Brick Math Lesson of the Month
September 2020
from
Fraction Multiplication Using LEGO Bricks

Understanding the Commutative Property when Multiplying Fractions

Teacher Lesson Guide

Students will learn/discover:
- How the result (product) changes when a fraction is multiplied by a whole number
- How the commutative property works when multiplying fractions

Why is this important?

The commutative property extends from whole number multiplication to fraction multiplication. Students will see that order does not matter if no constraints are given in the problem. For example: 3 x 4 has the same solution as 4 x 3, even though the numbers represent different things when applied to real-life situations. Similarly, ½ x ¼ has the same solution as ¼ x ½, even though the fractions mean different things when applied to real-life situations. Students will realize this fact and learn to find answers quickly even if quantifiers are used to distinguish a specific order of terms in a problem. Students should always include quantifiers when providing solutions to problems in order to understand the meaning behind the numerical answer.
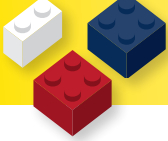
Vocabulary:
- Commutative property of multiplication: the idea that order does not matter when multiplying (i.e., a x b = b x a)
- Justify: prove
- Expression: math statement without an equals sign

How to use the companion student book, *Fraction Multiplication 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 is larger than the terms when multiplying two whole numbers (example: 3 x 4 = 12).

Ask students what they think happens when a fraction is multiplied by a whole number. Often, students will answer that the solution will be larger than the two products. This is a misconception for students because they associate multiplying with repeated addition, which increases with each factor iteration.

Problem #1: $\frac{1}{2}$ x 6 and 6 x $\frac{1}{2}$

1. Discuss the terminology of each problem.
- $\frac{1}{2}$ x 6 means $\frac{1}{2}$ of 6 wholes
- 6 x $\frac{1}{2}$ means six sets of $\frac{1}{2}$

Ask students if the two problems are different. Discuss the commutative property of multiplication as it applies to fractions. Students should understand that the order of the fractions does not affect the product. The fractions can be multiplied in any order.

To solve this problem, you will ask the students to build two models and compare them. When completed, you will ask students what they notice about the models. Students should recognize that the solutions are the same despite the fact that the order of terms is reversed.
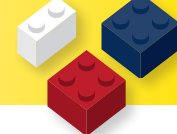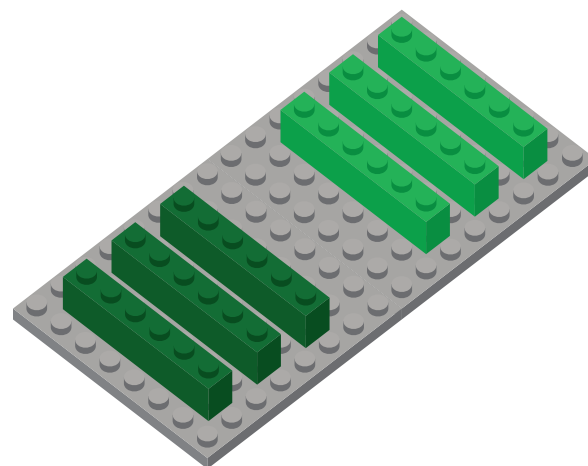
2. Have students build a model of $\frac{1}{2}$ x 6 ($\frac{1}{2}$ of 6 wholes). Note: students may build the model with six 1x1 bricks or one 1x6 brick, or they may use 6 bricks to model $\frac{1}{2}$ of 6 wholes. To prove the solution, one 1x6 brick may be the better choice, but it is not required. Both models illustrated are appropriate models of $\frac{1}{2}$ x 6 ($\frac{1}{2}$ of 6 wholes).

