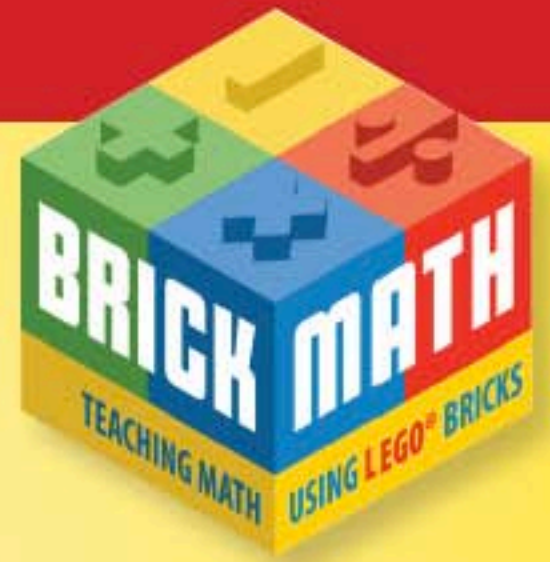
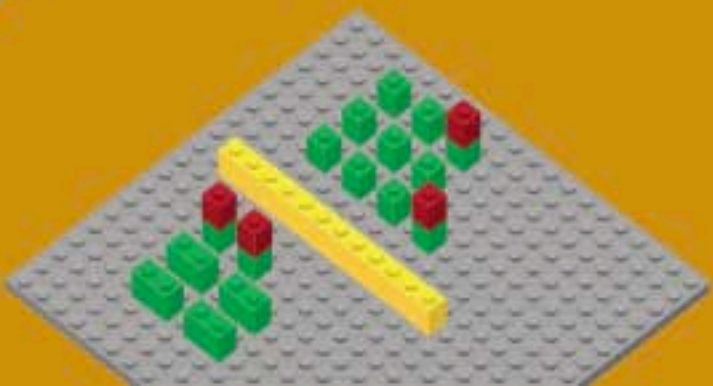
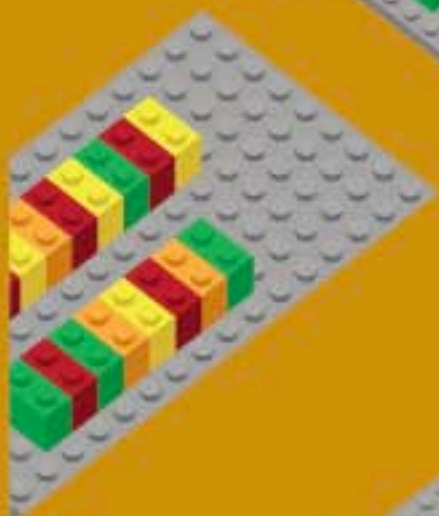
