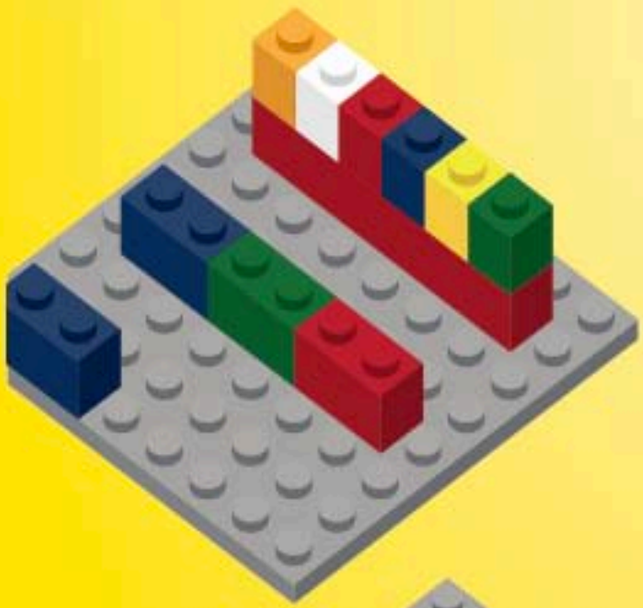
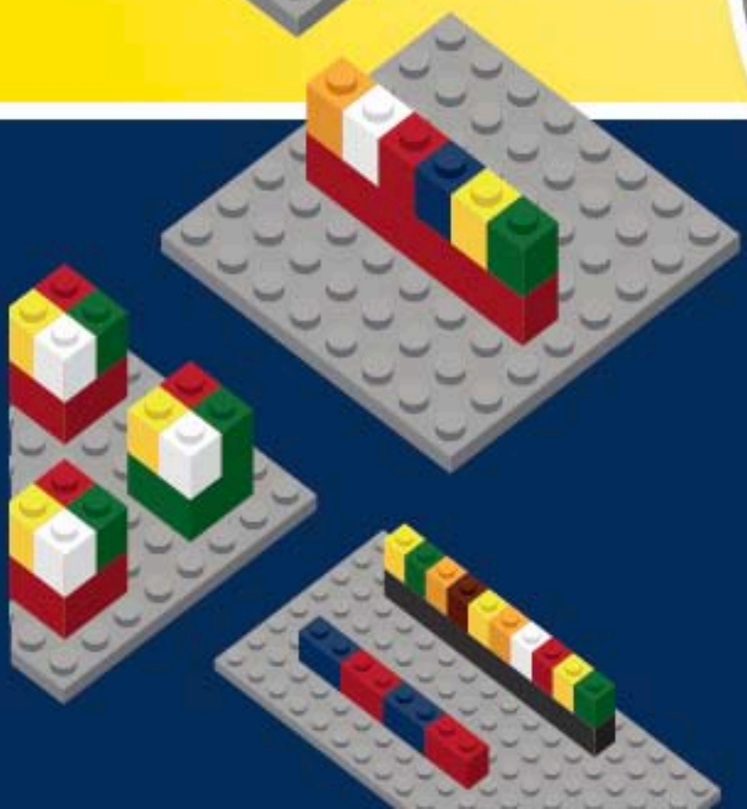
TEACHER EDITION

FRACTION DIVISION

USING LEGO® BRICKS





Dr. Shirley Disseler

FRACTION DIVISION USING LEGO® BRICKS DR. SHIRLEY DISSELER

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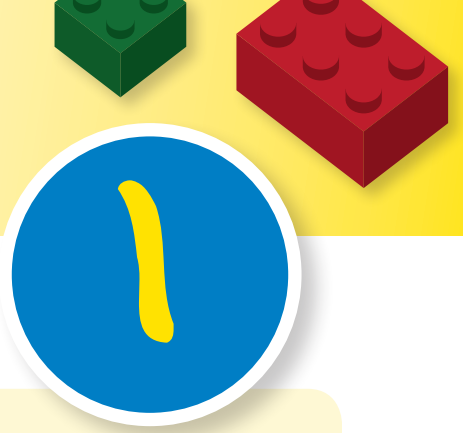


UNDERSTANDING FRACTION DIVISION

Students will learn/discover:

- The meaning of fraction division
- The meaning of the term *reciprocal*
- How fraction division and fraction multiplication are related

Why is this important?

Understanding the relationship between whole-number division and multiplication can lead to better understanding of fraction division because they work in a similar way. If students understand that division and multiplication undo one another when working with whole numbers, they will be better able to grasp the idea that the same properties apply to fractions.

Reciprocals in fraction division provide the link between multiplication and division when dividing two fractions. Many real-world situations involve fraction division, so it is important for students to gain a firm understanding of more than just the mathematical procedures. But students *must* understand whole-number division and its relationships before starting fraction division.

