A guide for parents and teachers.

Bond Blocks Out of the Box

2nd ed.

What to do with a single set of blocks.

Bond® Blocks
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Bond Blocks Out of the Box: What to do with a single set of blocks. (2nd ed.)

First published 2021, revised 2025
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Printed in Australia for A-Z Type
The author may be contacted at: info@bondblocks.com.au
Thank you to Leighland and Daniel Swan for design.

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

Curiosity,
Connections and
Confidence with maths.

- Narelle and Paul.

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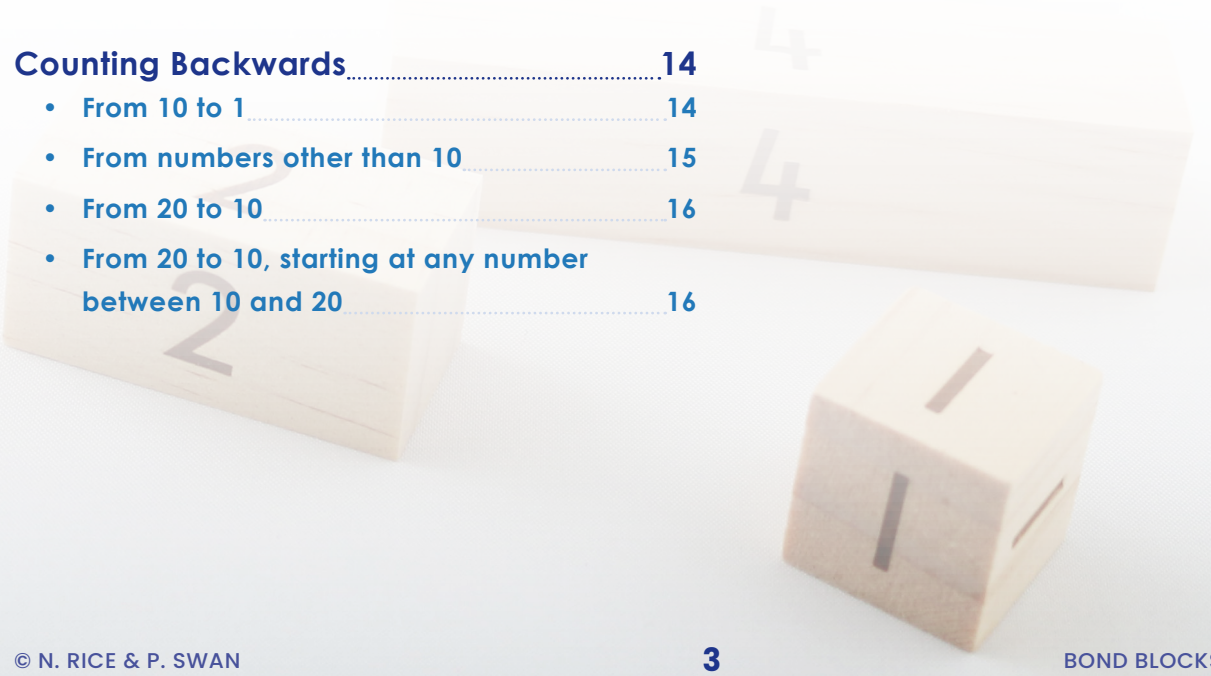
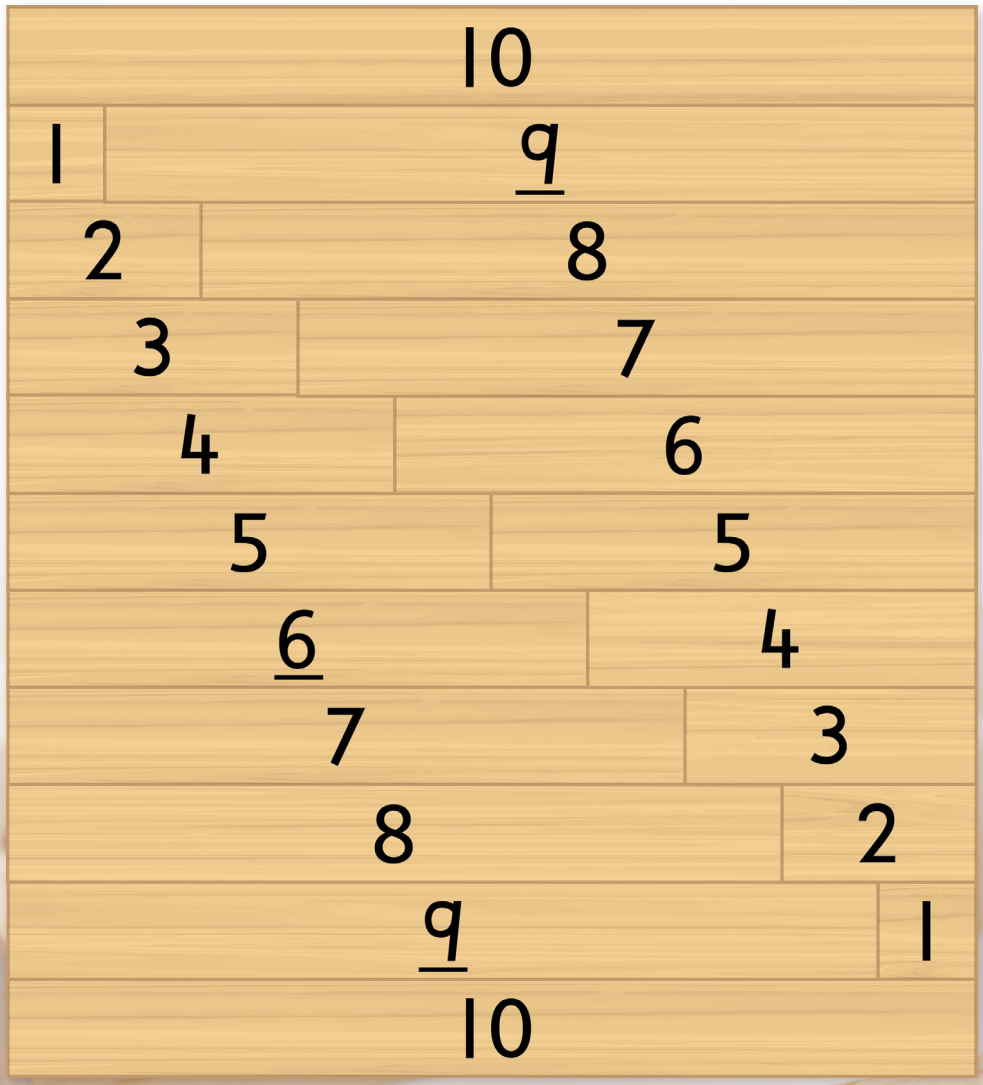


About the Blocks

A Set of Bond Blocks

A set of Bond Blocks contains:

Linear Bond Blocks



Linear Ten Blocks

(Join to make twenty)

More Linear Blocks

An extra 1, 2, 3, 4 and two 5 Blocks. Used for more complex three-part bonds when bridging ten.

Bond Block Features

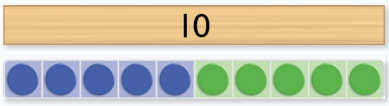
Bond Blocks are a **representational manipulative** that have been designed to help students move **from counting to calculating** with numbers.

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

1. The length of the block and
2. The written numeral on the block.

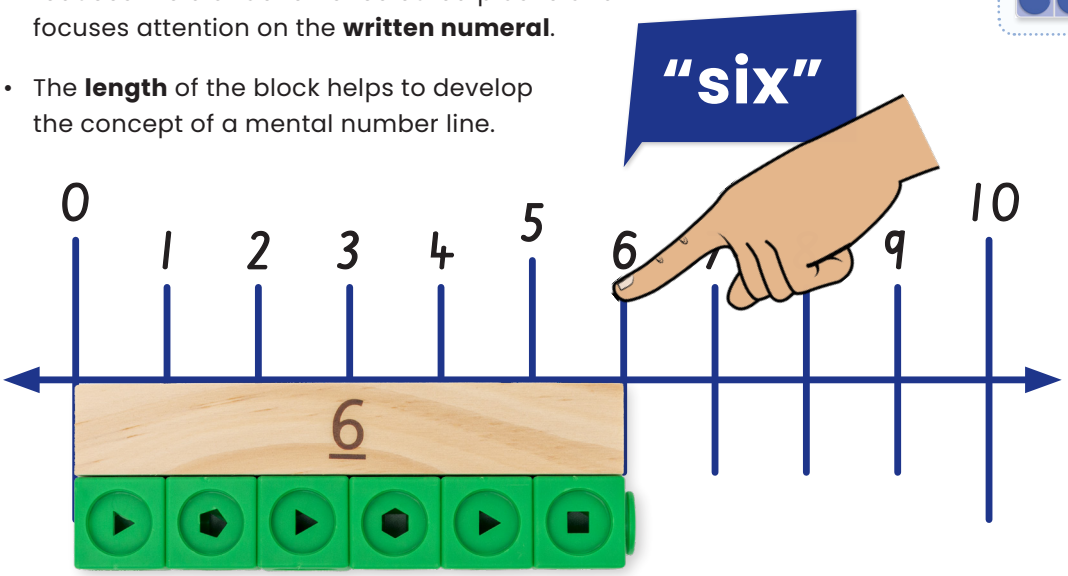
Linear Ten Block

Similar to ten strip.

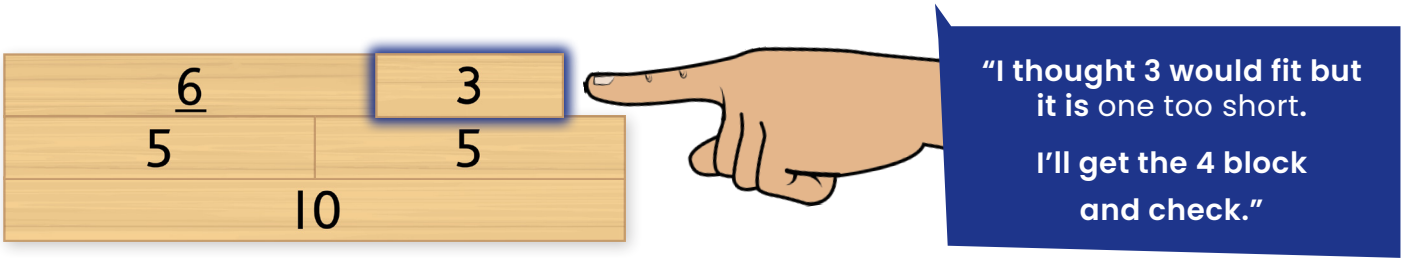


Other unique features:

- They are **not scored** with individual unit lines.
- The **natural wood** (sustainably sourced pine) reduces the distraction of coloured plastic and focuses attention on the **written numeral**.
- The **length** of the block helps to develop the concept of a mental number line.



- They can be used with other common manipulatives, such as 2 cm cubes because they match in size. They are a **ratio of one unit to 2 cm** making them easy to manipulate.
- **Self-checking.** Develop number sense and estimation using them.

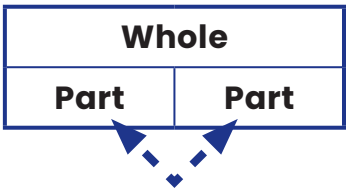


Number Bonds

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'** and **'bar model maths'**.



Parts BOND together to make a whole.

Concrete, Representational, Abstract

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

Concrete Prerequisite: Counting

Before using Bond Blocks students need to be confident counting up to 10 discrete objects using the **first three counting principles**.