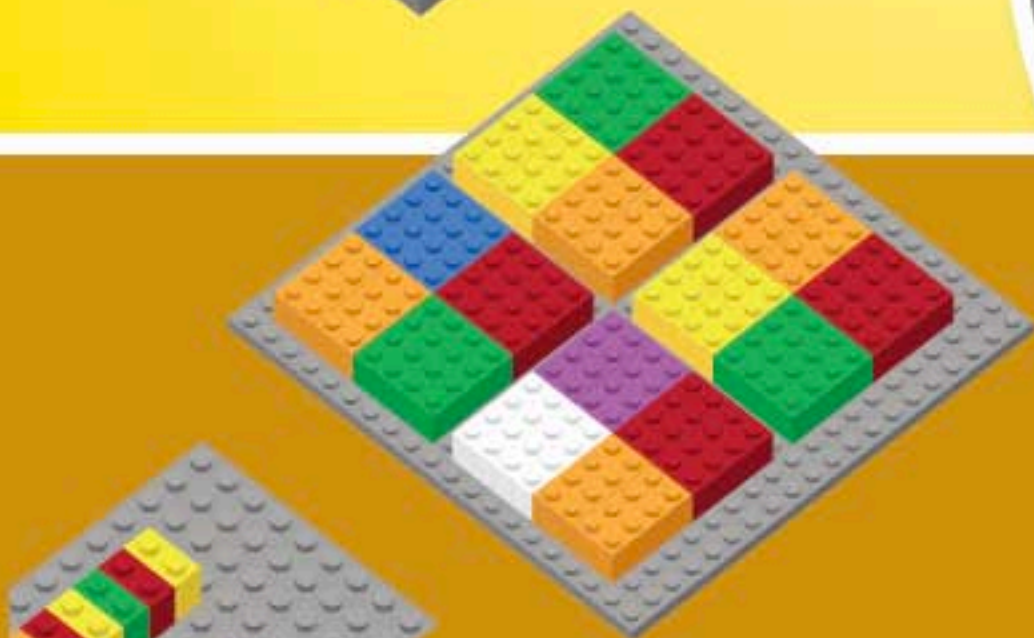
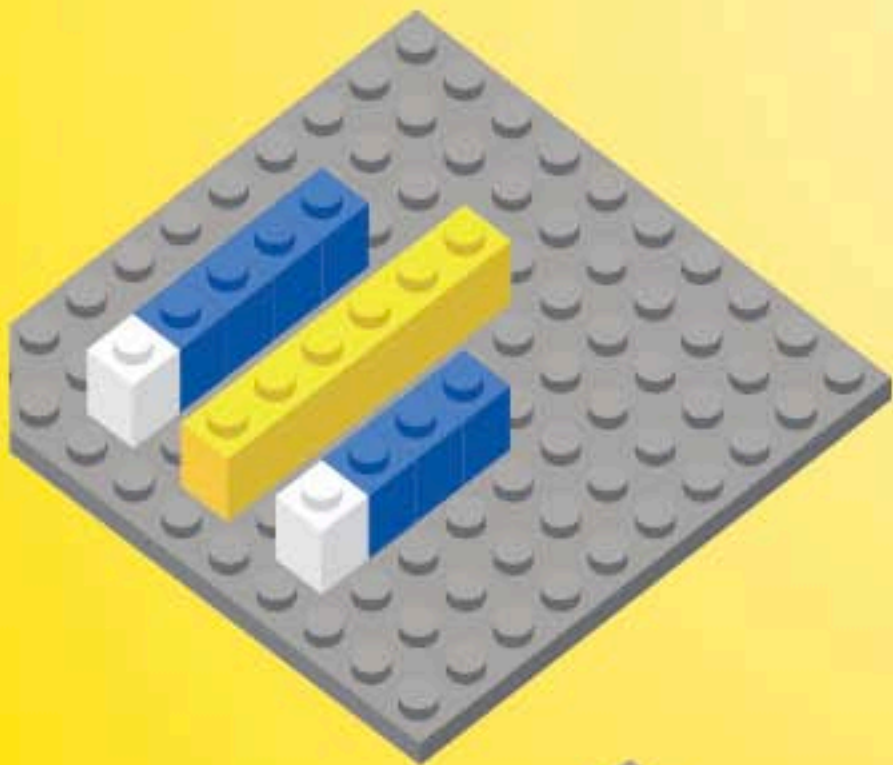