Vocabulary:

- **Dividend:** The number that is being divided into sets (example: in the problem *5 divided by* $^1/_2$, 5 is the dividend); usually, the first number in a division problem
- **Divisor:** The number by which another number is divided (in the problem *5 divided by* $^1/_2$, $^1/_2$ is the divisor); usually, the second number in a division problem

SUGGESTED BRICKS

Size	Number
1x1	15-20
1x2	12
1x3	6
1x4	6
1x6	2
1x8	2
1x12	1
2x3	3
2x6	1

Note: Using a baseplate helps keep the bricks in place. One large baseplate is suggested for these activities.

- **Quotient:** Answer to a division problem
- **Reciprocal:** One of a pair of numbers that when multiplied together equals 1; dividing 1 by a number gives that number's reciprocal (example: the reciprocal of 2 is $\frac{1}{2}$)
- **Multiplicative Inverse:** The process for obtaining the reciprocal
- **Division:** Separation into parts

How to use the companion student book, *Fraction Division Using LEGO® Bricks–Student Edition*:

- After students build their models, have them draw the models and explain their thinking in the student book. 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 book.
- Use the assessment in the student book to gauge student understanding of the content.

Part 1: Show Them How

Ask students what it means to multiply whole numbers. Discuss how the solution gets larger when you multiply two whole numbers (example: 3 x 4 = 12).

Ask students what it means to divide whole numbers. Discuss how the solution gets smaller when you divide two whole numbers (example: 12 ÷ 4 = 3).

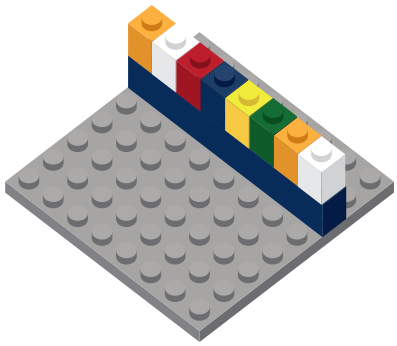
Ask students what they think it means to divide two fractions. Many will answer that the solution will be smaller than the two products. This is a misconception, because students associate multiplying with repeated addition, which increases with each factor iteration, and they associate division with repeated subtraction, which decreases with each iteration.

Show the problem 16 ÷ 8 = 2

Discuss the meaning of this math sentence: How many groups of 8 are there in 16 (*answer*: 2)?

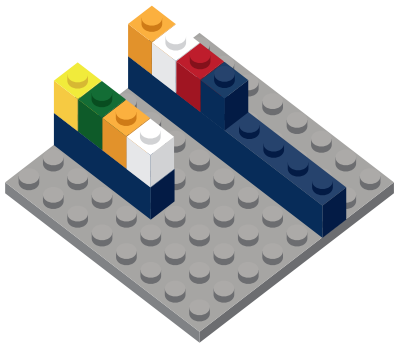
Tell students that this thinking can also work with fractions.

Problem #1: $\frac{1}{2} \div \frac{1}{8}$



1. Discuss the problem as a real-world scenario: Envision a flatbread pizza cut into 8 pieces.

Place a 1x8 brick on a baseplate to represent the pizza. Ask students how many pieces of pizza there are (*answer*: 8). Place eight 1x1 bricks on the top of the 1x8 brick to represent the 8 pieces of pizza.



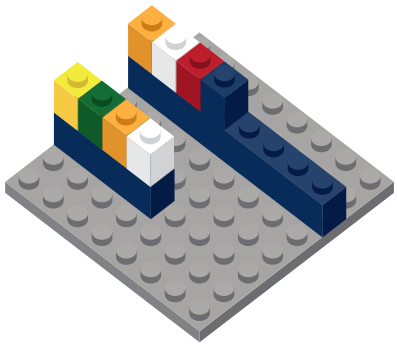
2. Since the problem calls for only half the pizza, make a model that shows $\frac{1}{2}$ of the pizza. Since 4 is $\frac{1}{2}$ of 8, use a 1x4 brick to show the half-pizza. Move 4 of the 1x1 bricks onto the 1x4 brick to show the pieces in that half. Have students build and draw this model.

3. Ask students how many pieces are in the half (*answer*: 4 whole pieces). Therefore, the solution to $\frac{1}{2} \div \frac{1}{8}$ is the whole number 4. *Note:* Students should include the quantifier *pieces* when they explain the solution to the pizza problem.

4. Explain how this relates to the reciprocal by referring to the whole number problem, $16 \div 8 = 2$. Use multiplication to see how that answer is correct by using the reverse: $2 \times 8 = 16$.