1 Stable Order
Number names are said in the conventional order.

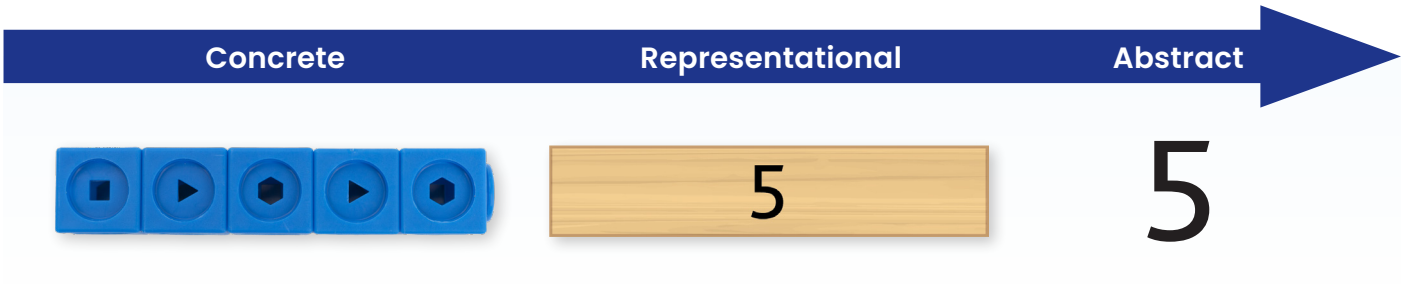
2 One-to-One Correspondence
Each item is counted once, as the corresponding word is said.

3 Cardinal Value
The last number said indicated the total for the group.

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

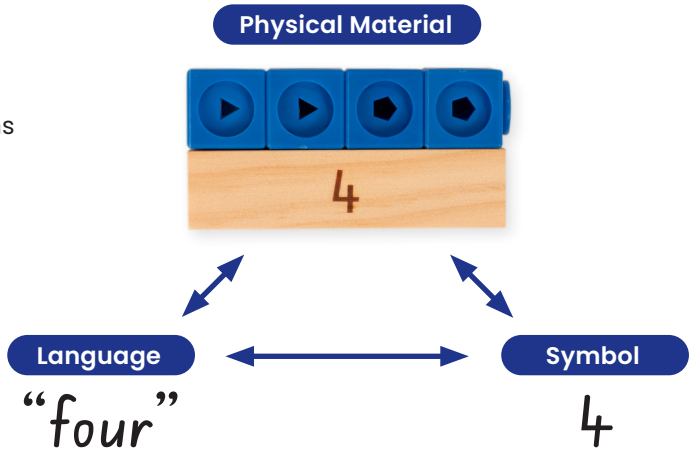
Begin using Bond Blocks in conjunction with discrete objects that can be counted with one-to-one correspondence. Bond Blocks were designed to be the same size as standard 2 cm cubes for this reason. Using discrete materials such as 2 cm cubes in conjunction with Bond Blocks helps students move towards a length based concept of number.

This follows Bruner's (1966) pedagogical principle of moving from Concrete to Representational to Abstract.



Please note that making these mathematical connections does not require students to write the number. Handwriting the number is a different fine motor skill.

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



Concrete

Most manipulatives can be counted by ones.

Many students struggle to move from counting to add and subtract at a concrete level, to fluently adding and subtracting at an abstract level.

Bridging the Gap

Representational

Bond Blocks bridge the gap from concrete to abstract because they do not have individually scored lines. Bond Blocks are a representational manipulative because:

- The length and written numeral represent the number of cubes.
- How they are arranged (using part-part-whole) and moved represents the operations of addition and subtraction.

The length base of Bond Blocks makes them self-checking.

Students say the number sentence as they manipulate the physical blocks. Connecting verbal and visual information helps students build connected schemas and effectively store information in their long-term memory.

Abstract

Adding and subtracting using numbers and symbols.

Part + Part = Whole

3 + 2 = 5

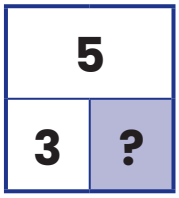
2 + 3 = 5

Whole - Part = Part

5 - 3 = 2

5 - 2 = 3

Extend with algebraic thinking.



5 - ? = 3

3 + ? = 5

Introductory Play

Opening the box

Each student needs one set of blocks. Teach students how to open a box of Bond Blocks. Before opening the clips, the box must be on a **flat surface**, with the **label facing up**. Otherwise, the blocks will spill out onto the floor.

Build

Set expectations for appropriate use of the blocks. Instruct the students to build with their set of blocks. They can use some or all of their blocks.

Talk

After building, ask students to describe their build to the teacher or another student. The teacher can draw attention to length relationships, shapes, positional language and patterns. For example,

"Tell me about what you have made."

*"Your **pyramid** looks very stable. What do you think it is that is making it so strong?"*

"These look like steps. Can you make your dinosaur climb up to the top?"

Pack away

Teach students how to pack away a set of Bond Blocks:

1. Put all of the Bond Blocks away. Use the template inside the box to make sure **no blocks are lost**. Packing away the blocks helps students develop consideration for their environment and other students who will use the blocks after them.
2. When students are ready to learn about the correct **orientation of numbers**, they should use the template to make sure blocks are not returned with the numbers upside down.
3. After the blocks are packed away, but before the lid is shut, students can practise **counting**. Students can count forwards from one or backwards from ten. Instruct students to touch the Bond Block, next to the **written numeral** as they say the **number name**.
4. Ensure that students **click shut both clips**, listening for two clicks, before they pick up the box of blocks by the handle. Otherwise, the blocks will spill out onto the floor.
5. Show students where the box of blocks live in the classroom and how to return it with the **sticker face up** and the **handle out**. This makes it easier for the next person to use the blocks.

The template inside the box includes numbers and lines to help students place the blocks away in the correct places.

Counting Forwards

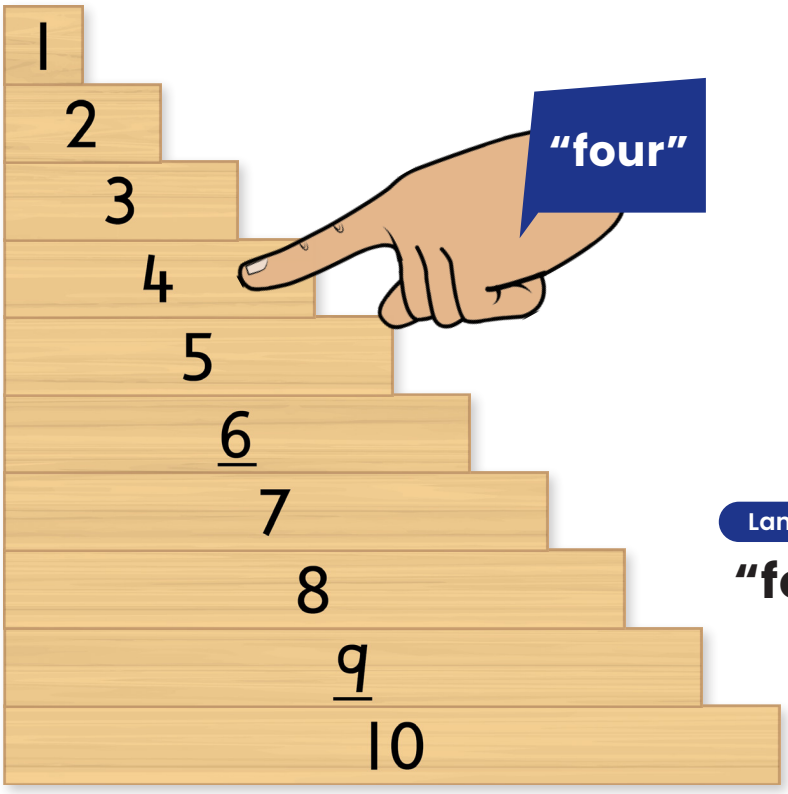
From 1 to 10

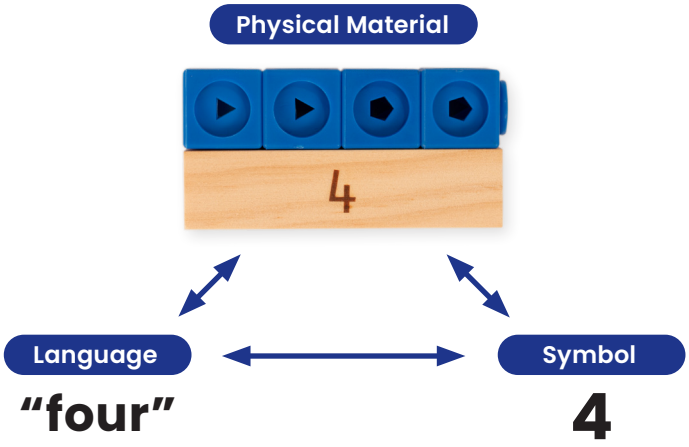
When students start building with the shortest block, to the longest, they create a counting forwards sequence. Encourage students to use their steps to **count aloud**.

"One, two, three, four, five ..."

1. Build a set of steps from 1 to 10.
2. Count forwards.

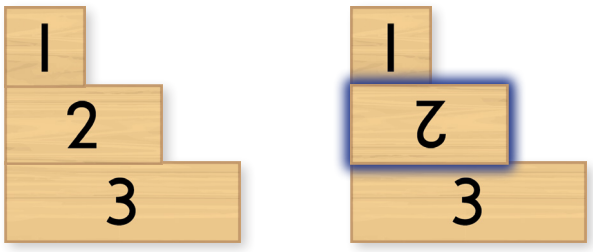
Make sure students **touch the block**, next to the number, **as they count**.
This is important because this helps students connect the physical material with the language and symbols.



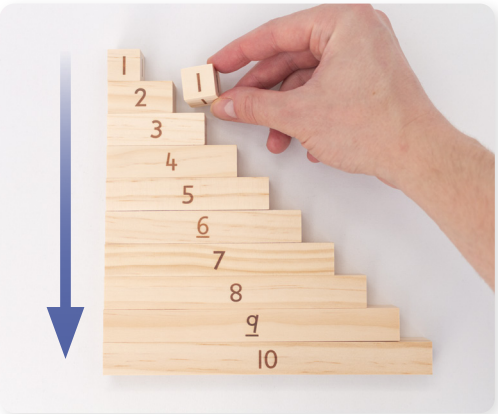


Check Numeral Orientation

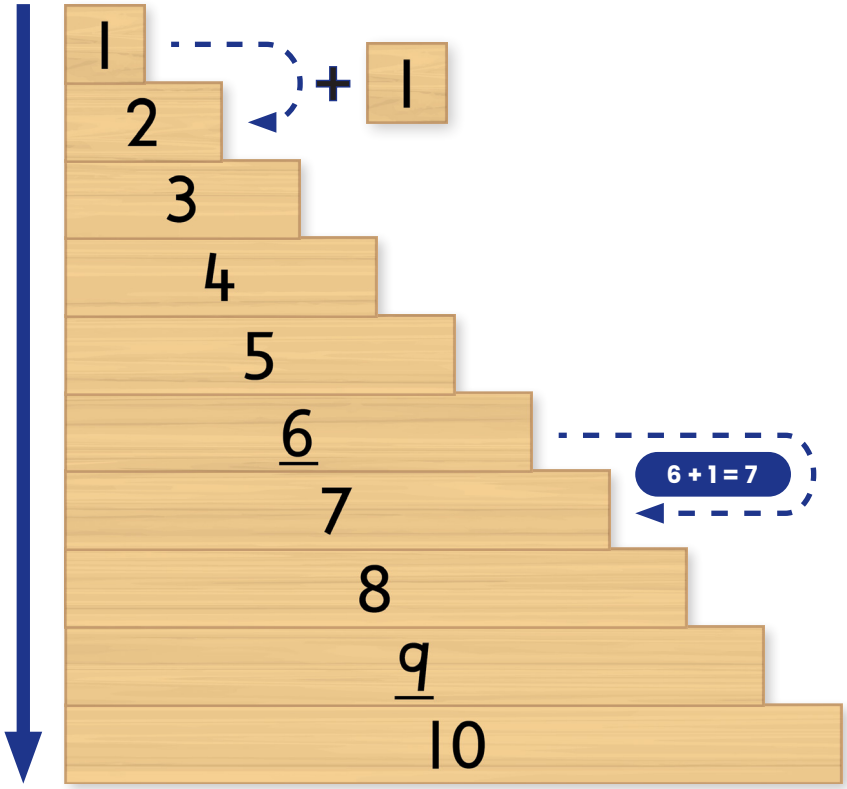
Correct number orientation by placing a second set of steps, with the numbers orientated correctly, next to the student's set. Instruct the student to identify and correct any numbers that were placed upside down.