TEACHER EDITION



PRE-ALGEBRA

USING LEGO® BRICKS



Dr. Shirley Disseler

TEACHER EDITION



PRE-ALGEBRA

USING LEGO® BRICKS

Dr. Shirley Disseler



Pre-Algebra Using LEGO® Bricks—Teacher Edition

Copyright ©2023 by Shirley Disseler
Published by Brigantine Media/Compass Publishing
211 North Avenue, St. Johnsbury, Vermont 05819

Cover and book design by Anne LoCascio
Illustrations by Bonnie James
All rights reserved.

Your individual purchase of this book entitles you to reproduce these pages as needed for your own classroom use only. Otherwise, no part of this book may be reproduced or utilized in any way or by any means, electronic or mechanical, including photocopying, recording, or information storage or retrieval system, without prior written permission from the publisher. Individual copies may not be distributed in any other form.

Brigantine Media
211 North Avenue
St. Johnsbury, Vermont 05819
Phone: 802-751-8802
Fax: 802-751-8804
E-mail: neil@brigantinemedia.com
Websites: www.brigantinemedia.com
www.brickmath.com

LEGO®, the LEGO® logo, and the Brick and Knob configurations are trademarks of the LEGO® Group, which does not sponsor, authorize, or endorse this book. All information and visual representations in this publication have been collected and interpreted by its author and do not represent the opinion of the LEGO® Group.

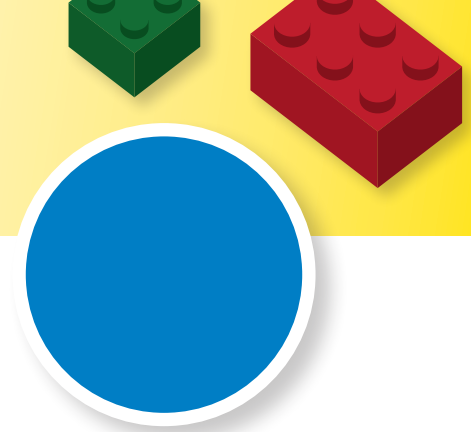
ORDERING INFORMATION

Quantity sales

Special discounts for schools are available for quantity purchases of physical books and digital downloads. For information, contact Brigantine Media at the address shown above or visit www.brickmath.com.

Individual sales

Brigantine Media publications are available through most booksellers. They can also be ordered directly from the publisher.
Phone: 802-751-8802 | Fax: 802-751-8804
www.brigantinemedia.com
www.brickmath.com
ISBN 978-1-9384069-2-8



CONTENTS

Introduction	5
How to Teach with the Brick Math Series	10
Chapter 1: Absolute Value	13
Chapter 2: Modeling Positive and Negative Numbers in Real World Contexts	22
Chapter 3: Exponents	36
Chapter 4: Negative Exponents and Multiplicative Inverse	46
Chapter 5: Rules of Integers	54
Chapter 6: Algebraic Expressions	77
Chapter 7: Simplifying Expressions	88
Chapter 8: Rules of Exponents	97
Chapter 9: Two-Step Equations and Inequalities	123
Chapter 10: Multiplying and Dividing Inequalities with Negative Coefficients	144
Chapter 11: Slope	175
Appendix	190
• Suggested Brick Inventory	
• Student Assessment Chart	
• Brick Modeling Chart for Constants and Variables	
• Baseplate Paper	



ABSOLUTE VALUE

Students will learn/discover:

- How positive and negative numbers are used together to describe quantities with opposite directional values (integer value) using real-world examples such as temperature, elevation, and credit/debit
- How to use a number line to identify negative and positive numbers and understand that numbers exist that are less than zero
- How to identify absolute value as the distance of a number from zero

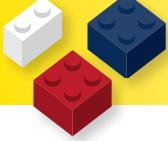
Why is this important?

Understanding positive and negative numbers is important in many contexts. Being able to identify numbers less than zero (negative numbers) allows for better understanding of many real-world situations, including money, time, speed, location, and temperature. The accounting credit and debit system uses negative and positive numbers to describe losses and gains. Negative and positive numbers describe below and above freezing. Sea level and altitude descriptions also use negative and positive numbers. Sports such as golf and football use positive and negative numbers to note above and below par, or gains and losses of yards. Students should understand the relationship of integers in terms of below or above a given specification. In terms of speed, for example, one could drive above or below the speed limit, which can be noted by +/- signs.

SUGGESTED BRICKS

Size	Number
1x1	1 blue
1x2	10 red 10 green
1x3	1 white 3 red 3 green
1x4	1 white 3 red 3 green
1x6	1 red 1 green
1x10	1 red 1 green
1x16	2 white

Note: Using a baseplate helps keep the bricks in place. Two baseplates are suggested for these activities.