Students should know that $16 \div 8$ is the same as $\frac{16}{8}$ when written as a fraction. This fraction means $\frac{16}{1} \times \frac{1}{8} = \frac{16 \times 1}{1 \times 8}$

5. In the fraction problem, the model shows this process: $\frac{1}{2} \div \frac{1}{8} = 4$ whole pieces



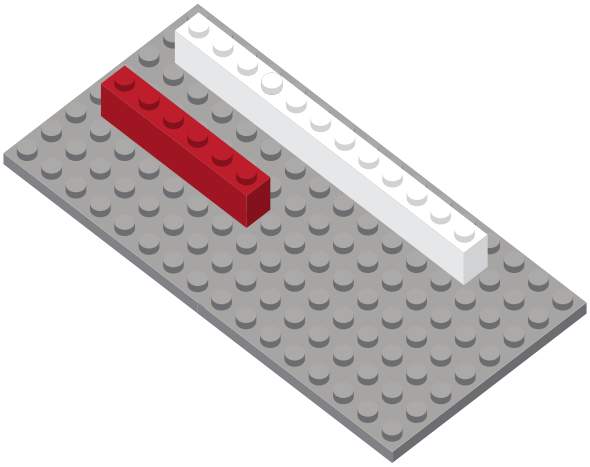
This can be reversed using the commutative property for multiplication as $4 \times \frac{1}{8} = \frac{1}{2}$. If the problem is written like a whole number multiplication problem using the reverse, the fraction is called the *reciprocal*. For example; the reciprocal of 2 is $\frac{1}{2}$ because $\frac{2}{1} \times \frac{1}{2} = 1$ whole.

This would look like: $\frac{4}{1} \times \frac{1}{8} = \frac{4}{8} = \frac{1}{2}$

Looking at the model, 4 sets of $\frac{1}{8}$ (four 1x1 bricks) is the same as $\frac{1}{2}$ in the original model. The model shows 8 studs divided into two parts. Each part has 4 pieces.

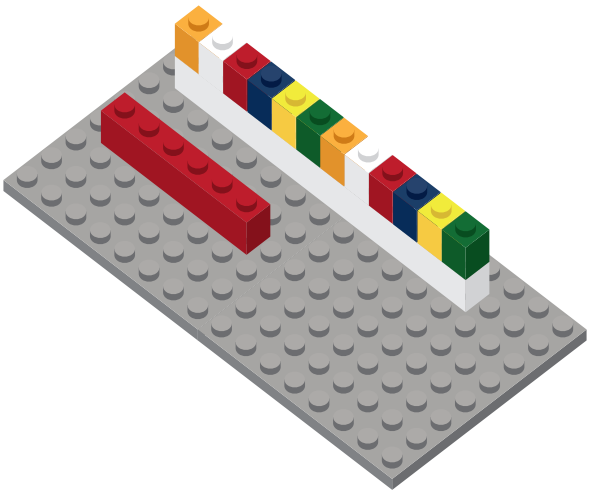
6. Rewrite the division problem using the reciprocal of $^1/_8$ (which is $^8/_1$) to show the mathematical procedure for solving the problem. $^1/_2 \div {}^1/_8 = {}^1/_2 \times {}^8/_1 = {}^8/_2 = 4$

Problem #2: $^1/_2 \div {}^1/_{12}$



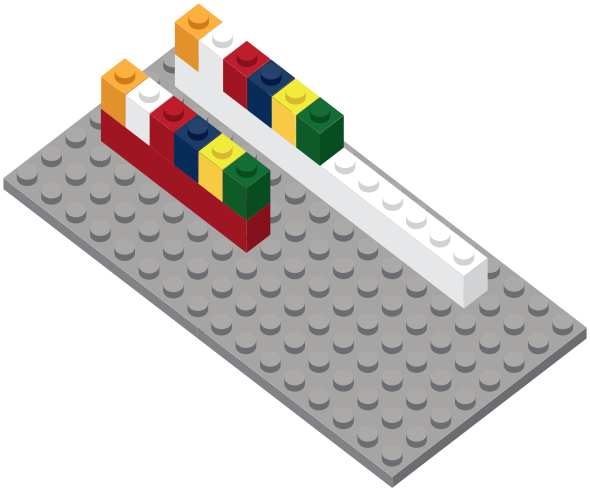
Step 1: Place a brick with 12 studs on a baseplate (*answer*: use a 1x12 or 2x6 brick).

Step 2: Determine what brick is equivalent to $^1/_2$ of the 12 studs (*answer*: a 1x6 brick).



Step 3: Discuss the problem as a real-world scenario: If the 1x12 brick represents a carton of eggs, how many eggs are in the carton (*answer*: 12)?

Place twelve 1x1 bricks on top of the 12 studs to show each egg. This shows that there are $^{12}/_{12}$ in the whole.



Step 4: Move $^1/_2$ of the 1x1 bricks to the model to show $^1/_2$ of the carton of eggs.