Use the steps to show that each number in this sequence is **one more than** the number **before**.



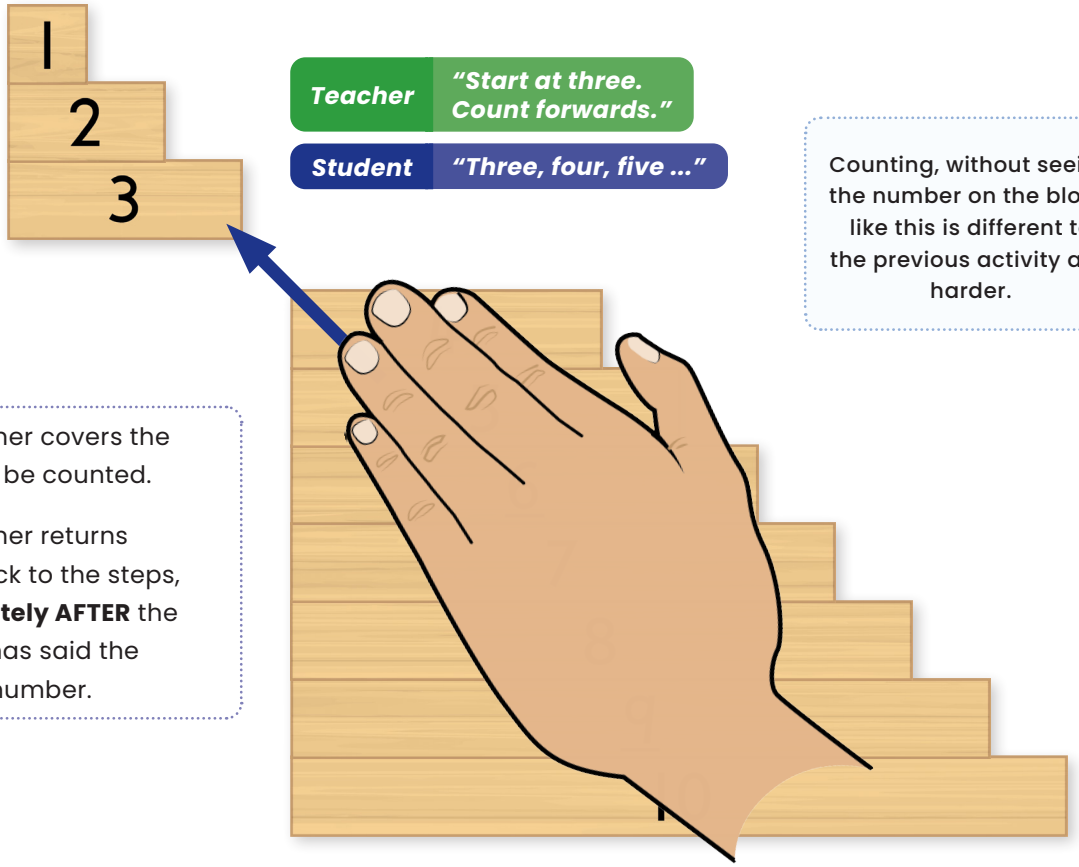
"Each number is one more than the number before."



Instruct students to **act this out** using a small figurine to jump up or down the set of steps, depending on the orientation of the blocks. Students **count aloud** as they move the figurine.

From numbers other than 1

It is important to start counting at numbers other than 1. Split the steps and count forwards starting at different numbers. For example, cover numbers 4 to 10 and instruct the student to **"start at three"** and **"count frowards"**.



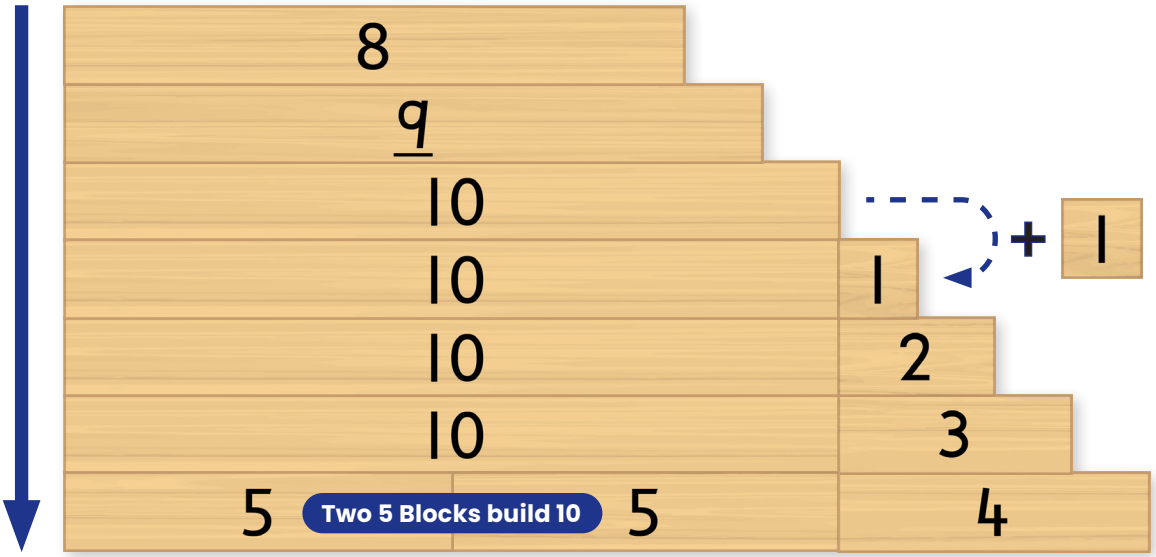
Counting, without seeing the number on the block, like this is different to the previous activity and harder.

The teacher covers the blocks to be counted.

The teacher returns each block to the steps, **immediately AFTER** the student has said the missing number.

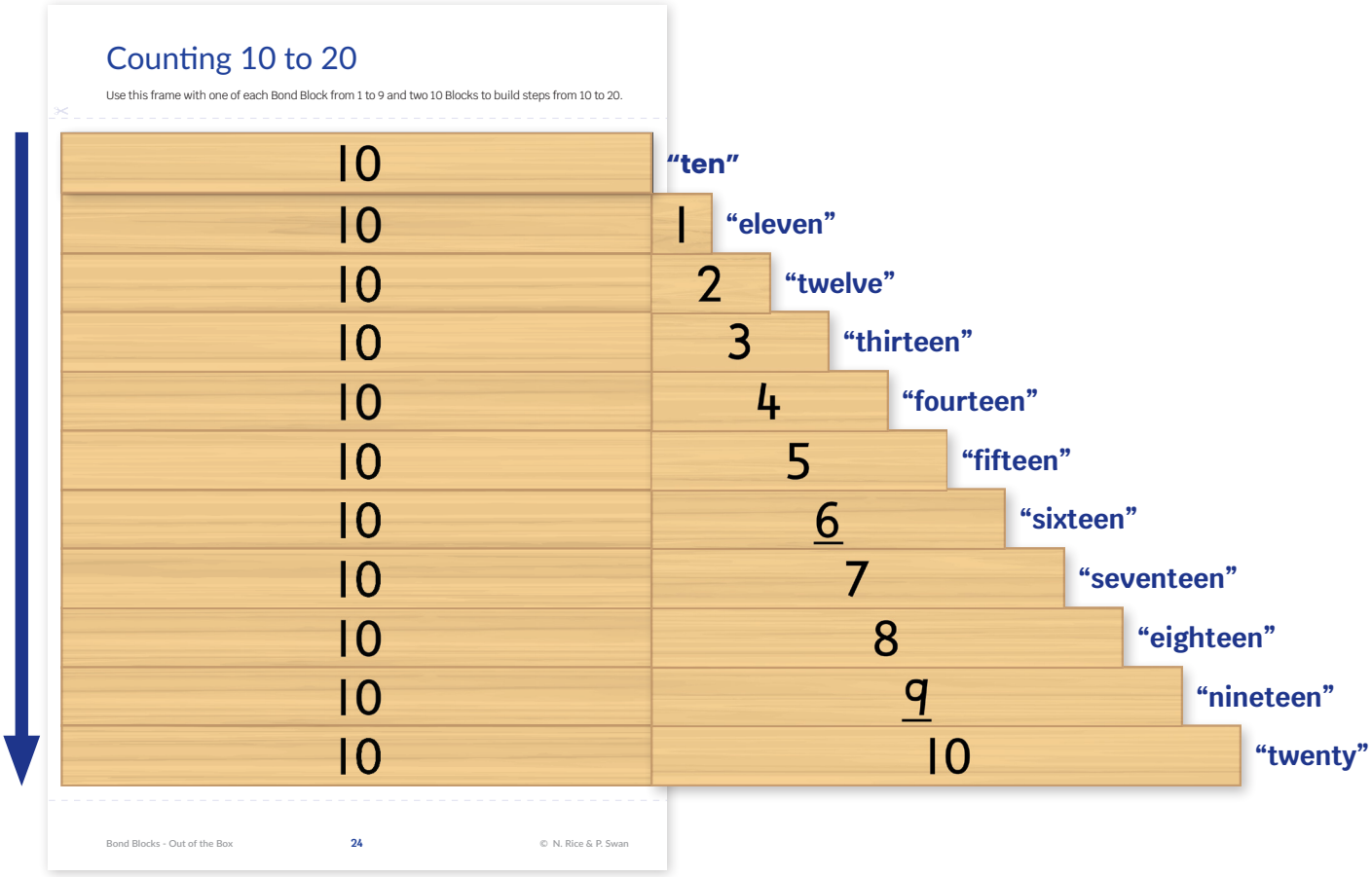
Extend counting forwards to 14

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



From 10 to 20

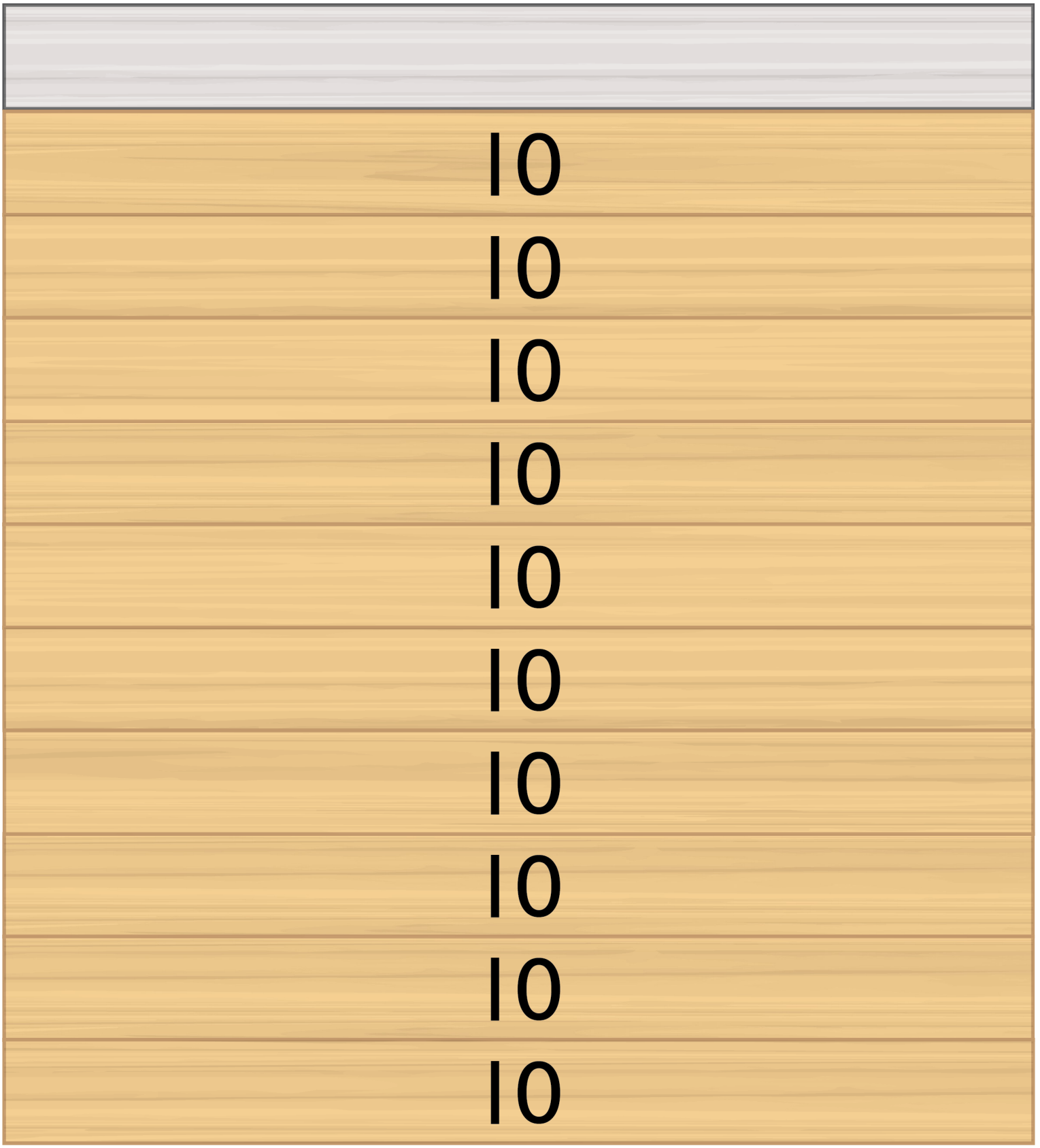
Bond Blocks can be used to count from 10 to 20. To do this, print the **'Counting 10 to 20 Board'** located on the following page. Students place a Bond Block to the right of the printed tens. This highlights how two-digit numbers are made up of 10 add another amount. As the student counts, move a single ten block down next to the steps, on top of the **'Counting 10 to 20 Board'**.