**Vocabulary:**

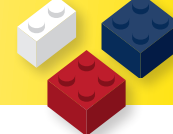
- **Integer:** A whole number that can be positive, negative, or zero
- **Positive number:** A whole number greater than zero
- **Negative number:** A whole number less than zero
- **Integer value:** The location of any integer on a number line relative to zero which informs whether it carries a negative or positive sign as an identifier

**How to use the companion student book,
Pre-Algebra Using LEGO® Bricks–Student Edition:**

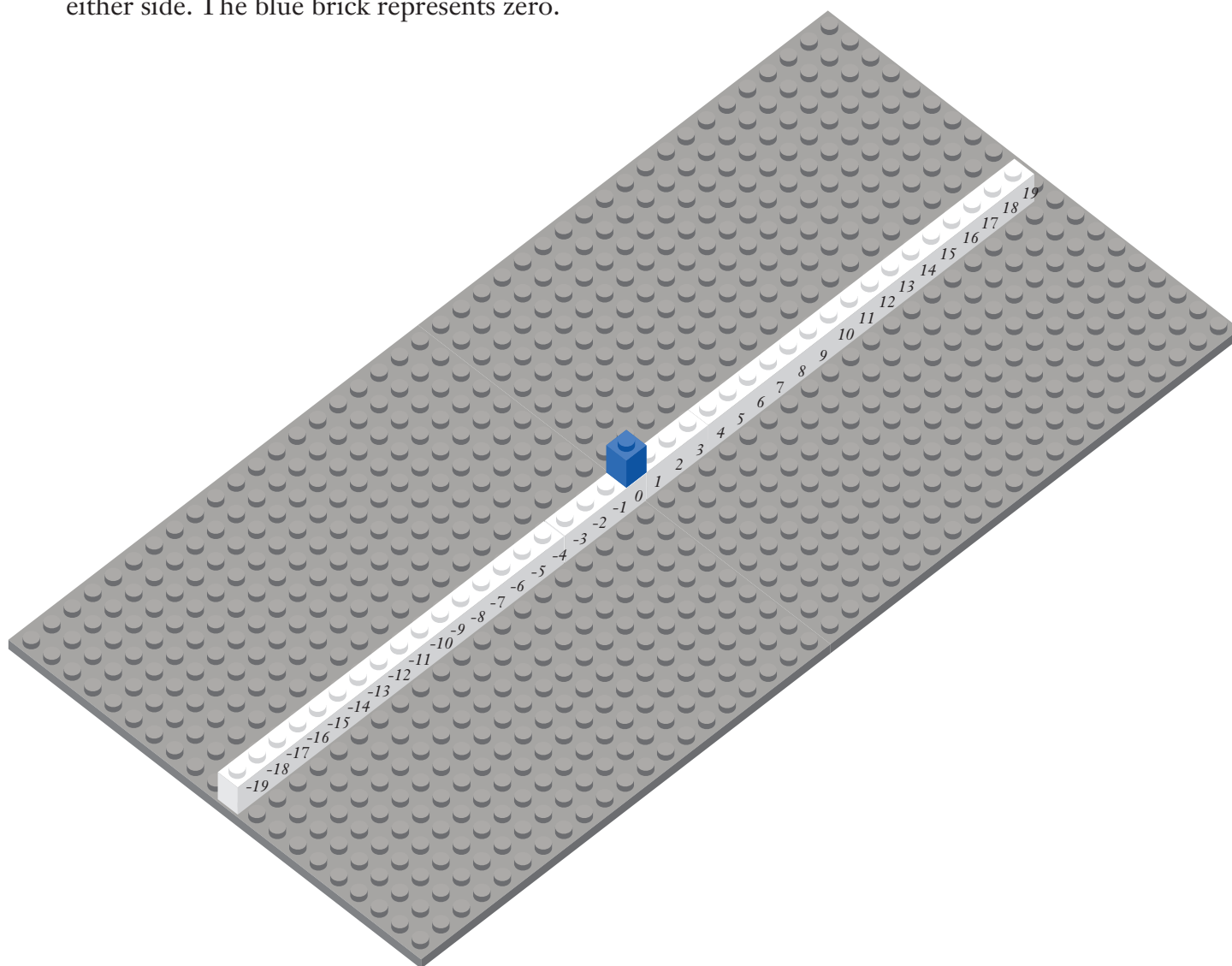
- After students build their models, have them draw the models and explain their thinking in the Student Edition. Recording the models on paper after building them with bricks helps reinforce the concepts being taught.
- Discuss the vocabulary for each lesson with students as they work through the Student Edition.
- Use the chapter assessments in the Student Edition to gauge student understanding of the content.

