

Math Objectives

- Students will recognize the Distributive Property of Multiplication over Addition: $a(b + c)$ is equivalent to $ab + ac$, and $ab + ac$ is equivalent to $a(b + c)$.
- Students will evaluate by substituting in an expression.
- Students will apply the Distributive Property of Multiplication over Addition in new algebraic situations.
- Students will look for regularity in repeated reasoning (CCSS Mathematical Practice).
- Students will use appropriate tools strategically (CCSS Mathematical Practice).

Vocabulary

- distributive property
- equivalent
- expression




About the Lesson

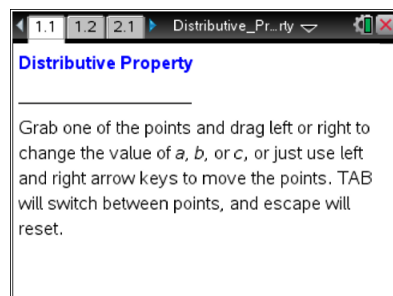
- The activity involves the concept of algebraic distribution of multiplication over addition using numbers. Students will change the values of the variables a , b , and c and will observe the changes in the expressions.
- As a result, students will:
- Understand the Distributive Property of Multiplication over Addition.

TI-Nspire™ Navigator™ System

- Send out the *Distributive_Property.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies:  TI-Nspire™ CX Handhelds,  TI-Nspire™ Apps for iPad®,  TI-Nspire™ Software



Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at <http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>

Lesson Materials:




- Student Activity*
- Distributive_Property.pdf
 - Distributive_Property.doc

TI-Nspire document

- Distributive_Property.tns

Discussion Points and Possible Answers



Tech Tip: If students experience difficulty dragging a point, make sure they have not selected more than one point. Press **esc** to release points. Check to make sure that they have moved the cursor (arrow) until it becomes a hand () getting ready to grab the point. Also, be sure that the word point appears. Press **ctrl**  to grab the point and close the hand (). When finished moving the point, press **esc** to release the point.



Tech Tip: Instead of grabbing you can click on the bottom of the screen and just use the left and right arrow keys to move a point. Press TAB to switch between points. Press ESC to reset.



Tech Tip: After moving the point, think how the expression will change, then tap the bottom of the screen to check if you were right. Students should note the color change indicating which pane is active. The border is light blue when the pane containing the number line is active and magenta when the pane containing the calculations are active.

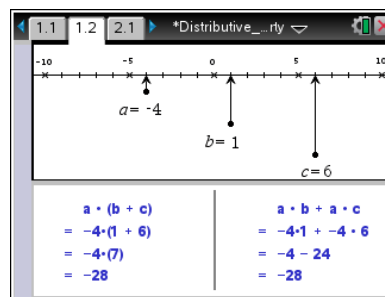


TI-Nspire Navigator Opportunities

Class Capture or Live Presenter could be used throughout this lesson to monitor student progress. If students are having difficulty with some questions, use Live Presenter by demonstrating or choosing a student to demonstrate.

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- As you grab a point to move an arrow beneath the number line, what do you observe about the value of the expressions when you change the value of a ? b ? c ?



Answer: The value of both expressions are the same no matter where the points for the values of a , b , and c are placed.



Teacher Tip: Teachers should make sure students understand that a , b , and c can be placed in any order on the number line. For example, “What happens when a is placed to the right of b and c ?” As a result of question 1, students should be able to observe that equivalence is maintained no matter what the values are for a , b , and c .

2. Place b and c so that their sum is a positive number. For positive value of a , what is the sign of the answer? Why?

Answer: The sum of b and c is a factor of the expression on the left regardless of the sign of the individual values. When this sum is positive and a is positive, the result will always be positive.

3. Place b and c so that their sum is a negative number. For positive values of a , what is the sign of the answer? Why?

Answer: The sum of b and c is a factor of the expression on the left regardless of the sign of the individual values. When this sum is negative and a is positive, the result will always be negative.