Counting 10 to 20 Board

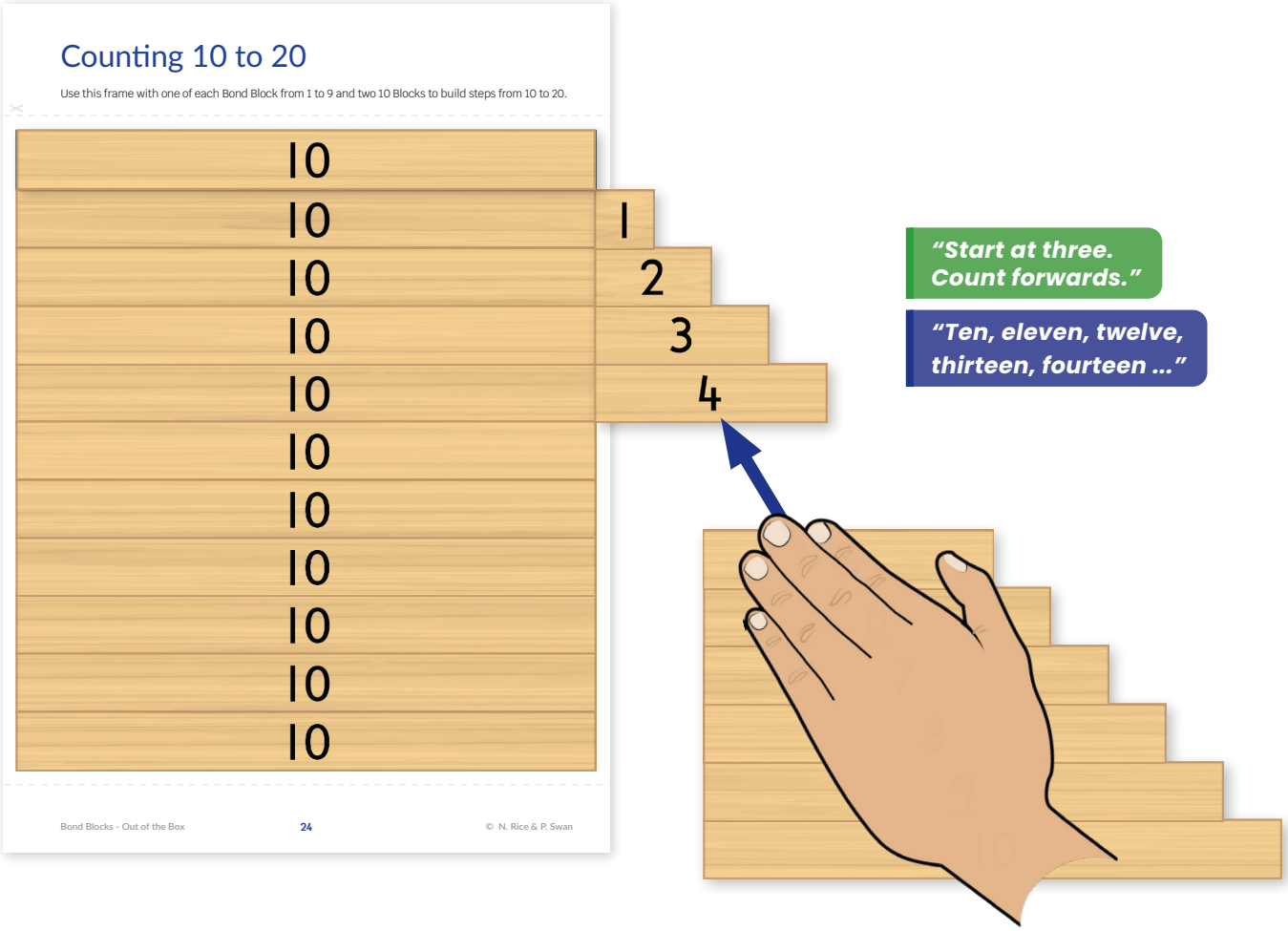
This resource is used for the activities:

- "Counting Forwards - **From 10 to 20**",
- "Counting Forwards - **From 10 to 20, starting at any number between 10 and 20**",
- "Counting Backwards - **From 20 to 10**" and
- "Counting Backwards - **From 20 to 10, starting at any number between 10 and 20**".



From 10 to 20, starting at any number between 10 and 20

Once students can confidently count from 10 to 20, extend counting to 20 by starting from numbers other than 10. Use the **'Counting 10 to 20 Board'** as demonstrated below.



The teacher covers the blocks to be counted.

The teacher returns each block to the steps, **immediately AFTER** the student has said the missing number.

Note: The teen numbers, 14, 15, ... 19 are said "right to left". This is different to all other numbers.

For example, 64 is said "left to right" according to place value. However, when reading 16, the six is said first.

Some students have difficulty hearing the differences in these sounds and saying the different sounds.

To increase their awareness of this draw attention to:

- the written spelling of 'ty' and 'teen' and
- the correct placement of the tongue when making the 'n' sound, which is against the roof of the mouth, behind the teeth.

Counting Backwards

Repeat the sequence of counting forwards activities with counting backwards.

- From 10 to 1.
- Starting at any number less than 10, to 1.
- From 14 to 1.
- From 20 to 10.
- From 20 to 10 starting at any number between 10 and 20.

From 10 to 1

When students start building with the longest block, to the shortest, they create a counting backwards sequence. Encourage students to use their steps to **count aloud**.

"Ten, nine, eight, seven, six ..."

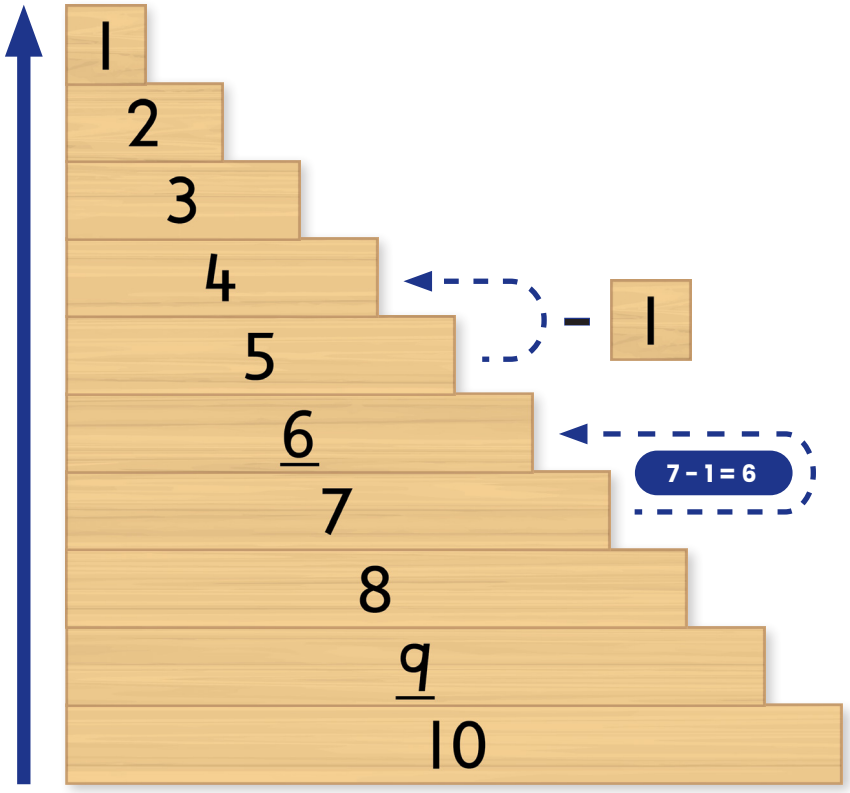
1. Build a set of steps from 10 to 1.
2. Count backwards.

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

Use the steps to show that each number in this sequence is **one less than** the number **before**.

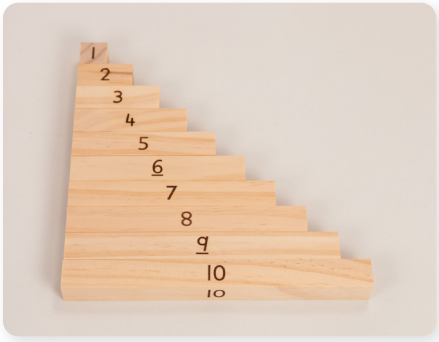
"Each number is one less than the number before."

Instruct students to **act this out** using a small figurine to jump up or down the set of steps, depending on the orientation of the blocks. Students **count aloud** as they move the figurine.



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 or standing up vertically like a tower.



Flat on a table.
Blocks placed in horizontal rows.

Standing up on a table.
Blocks placed in vertical columns.

Flat on a table. Blocks placed in vertical columns. Use the edge of the desk as a baseline.

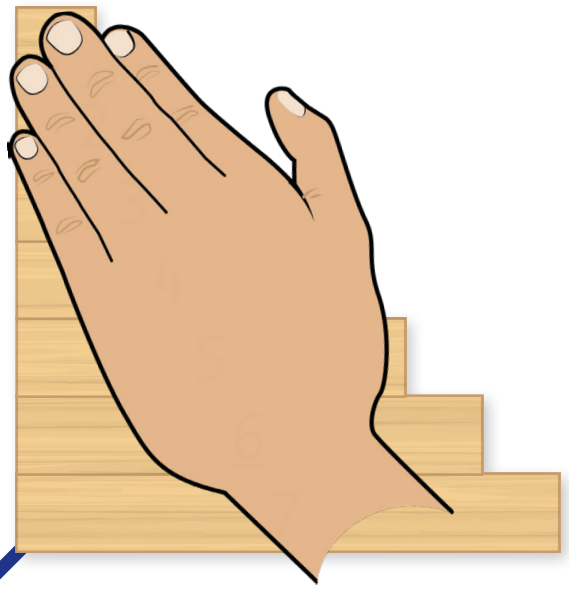
From numbers other than 10

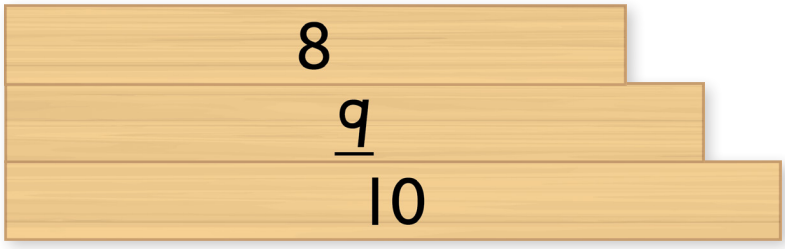
It is important to start counting backwards from numbers other than 10. Split the steps and count backwards starting at different numbers. For example, cover numbers 1 to 7 and instruct the student to **"start at eight"** and **"count backwards"**.