Part 1: Show Them How

In this chapter, *integer value* and *absolute value* will be discussed and modeled. Understanding what an integer is and what absolute value means are key ideas for algebraic thinking about numbers. Throughout this book, red bricks will be used to model negative numbers, and green bricks will be used to model positive numbers.

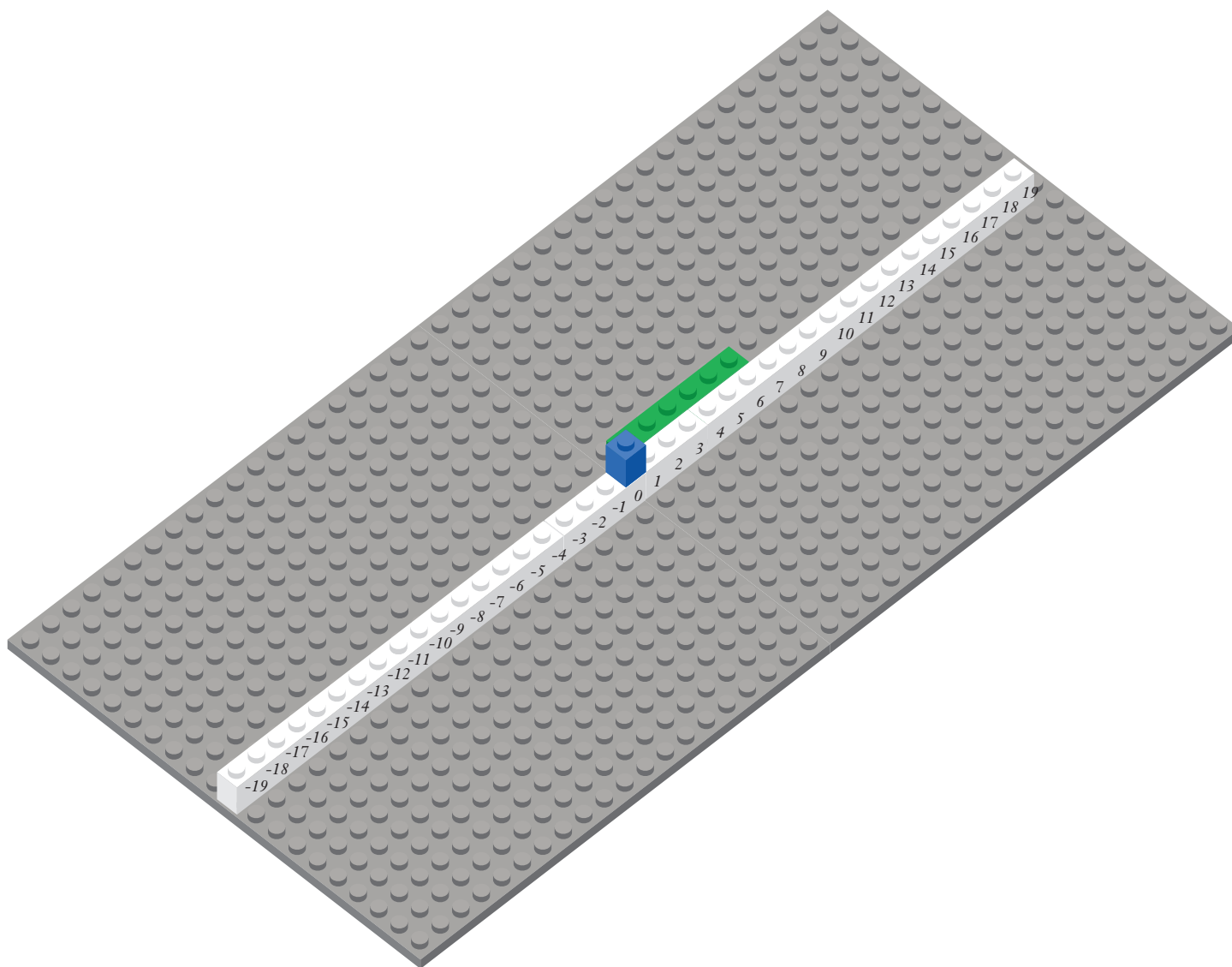


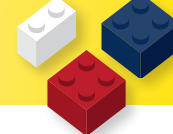
