# Multiply Using the Distributive Property

In this lesson, students will model the distributive property using multiple representations and explain why it works.

###### NC Mathematics Standards:

**Number and Operations in Base Ten**

**NC.4.NBT.5** Multiply a whole number of up to three digits by a one-digit whole number, and multiply up to two two-digit numbers with place value understanding using area models, partial products, and the properties of operations. Use models to make connections and to develop the algorithm.

###### Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them.

4. Model with mathematics.

1. Attend to precision.
2. Look for and make use of structure.

###### Student Outcomes:

* + - * I can use multiple representations for multiplication.
      * I can use the distributive property in multiplication.
      * I can explain the distributive property and why it works.

###### Materials:

* + - * Base ten blocks (at least 20 rods and 30 unit cubes per pair)
      * Recording Sheet (one per student)
      * Grid paper and blank paper (available for students to use)

###### Advance Preparation:

* + - * Gather base ten blocks. You may want to create a bag of blocks for each pair of students to make them easier to distribute.
      * Make copies of the Recording Sheet (one per student).
      * Consider how students should be paired or grouped for this lesson.

###### Launch:

1. Introduce Problem (5 minutes)

Introduce students to the Black Mountain Chocolate Factory.

Located in Winston-Salem, NC, the Black Mountain Chocolate Factory produces chocolate bars that are handcrafted from cocoa beans and other natural ingredients.

<https://www.blackmountainchocolate.com/> They make five types of chocolate bars: Mountain Milk Chocolate Bar, Dominican Single-Origin Dark Chocolate Bar, Sea Salt Dark Chocolate Bar, Cocoa Nib Dark Chocolate Bar, and Espresso Dark Chocolate Bar.

Present the following problem to students:

*The Black Mountain Chocolate Factory has orders for chocolate bars from 6 different stores across the state. Each order contains 32 chocolate bars. How many chocolate bars does the candy company need to make?*

Ask students to solve the problem using multiple representations (numbers, models, grid paper, base ten blocks). They may work individually or with partners to solve the problem.

**Explore:**

1. Solving the Problem (10 minutes)

Allow students time to work individually or with partners in order to solve the problem. As students work, observe students to see how they are solving the problem. Encourage students to use multiple strategies and share their strategies with one another.

Observe:

* How are students modeling the problem?
* How are students making connections between the multiple representations?
* What vocabulary are students using as they solve the task? (product, factors, array, partial products, distributive property, tens and ones)

Carefully select two to three solutions to share with the class. Look for solutions that used base ten blocks and decomposing by place value (distributive property). You may also want to include an array or drawing.

**Discuss:**

1. Discussion of Solutions (10 – 15 minutes)

Display the various solutions to students. Have them discuss the solutions with a partner. How are the solutions alike? How are they different?

Using base ten materials, students may model 6 x 32 by showing 6 groups of 32 as shown below:

Example of a response that decomposes by place value and uses the distributive property:

6 x 32 6 x 30 = 180 and 6 x 2 = 12 180 + 12 = 192

Example using an array:

30

2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

6 x 30 = 180 and 6 x 2 = 12 180 + 12 = 192

Example using an open array:

2

30

6 x 2 = 12

6

6 x 30 = 180 180

Example using a number line:

30

30

30

30

30

30

2

2

2

2

2

2

180

0

30

60

90

120

150

192

6 x 30 = 180 180 + (6 x 2) = 192

1. Have students share their observations about the different solutions and models.

Students may notice that each model includes 6 groups of 30 and 6 groups of 2. Help students make a connection between the blocks and the expression (6 x 30) + (6 x 2).

Point out how the number 32 was broken into 30 + 2. This makes it easier to multiply and add mentally. Thus, this problem could be written as follows:

6 x 32 = (6 x 30) + (6 x 2)

Introduce the term “Distributive Property.” Ask students to explain how the distributive property is related to expanded notation. As students share their thinking, record any method that makes this connection such as:

32 = 30 + 2 So 6 x 32 = (6 x 30) + (6 x 2)

1. Additional Practice: (20 – 30 minutes)

Present students with another problem.

*Harris Teeter orders four different chocolate bars from the Black Mountain Chocolate Factory - Mountain Milk Chocolate Bar, Dominican Single-Origin Dark Chocolate Bar, Sea Salt Dark Chocolate Bar, and Espresso Dark Chocolate Bar. They order 53 of each type of chocolate bar. How many chocolate bars will need to be delivered to Harris Teeter?*

Ask the students to work with a partner to model this problem with base ten blocks and draw their diagram on the Recording Sheet. Then show this problem using numbers and symbols. Students should take turns explaining the mathematics they are using and why it makes sense.

Present a third problem to students.

*Three different stores order 67 chocolate bars from the Black Mountain Chocolate Factory. How many chocolate bars with the chocolate factory need to produce?*

Ask students to solve the problem and use the same process of modeling the problem with blocks and recording their work on the Recording Sheet. This time, challenge students to use the term “distributive property” as they explain the mathematics they used with their partners.

Encourage students to create additional multiplication problems, modeling and recording their work on the Recording Sheet.

1. When most pairs have finished, ask students to share their thinking about the mathematics they are using. Challenge them to use the term “distributive property” as they explain their reasoning. Close the lesson by asking students to explain how using the distributive property can help you solve multiplication problems. This question might prompt a small group or whole-class discussion or it might be used as a journal prompt.

###### Questions to Pose:

As students work with their partner:

* + - * How does your model connect to the numbers and symbols?
      * Why does it make sense to use an addition symbol in the expression?
      * How does breaking the number apart help you solve the problem?
      * How did you decide where to start solving the problem?

During class discussion:

* Explain how the distributive property is helpful when you are multiplying large numbers. Create a multiplication problem that supports your explanation.
* What would happen if you tried to use the distributive property to solve a problem such as 458 x 7?
* How does the distributive property connect to the models we have been using?

###### Possible Misconceptions/Suggestions:

|  |  |
| --- | --- |
| **Possible Misconceptions** | **Suggestions** |
| * Students have difficulty decomposing numbers using place value. They have trouble recognizing that 32 is the same as 30 + 2. * Students do not connect multiplication with equal groups. | * Give students the opportunity to build two-digit numbers with a variety of manipulatives. * Emphasize the values of tens and ones. * Provide a variety of manipulatives for students to partition into equal groups. Encourage students to provide stories that match their manipulatives such as “Four squirrels each carried 8 acorns.” Help students write a multiplication expression that corresponds with their manipulatives and context. |

**Special Notes:**

Possible follow-up lessons:

* + - * Extend to multiplying with larger numbers including three digits by one digit.
      * This lesson applies the distributive property to decomposing large numbers by place value (32 = 30 + 2). Provide problems that model and apply the distributive property to decomposing numbers by addends such as 4 x (8 + 4) or 4 x (6 + 6) or 4 x (7 + 5).
      * Explore whether or not the distributive property could be used in addition, subtraction, and division.

###### Solutions: NA

*\*Adapted from: “Exploring the Distributive Property” Mathematics Enhanced Scope and Sequence. Virginia Department of Education, 2011*

**Multiply Using the Distributive Property**

**Recording Sheet**

|  |  |
| --- | --- |
| **Pictures & Models**  (Use for tens and for ones.) | **Numbers & Symbols** |
|  | **4 × 53 = (**\_\_\_**×**\_\_\_**) + (\_\_\_×**\_\_\_**)** |
|  |  |
|  |  |
|  |  |
|  |  |