"Start at eight. Count backwards by one."

"Eight, seven, six ..."

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



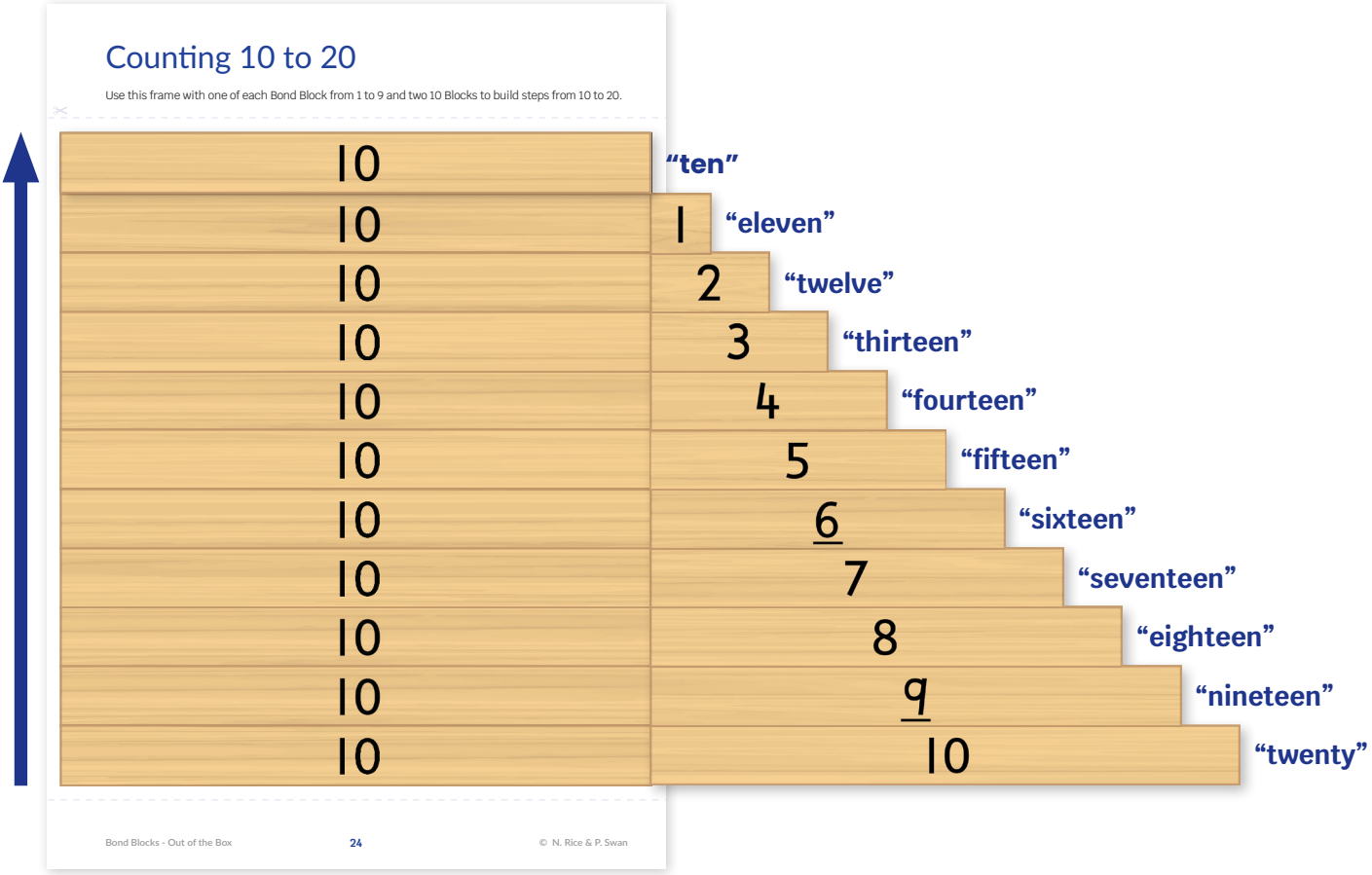


The teacher covers the blocks to be counted.

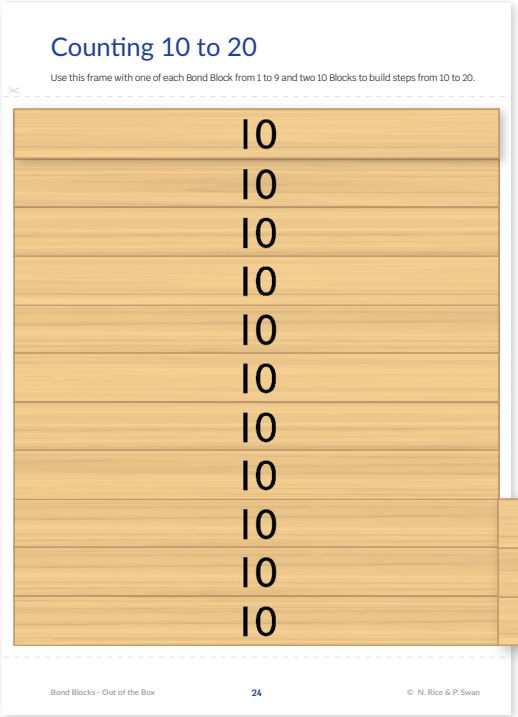
The teacher returns each block to the steps, **immediately AFTER** the student has said the missing number.

From 20 to 10

Bond Blocks can be used to count from 20 to 10. Print the **'Counting 10 to 20 Board'**. Students place a Bond Block to the right of the printed tens. This highlights how two-digit numbers are made up of 10 add another amount. As the student counts, move a single ten block up next to the steps, on top of the **'Counting 10 to 20 Board'**.



From 20 to 10, starting at any number between 10 and 20

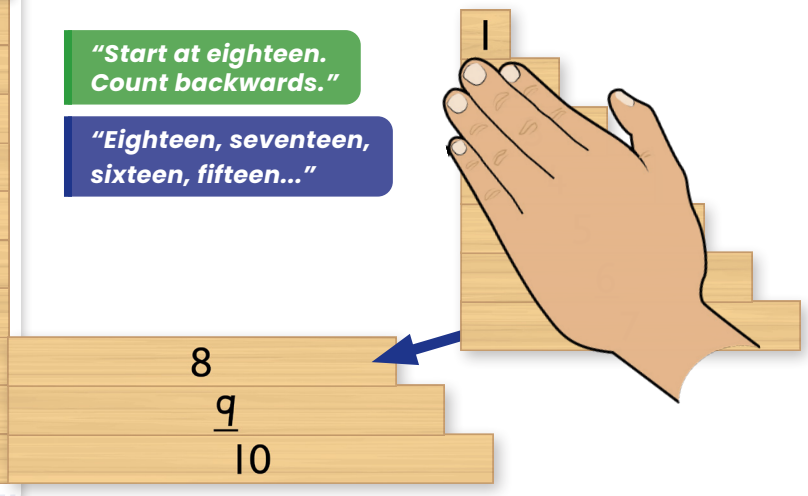


The teacher covers the blocks to be counted.

The teacher returns each block to the steps, **immediately AFTER** the student has said the missing number.

"Start at eighteen. Count backwards."

"Eighteen, seventeen, sixteen, fifteen..."



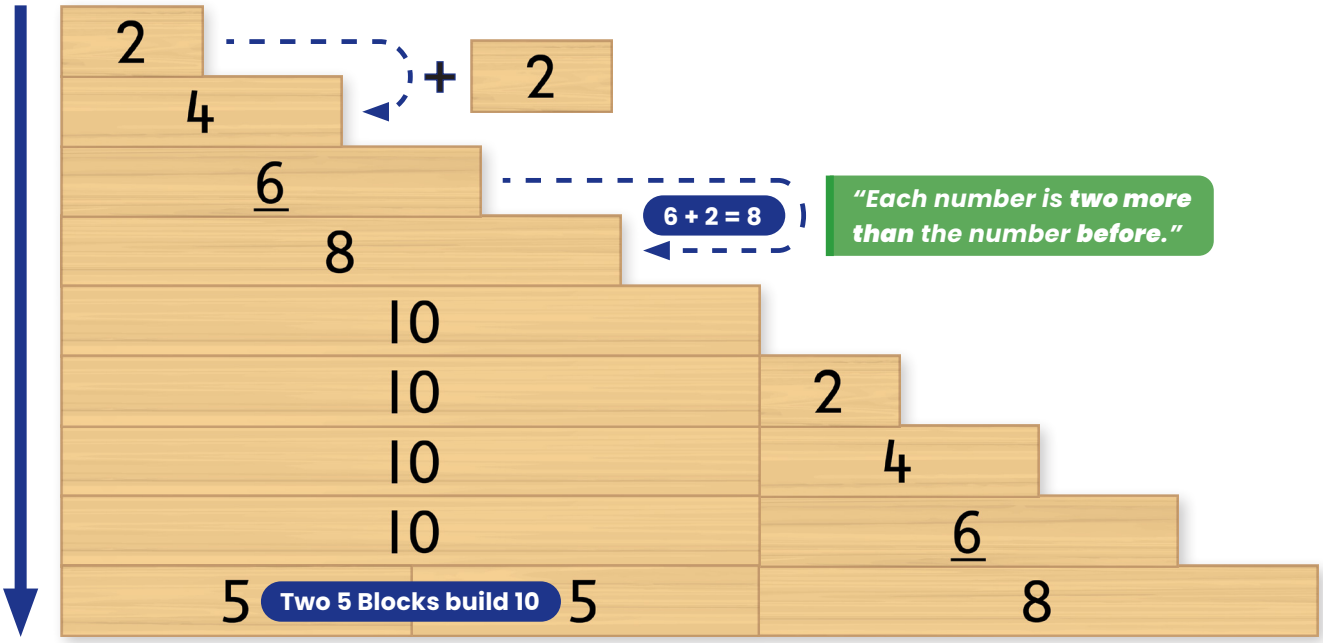
Note: When counting backwards from 20, errors in 'ty' and 'teen' often reappear because of the increased intrinsic cognitive load.

Counting by ...

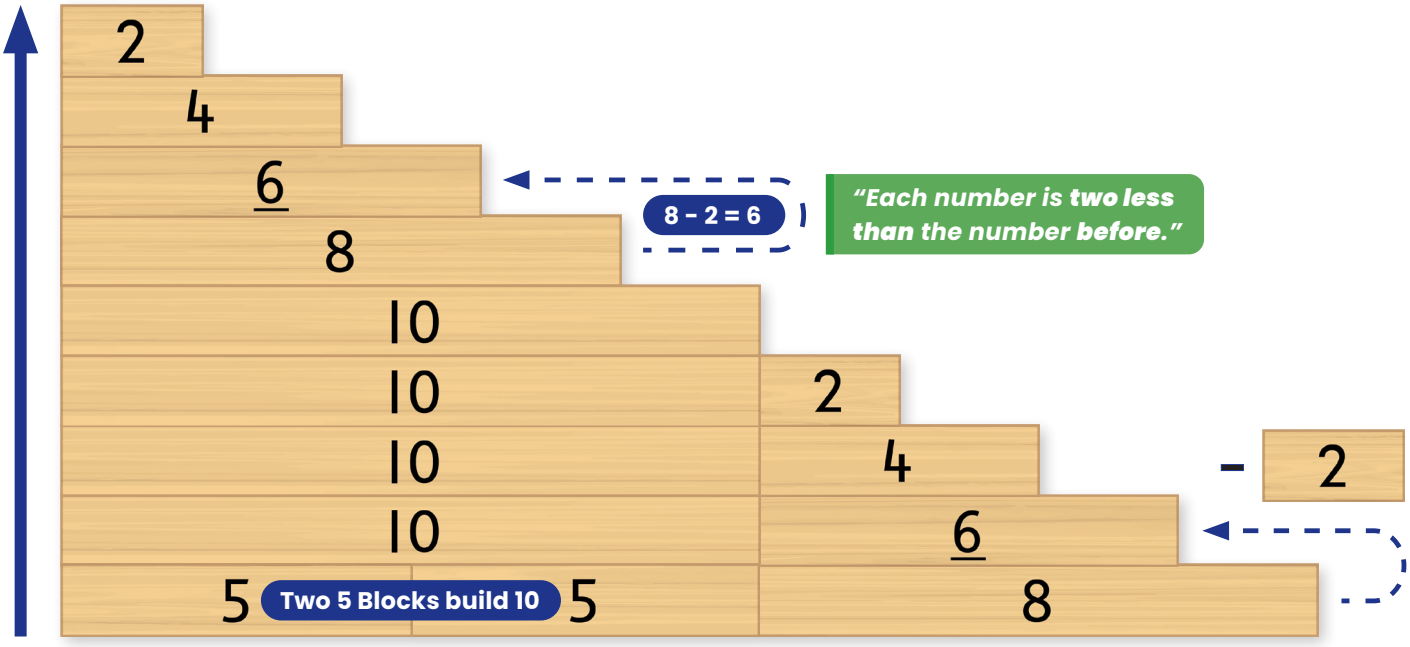
Counting by two with even numbers

We can count forwards by numbers other than one. By starting at two and adding two repeatedly we make even numbers.