Have students begin by building a number line using two white 1x16 bricks, one white 1x4 brick, and one white 1x3 brick across two baseplates. Place one blue 1x1 brick on top of the bricks, directly in the center. It should be a long row of bricks: one blue stud on top, with 19 white studs on either side. The blue brick represents zero.



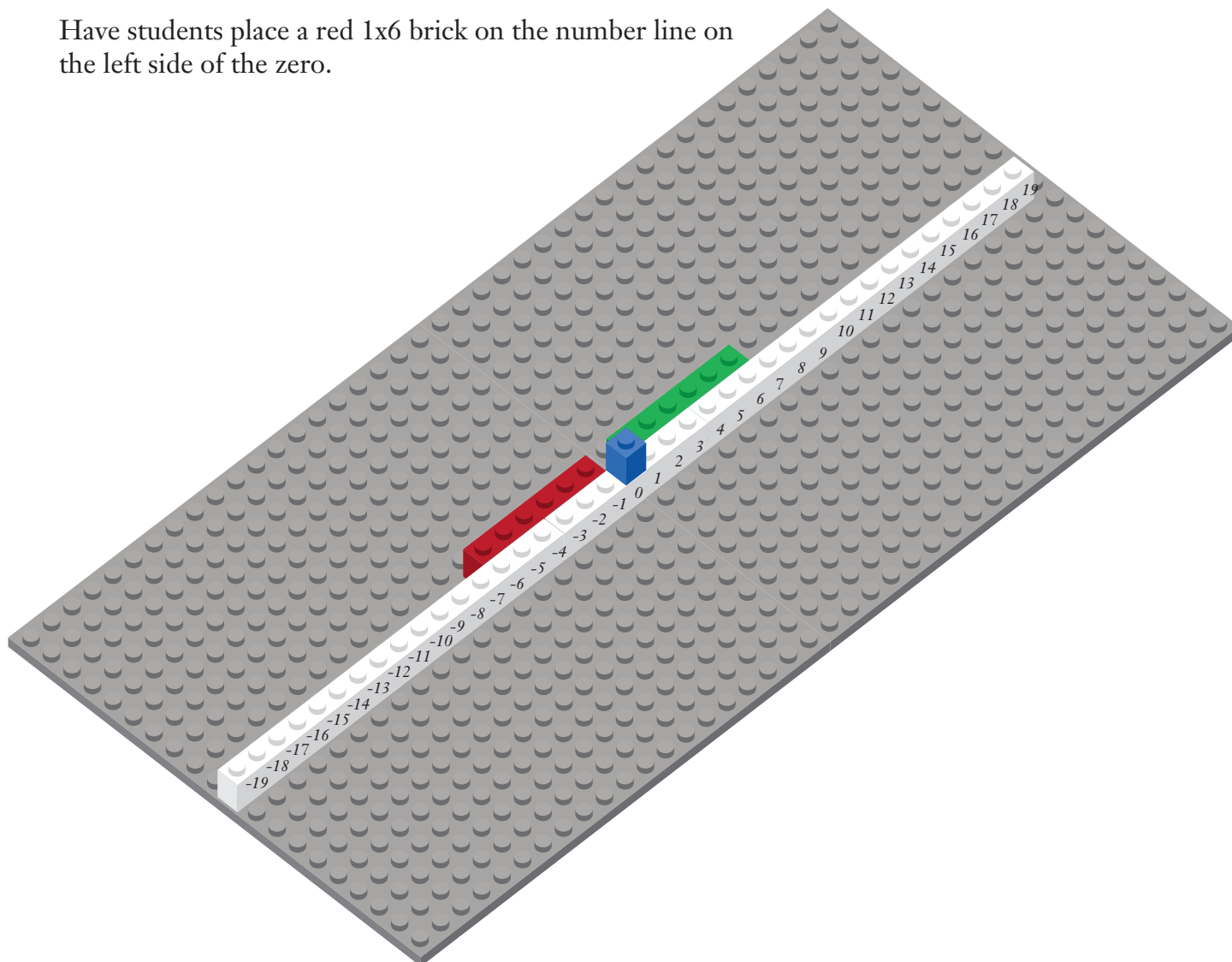


Have students place one green 1x6 brick above the number line starting at zero and ending at the sixth stud.





