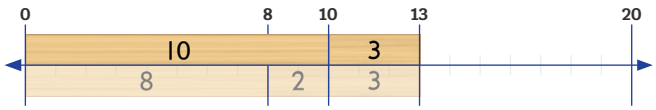




Subtraction (solved by *adding on*)

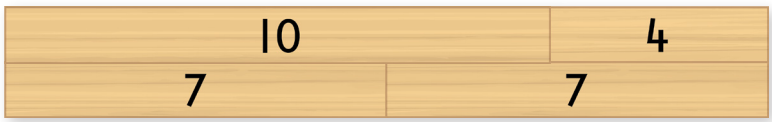
13 – 8, add on 2 to bridge 10, then add on 3, to make the parts equal to the whole.





Doubling and Halving

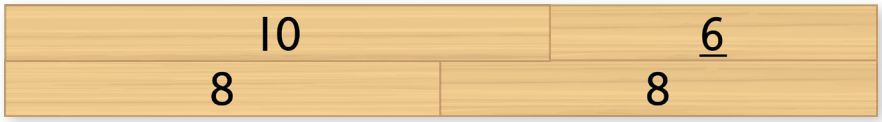
Relate a double to halving.



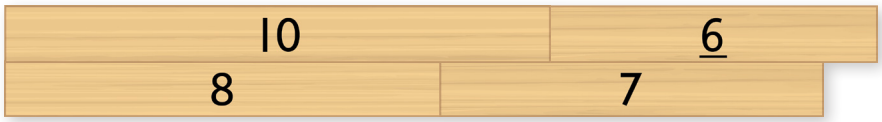
"Double 7 is 14."

"One half of 14 is 7."

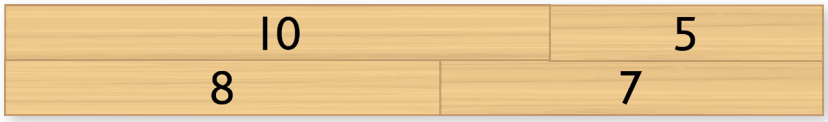
Use a double, to work out a near double. For example, ***use double 8***, to work out ***8 + 7.***



"I know 8 and 8 is 16."



"So 8 and 7 must be one less."

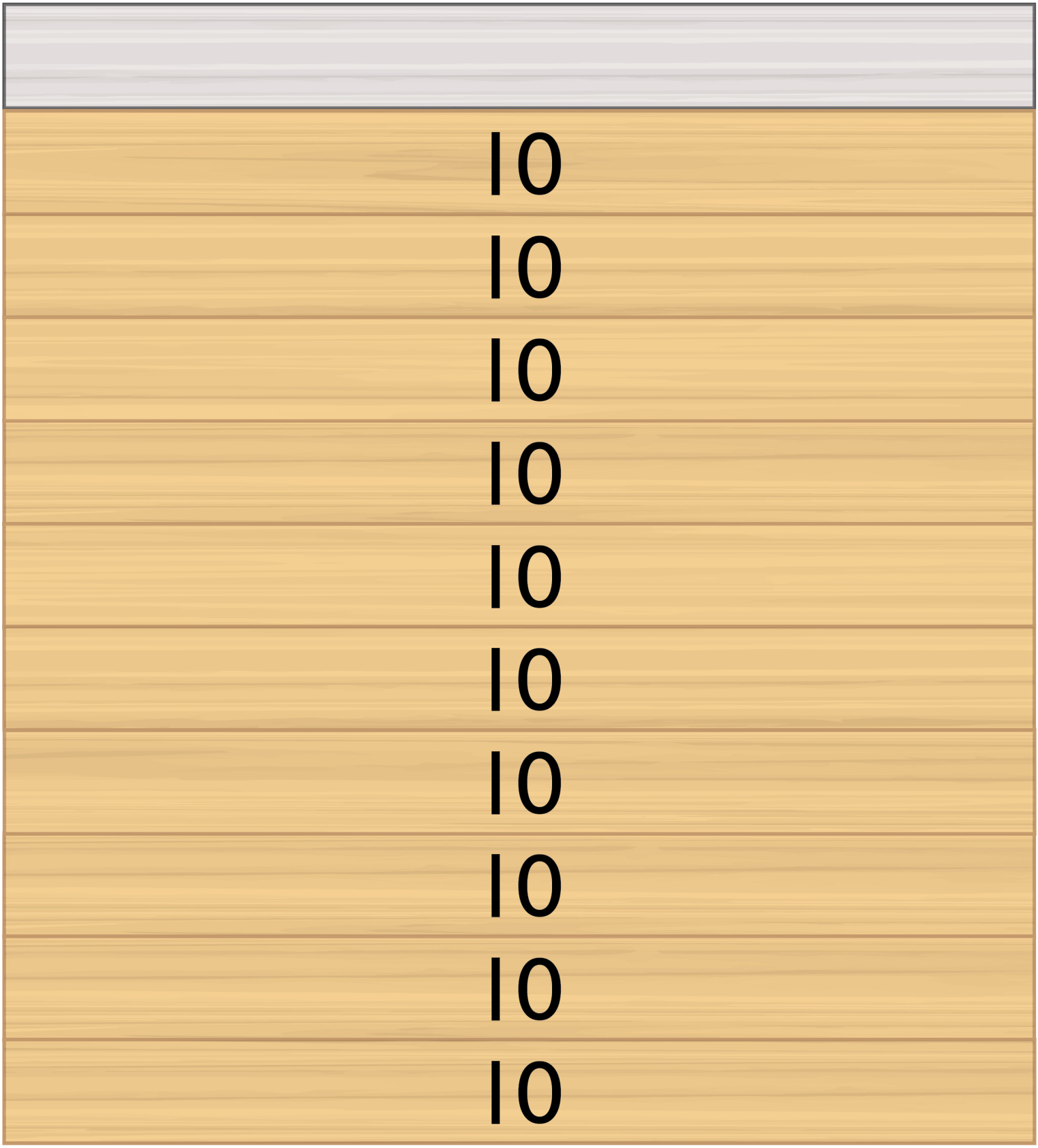


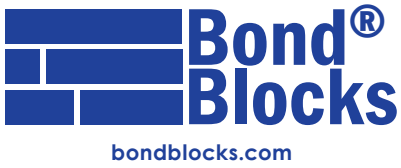
"Yes, 8 and 7 is 15."

If students can add and subtract confidently without the blocks please do not insist they use them. The goal of Bond Blocks is to make the blocks redundant.

Counting 10 to 20

Use this frame with one of each Bond Block from 1 to 9 and two 10 Blocks to build steps from 10 to 20.

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