The repeating pattern of the last block added is 0, 2, 4, 6, 8.



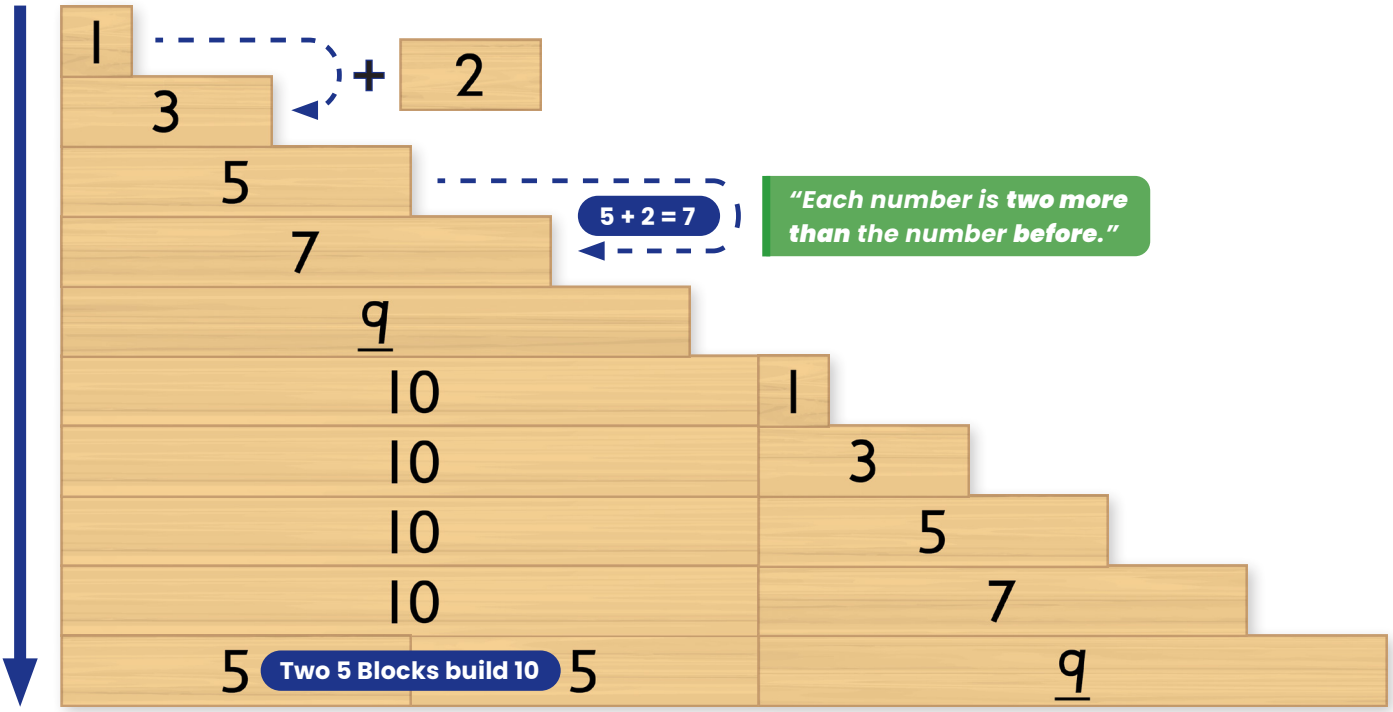
Once students can count confidently forwards by two with even numbers, extend the sequence to counting backwards.



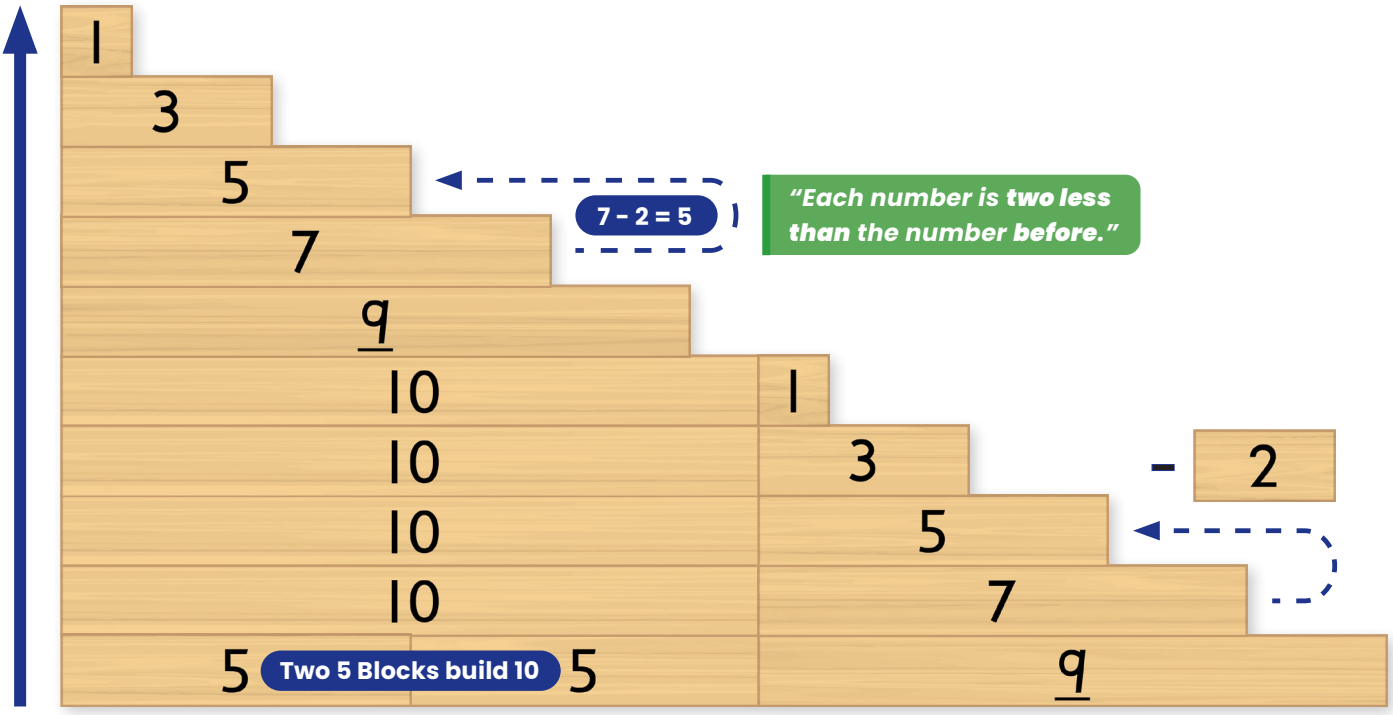
Counting by two with odd numbers

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.



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

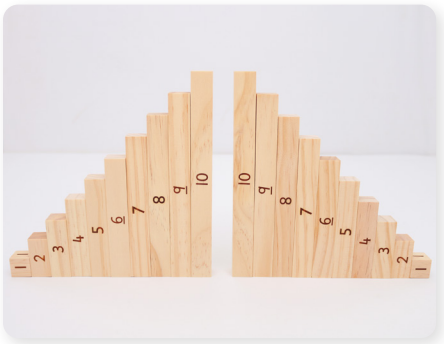


Comparing Steps

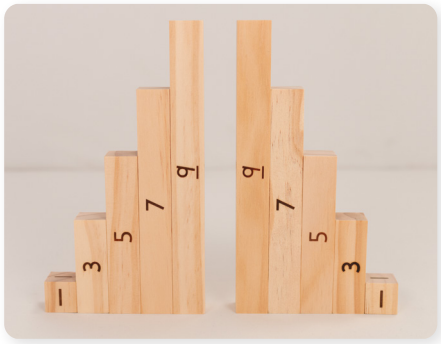
Same Blocks in a Different Order

Prompt students to:

"Build two *sets of steps*, using the *same* blocks, in a *different order*."



This example uses blocks 1 to 10.



This example uses blocks 1, 3, 5, 7 and 9.

This example uses blocks 2, 4, 6, 8 and 10.

After they have done this ask the students comparing questions such as:

"How are they the *same*?"

"How are they *different*?"

Same Blocks in a Different Order

Prompt students to:

"Build a set of steps that have the *same sized jump* each time, but the jump is not one."

Instruct students to **act this out** using a small figurine to jump up and down the set of steps.
Then, ask the students questions that relate to the size of the jump between each step.
For example:

"How *big* do you think this jump is?"

"How could you check?"

Each jump is two high.

Each jump is three high.

Different Sized Jumps

Prompt students to:

"Build a set of steps that have *different sized* jumps."

Instruct students to **act this out** using a small figurine to jump up and down the set of steps.
Then ask questions such as:

"Which part was the easiest to climb?"

(Student answers)

"Why?"

"Which part was the hardest to climb?"

(Student answers)

"Why?"

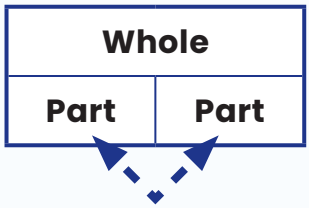
Efficient Addition and Subtraction

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

- Know basic facts
- Understand addition and subtraction concepts and relationships
- Calculating strategies

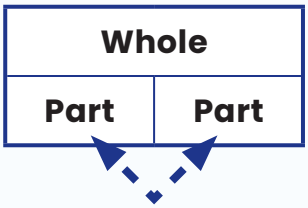
Know Basic Facts

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. Bond Blocks are arranged using part-part whole.



Parts BOND together to make a whole.

Part + Part = Whole	Whole − Part = Part
3 + 7 = 10	3 + 7 = 10
7 + 3 = 10	7 + 3 = 10



Two-part bond of ten.

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.

"0 and 5 is 5."
"1 and 3 is 5."
"2 and 3 is 5."
"3 and 2 is 5."
"4 and 1 is 5."
"5 and 0 is 5."

Building walls lays a foundation for part-part-whole understanding.

Each row going horizontally across is an equal length that can be split differently.

Rows can be made of one block or multiple blocks.

Know Basic Facts: Build walls on one block

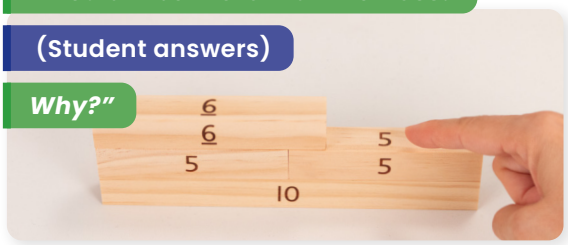
Guess, Test and Improve

Encourage students to build a wall, starting with one block as the foundation. Prompt students to:

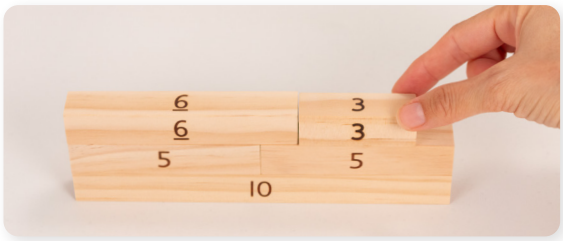
> ***"Build a wall. Place one block on the floor. This is the foundation. Build your wall as high as you can. Make sure every row is the same length."***

As students are building each row, encourage them to work mathematically using the problem solving strategy of **GUESS, TEST AND IMPROVE**.