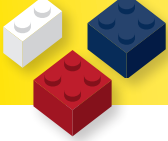
Have students place a red 1x6 brick on the number line on the left side of the zero.



Explain to students that these two bricks show the same distance from zero. The distance a number is from zero is its *absolute value*. The absolute value here is 6, which is written as $|6|$.

In this model, the red brick indicates a negative direction and the green brick represents a positive direction. Discuss the idea that a negative number lies on the number line to the left of zero, while a positive number lies to the right of zero. These numbers are called *integers* and their value is known as the *integer value*.

Point out that this model shows +6 and -6.



Have students remove the two 1x6 bricks and model the following pairs of integers.

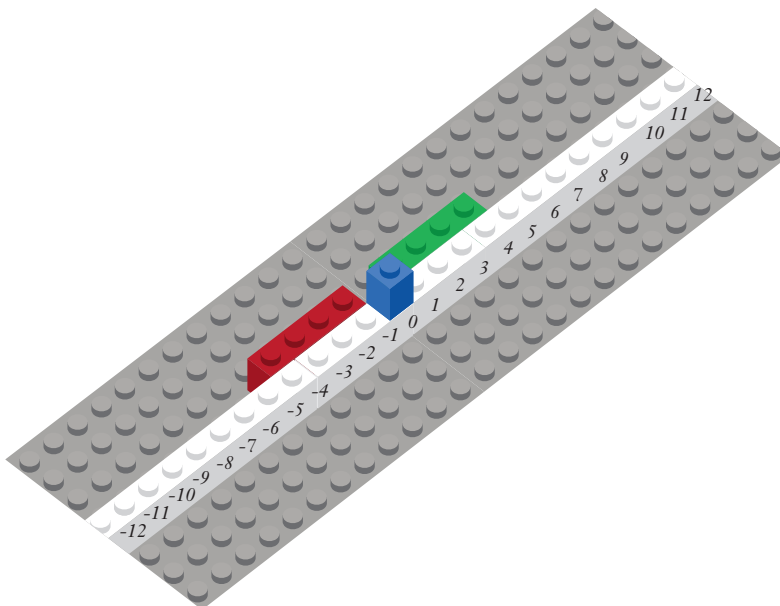
Problem #1: Model -4 and +4

Ask students which bricks they will use for the model.
(*Answer:* one red 1x4 brick and one green 1x4 brick)

Have students build models of -4 and +4.

Ask students: How do you know the absolute value when you look at your completed model? (*Answer:* the absolute value is shown by the distance from zero on the number line, which is 4 in both directions)

Have students draw the model and label it. Have students identify the absolute value.



Problem #2: Model +10 and -10

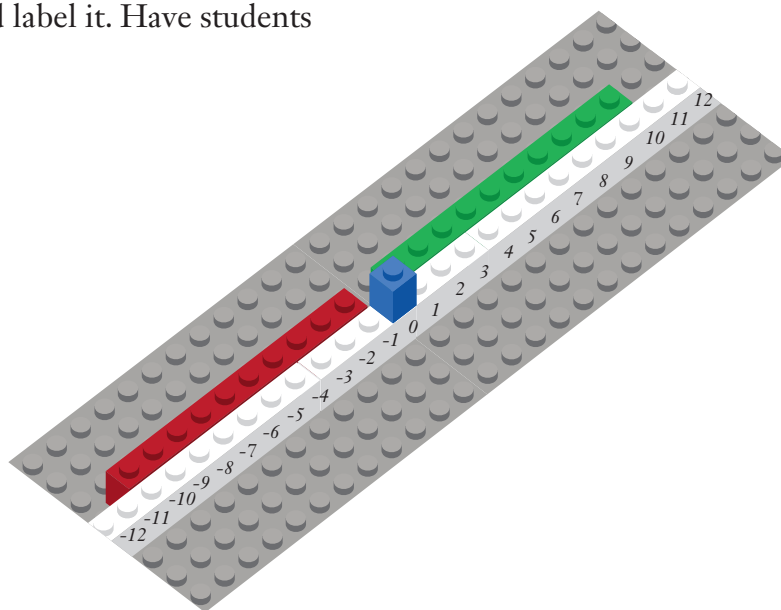
Ask students which bricks they will use for the model.
(*Answer:* 1 red 1x10 brick and 1 green 1x10 brick)