Have students draw their models. In writing, have students explain their thinking and how they derived the solution of 3. (*Answer for model A:* 6 studs broken down into 2 sets of 3 studs each. Therefore, the solution is 3. This model counts **studs**. *Answer for model B:* 6 bricks broken down into 2 sets of 3 bricks each. Therefore, the solution is 3. This model counts **bricks**.)
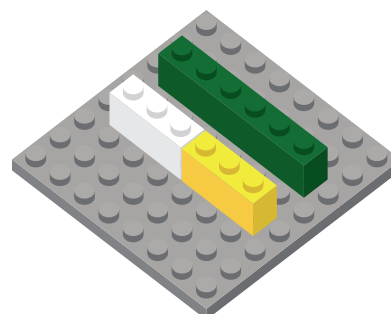
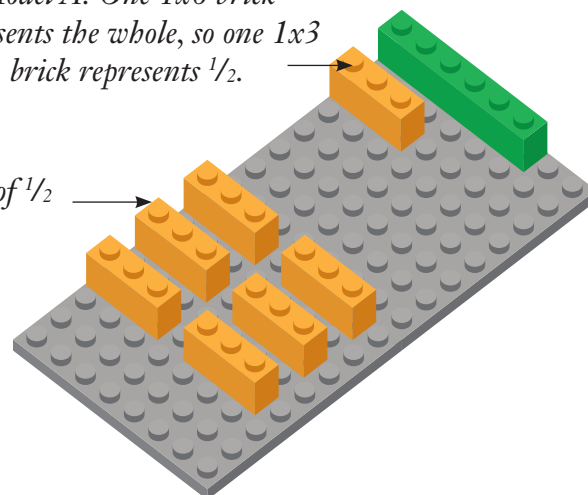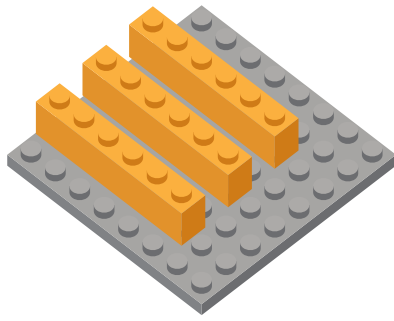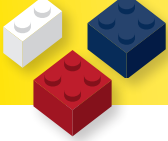*Model A: $\frac{1}{2}$ of a 1x6 brick = 3 studs*

Model B: $\frac{1}{2}$ of 6 bricks = 3 bricks

3. Have students build a model of 6 x $\frac{1}{2}$ (6 sets of $\frac{1}{2}$).

Model A: One 1x6 brick represents the whole, so one 1x3 brick represents $\frac{1}{2}$.

Model B: 6 sets of $\frac{1}{2}$

If using Model B, students join the 1x3 bricks together to show the sets made into wholes. The model shows 3 wholes of 6 studs each in the 6 sets of ½.

In writing, have students explain their thinking and how they arrived at the solution of 3. (*Answer:* Building ½ six times and joining together the numerators of all six fractions and comparing them to the denominator of 2 yields the whole number three. It is repeated addition of parts rather than wholes.)

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Student Workbook Pages
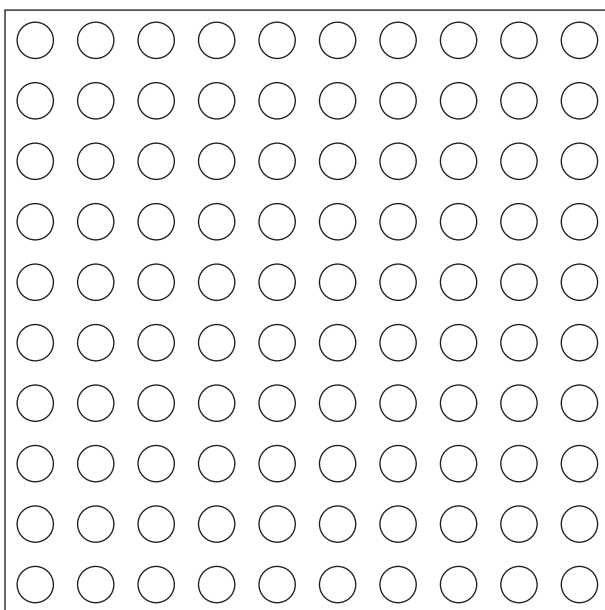
What does it means to multiply whole numbers?

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Problem #1: ¹/₂ x 6 and 6 x ¹/₂

1. What do each of these problems mean?

¹/₂ x 6: _____

6 x ¹/₂: _____

2. Model ¹/₂ x 6 (¹/₂ of 6 wholes). Draw your model. Explain your thinking and how you arrived at the solution.

3. Model 6 x ½ (6 sets of ½). Draw your model. Explain your thinking and how you arrived at the solution.

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