> ***"What block do you think will fit here?"***
>
> ***"Would it be more than 5 or less?***
>
> (Student answers)
>
> ***Why?"***



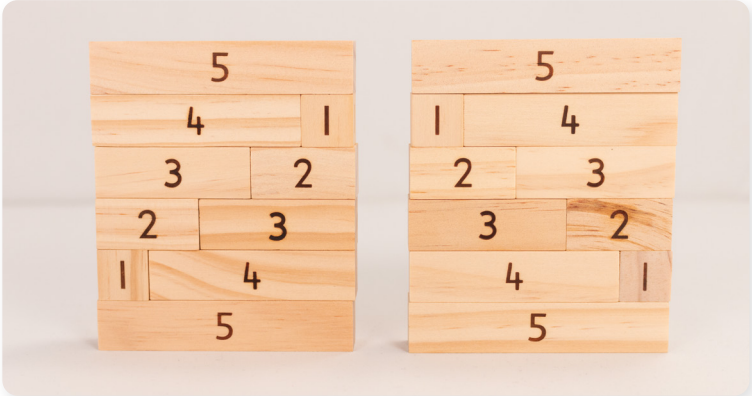
> ***"I guessed 3 but that was too short. I'll try 4 because it's a bit bigger."***



Rearranging Rows

Prompt students to:

> ***"Try to rebuild your wall using the same blocks, arranged in a different order. Focus on rearranging the blocks in each row, one at a time."***



Know Basic Facts: Starting with Two Blocks (or more)

Prompt students to:

> ***"Build a wall. Place two shorter blocks on the floor. This is the foundation. Build your wall as high as you can. Make sure every row is the same length."***

Ask questions to draw attention to equal lengths and relationships between blocks. For example:

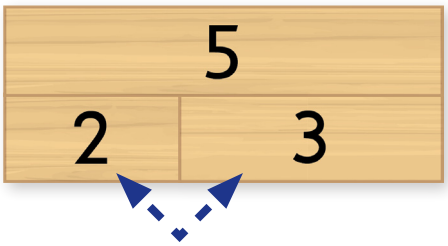
> ***"I wonder if there is one block the same length as those blocks joined together?"***

Understanding and relating addition and subtraction

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

The Commutative Property of Addition

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.

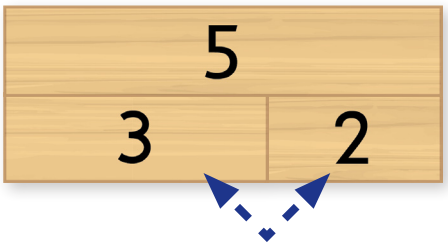


Swap to make 3 and 2.

Part + Part = Whole

so **2 + 3 = 5**

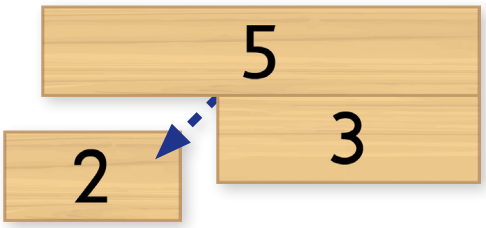
and **3 + 2 = 5**



Swap to make 2 and 3.

Inverse

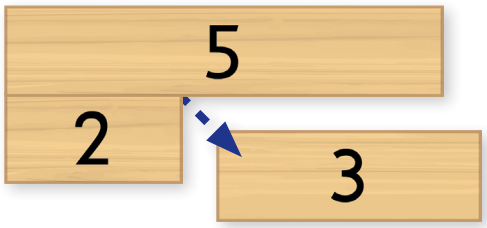
Subtraction is **not commutative**. However, it is related to addition. Mathematicians call this the inverse.



Whole – Part = Part

so **5 – 2 = 3**

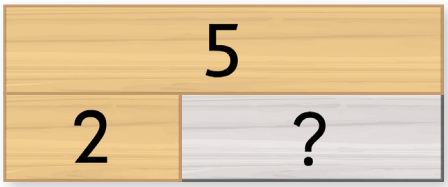
and **5 – 3 = 2**



The relationship between addition and subtraction is used to find **missing numbers**.

"Two add what number equals 5?"

2 + ? = 5



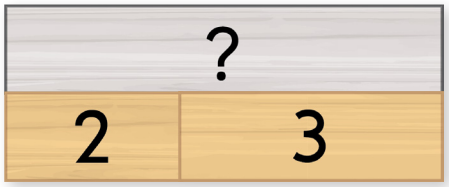
"You can solve this by thinking..."

Whole – Part = Part

5 – 2 = ?

"What number subtract two equals 3?"

? - 2 = 3

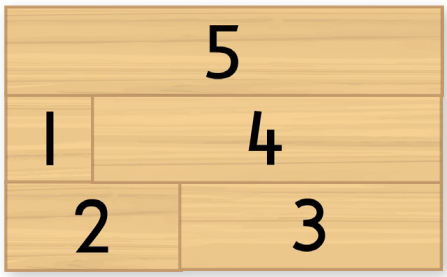


"You can solve this by thinking..."

Part + Part = Whole

2 + 3 = ?

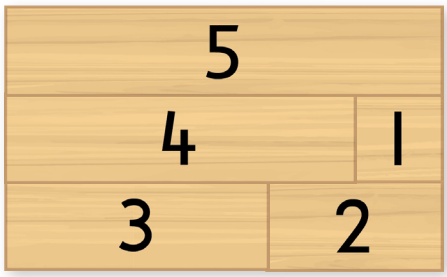
The Bond Wall is split and rearranged to show that knowing the **Commutative Property of Addition** almost halves the number of two-part bonds we need to remember used for addition and subtraction.



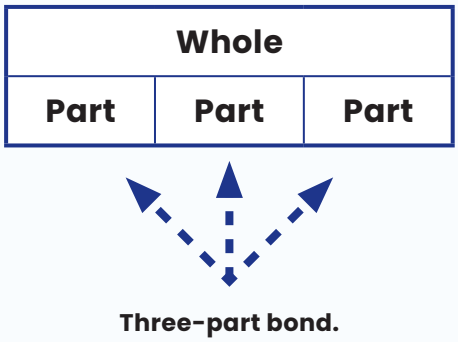
"0 and 5 is equal to 5 and 0"

"1 and 3 is equal to 4 and 1"

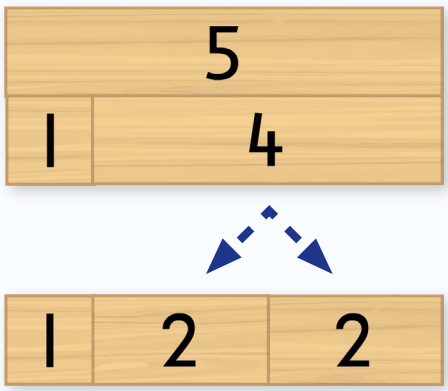
"2 and 3 is equal to 3 and 2"



Students can be challenged to find three-part bonds.



Three-part bond.



Calculating Strategies

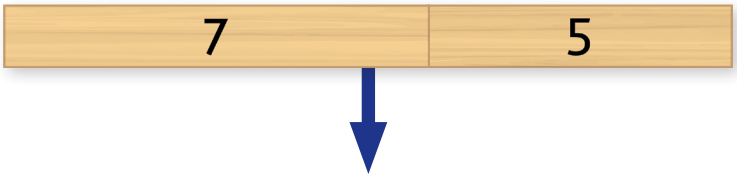
Students combine **(1) knowledge of basic facts** with **(2) understandings about addition and subtraction relationships**, to develop **(3) efficient strategies** to add and subtract with numbers larger than basic facts.

Partitioning

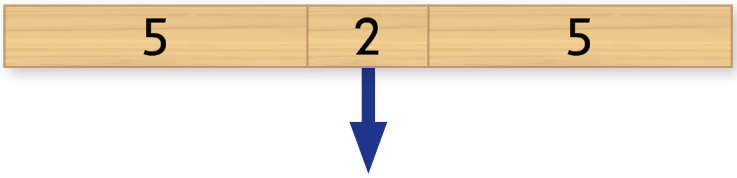
Partitioning: Addition

e.g. **7 + 5**.

"Show me the part of 7 and the part of 5."

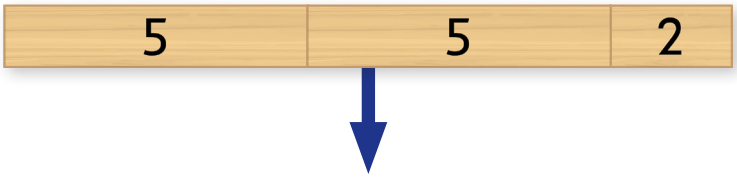


"Split 7 into the parts of 5 and 2."



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

"Change the position of the parts to make the addition easier."



Blocks rearranged to build **10 + 2**

"I know 5 and 5 is 10."

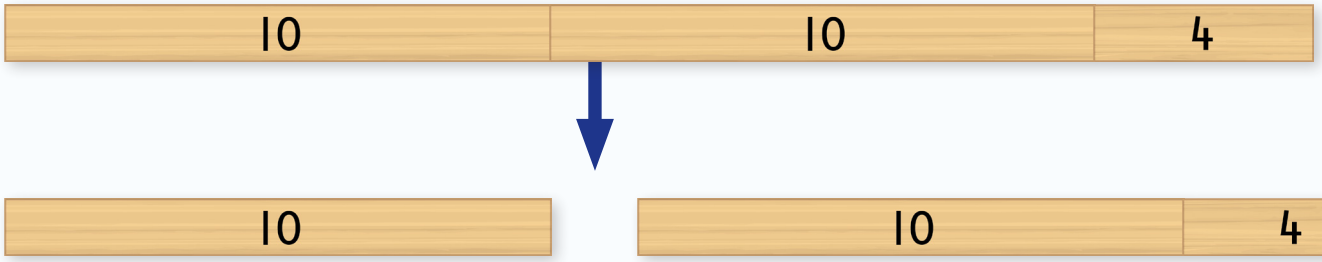
"I know 10 and 2 is 12."

"A part of 7 add a part of 5 is a whole of 12."

Partitioning: Subtraction

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

"This is the whole of 24."



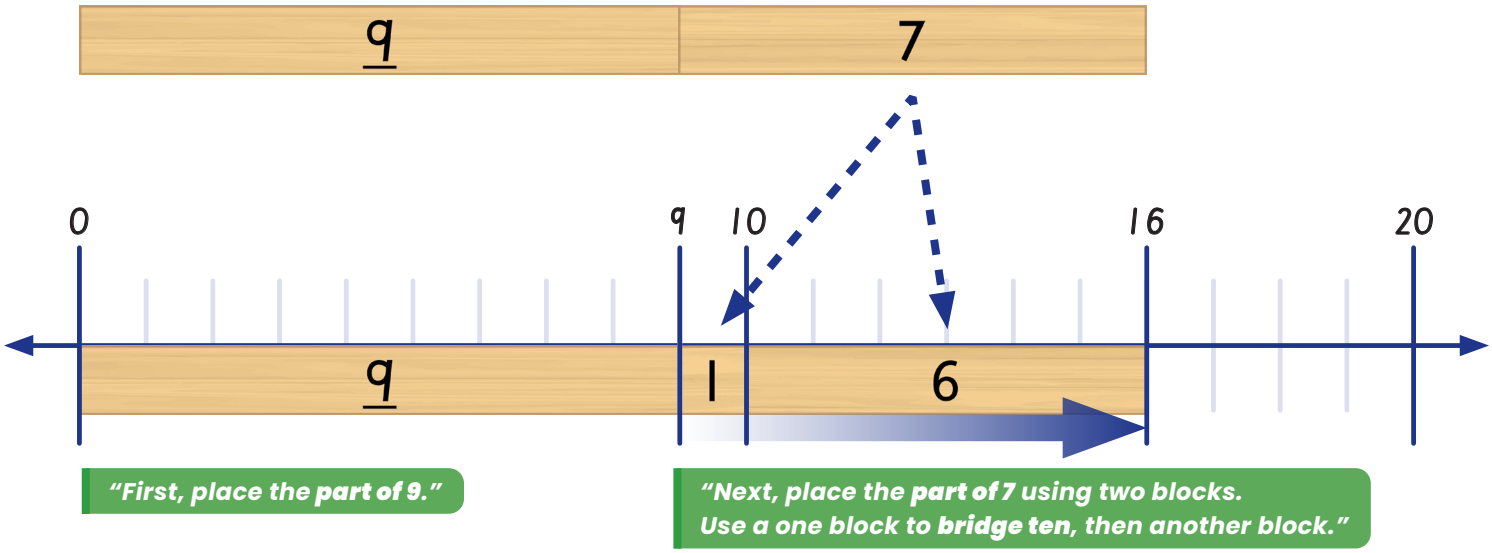
"This is the part of 10, from the question."