Have students build models of +10 and -10.

Ask students: How do you know the absolute value when you look at your completed model? (*Answer:* the absolute value is shown by the distance from zero on the number line, which is 10 in both directions)



Have students draw the model and label it. Have students identify the absolute value.

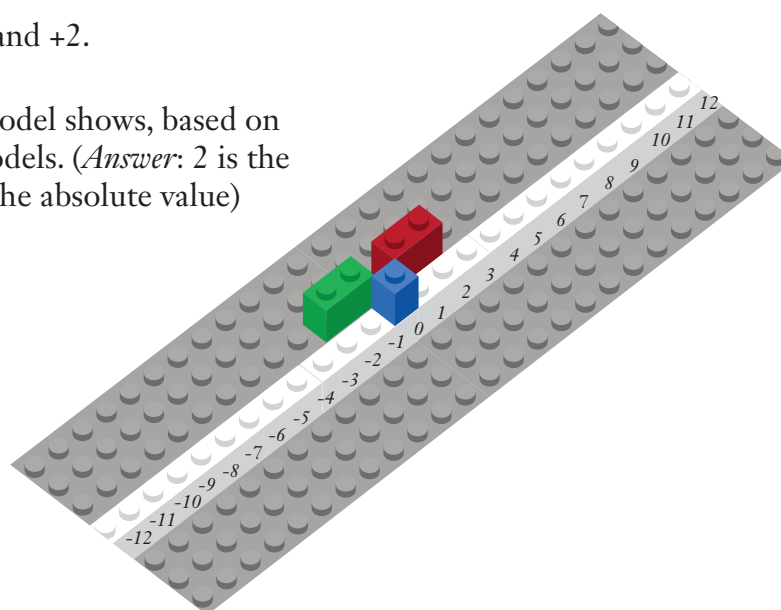


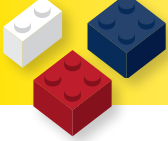
Discuss with students that $+10$ means you have 10 more than zero, and -10 means you have 10 less than zero (it indicates subtraction). In other words, when you have 10 and then give 10, you have zero. This means that there is a one-to-one ratio on both sides of the zero on the number line and they cancel each other out. This is called a zero pair. *Note:* This concept will be important in computation in later chapters in this book.

Problem #3: Model -2 and +2

Have students build models of -2 and +2.

Ask students to define what this model shows, based on their knowledge from previous models. (*Answer:* 2 is the number's distance from zero; 2 is the absolute value)





Part 2: Show What You Know

1. Build a model to show -8 and $+8$ on a number line. Draw your model and label each number.

What is the absolute value of -8 ? *Answer:* $|8|$

Explain how you know the absolute value. *Answer:* 8 is located exactly 8 studs from zero, which is its absolute location. -8 is located exactly 8 spaces to the left of zero and 8 is located exactly 8 spaces to the right of zero.

2. Build a model to show two numbers whose absolute value is 12 . Use red and green bricks to show the positive and negative numbers. *Hint:* You will need several bricks to model each of these numbers. Draw and label your model.

Which bricks did you use to make the model? *Answer:* Various possibilities

What two numbers did you model? *Answer:* -12 and $+12$

3. Model two numbers that make a zero pair. Draw and label your numbers. Identify the absolute value of your numbers.

What numbers did you model?

Which bricks did you use to model your numbers?

Solutions will vary