"This is the part of 14, that is the answer."

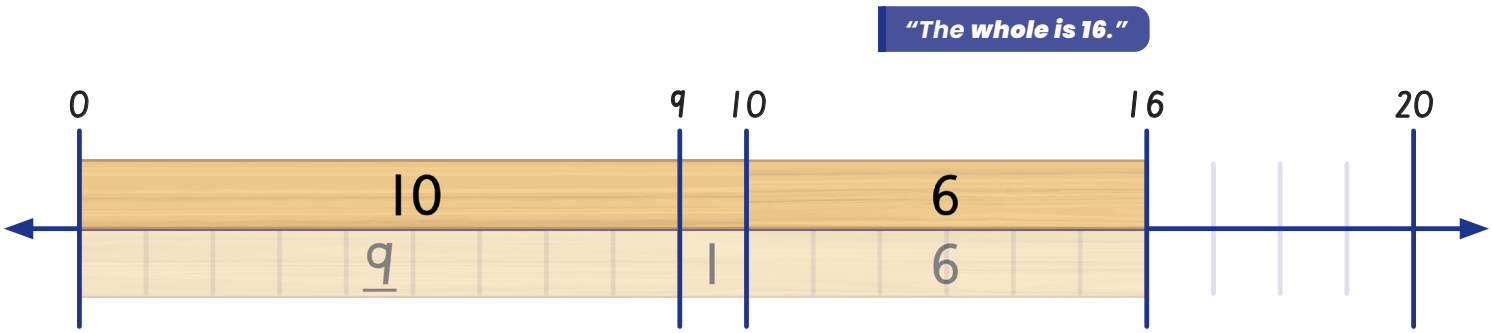
Bridging Ten

Bridging Ten: Addition

e.g. **9 + 7**, partition **7 as 1 and 6,** to add on bridging ten.



Blocks that represent parts are placed below the line.
Blocks that represent the whole are placed above the line.



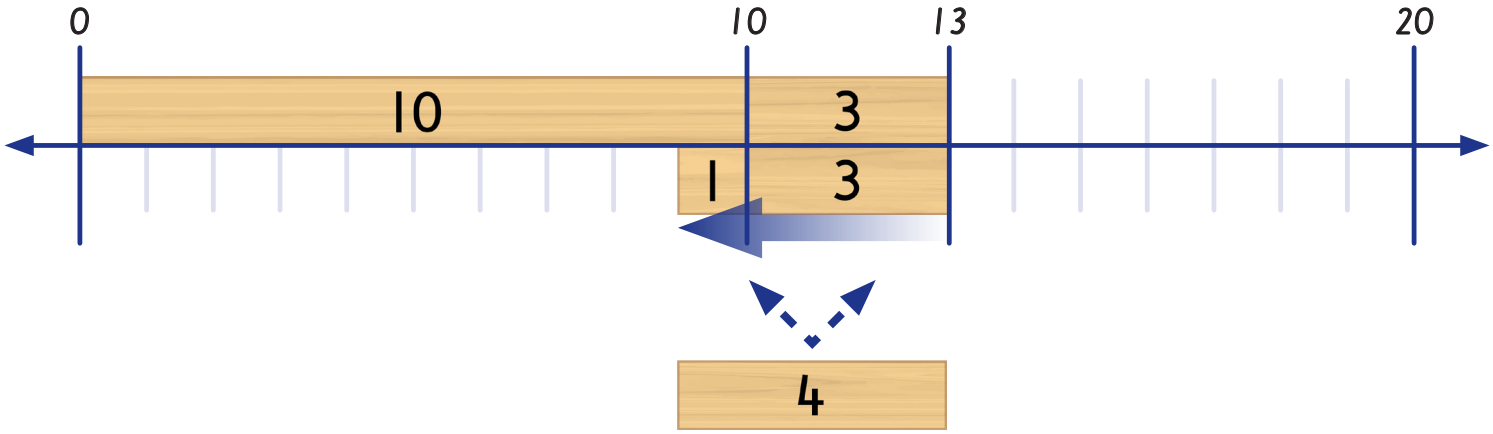
Students place the block to complete the **whole**.

The goal is for the blocks to become unnecessary. Reduce block use as confidence increases.
In time students will not need to place the blocks that represent the whole.

Bridging Ten: Subtraction (solved by taking away)

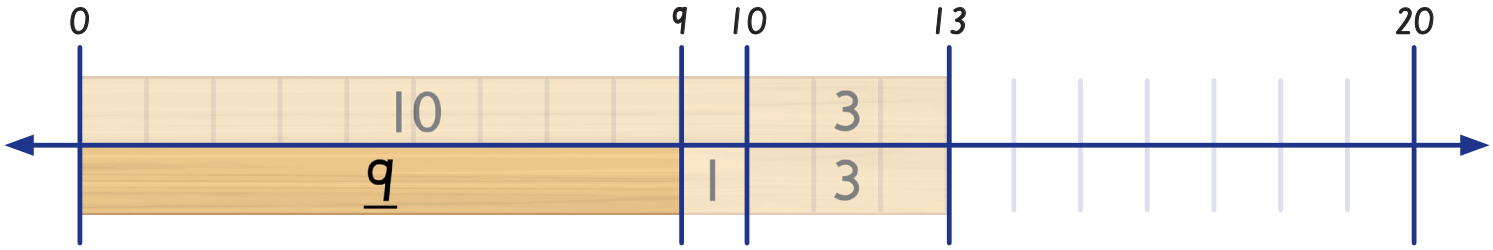
e.g. **13 – 4**, partition the **4 as 3 and 1,** to take away bridging ten.

"First, place the whole of 13. Use a 10 block, then a 3 block."



"Next, place the part of 4 using two blocks. Use a block to bridge ten, then another block."

Blocks that represent parts are placed below the line.
Blocks that represent the whole are placed above the line.



"The part is 9."

Students place the block that was the **unknown part**.

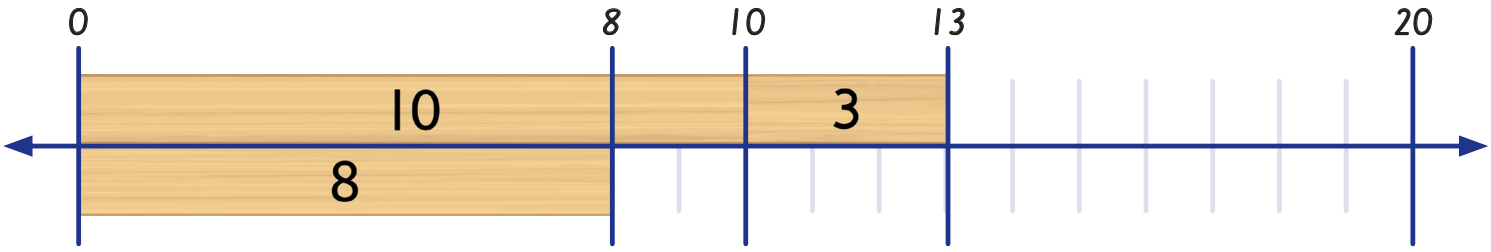
Reduce block use as confidence increases. In time students will not need to place the block that represents the part that is the answer.

Bridging Ten: Subtraction (solved by adding on)

e.g. **13 - 8**, add on 2 to bridge 10, then add on 3, to make the parts equal to the whole.

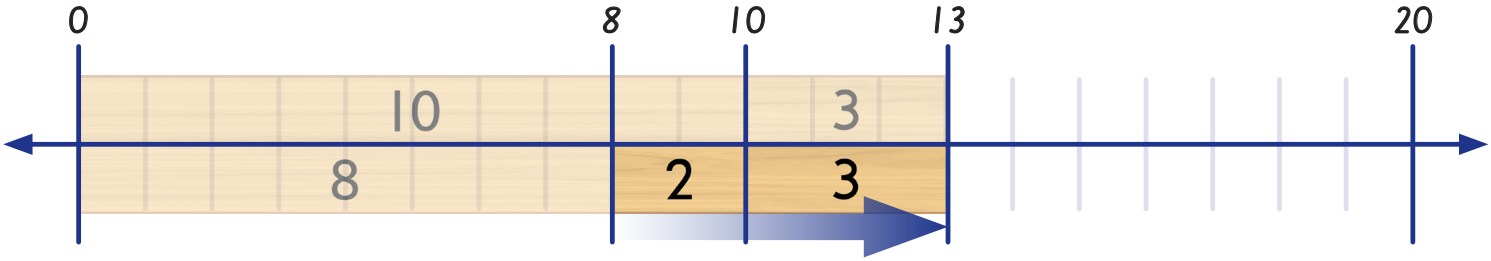
Students place blocks that represent the **whole**.

"First, place the whole of 13. Use a 10 block, then a 3 block."



"Next, place the part of 8."

Blocks that represent parts are placed below the line.
Blocks that represent the whole are placed above the line.



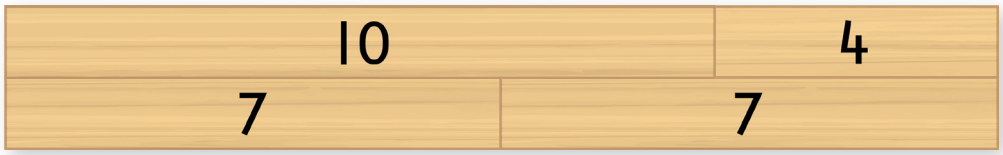
"We're going to place the part that is the answer, using two blocks. Use a block to bridge ten, then another block."

"The part is 5."

Reduce block use as confidence increases.
In time students will not need to place the blocks that represent the whole.

Doubling and Halving

Relate doubling to halving.

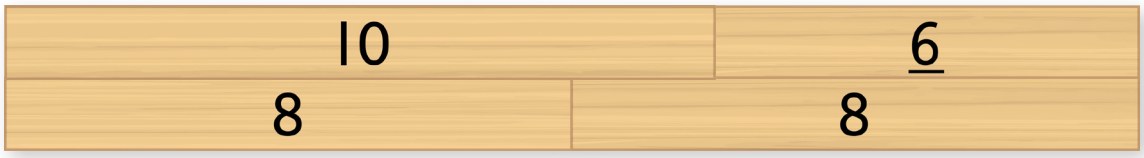


"Double 7 is 14."

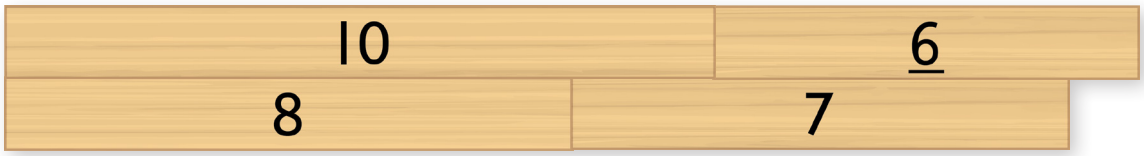
"One-half of 14 is 7."

Near Doubles

Relate a doubles to near doubles.



"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.