Teacher Tip: The teacher should ask students, “Why are we concerned about the sign of the sum of b and c rather the individual signs of b and c ?” Students should notice that the sum of b and c is a factor of the expression on the left. They should also make connections to the Multiplicative Property of Zero.

4. Describe the first step used to evaluate each expression.

Answer: The first step to evaluate the expression on the left is to compute the sum of the two numbers in the parentheses. The first step to evaluate the expression on the right is to perform the two multiplications.

Teacher Tip: The teacher should realize that each student could have different numbers. However, the steps taken to evaluate are the same regardless of the numbers used. This is a good time to have students share their answers with their classmates.

5. Compare the two expressions. How are they similar? How are they different?

Answer: The two expressions are the same in that the expressions on both sides calculate to the same result. The two expressions are different in the order of how the calculation is determined. The steps in evaluating each expression are done in a different order. Other answer could include the following:

- The two expressions are alike in that the values of both are always equal.
- The same operations (multiplication and addition) are used in both.
- The same values are being substituted in both expressions.
- They are different in that the steps to get the values of the expressions are not the same.
- On the left, you add first; on the right, you multiply first.
- Only one expression has a set of parentheses.

6. Do you think these expressions will always have the same value? Why or why not?

Answer: The two expressions are equivalent in that the values of both expressions result in the same number. Answers may vary, but students could show a numerical example with correct order of operations on both sides of the vertical line. Students will likely observe that all possible combinations of a , b , and c result in equivalent expressions.

Teacher Tip: Encourage students to explore multiple and different numerical values of the variables rather than deciding on the response to this question based on one or two combinations of a , b , and c .



TI-Nspire Navigator Opportunities

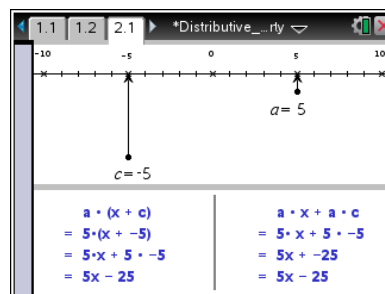
While students are working on this page, you may want to set up an Open Response Quick Poll for students to answer the questions. For these questions, explain to the students the format that you would like them to follow in answering the questions. For example, no spaces between the coefficient and the x , no spaces before and after the signs, and so on.

If you are not specific, you will get many answers in many different forms and will have to scroll through a large number of responses. By carefully specifying the form of the answers, fewer responses will show.

As an alternative to Quick Polls, you may want to edit the .tns file and add Learn Check questions. You can then collect students' answers and analyze them in Class Analysis.

Move to page 2.1.

7. Drag the points to change the values of a and c . Notice that the expression on the left is still equal to the expression on the right. The answer is a simplified expression instead of a value. Write an equivalent expression for each expression below.



- | | |
|----------------|--|
| a. $4(x + 2)$ | <u>Answer:</u> $4x + 8$ |
| b. $3(x - 5)$ | <u>Answer:</u> $3x - 15$ |
| c. $-2(x + 3)$ | <u>Answer:</u> $-2x - 6$ |
| d. $-7(x - 2)$ | <u>Answer:</u> $-7x + 14$ |
| e. $2x + 6$ | <u>Answer:</u> $2(x + 3)$ |
| f. $5x + 35$ | <u>Answer:</u> $5(x + 7)$ |
| g. $-6x + 18$ | <u>Answer:</u> $-6(x - 3)$ or $6(-x + 3)$ |

Teacher Tip: Students may or may not use the .tns file to answer these questions. In some cases, there may be different variations if students complete them without the use of the .tns file.

8. The Distributive Property states $a(b + c)$ and $ab + ac$ are equivalent for all real numbers a , b , and c because they are equal for all possible values of the variables. Use the Distributive Property to write an equivalent expression for each expression below.

- | | |
|------------------|--|
| a. $17(x + 2)$ | <u>Answer:</u> $17x + 34$ |
| b. $15(c + d)$ | <u>Answer:</u> $15c + 15d$ |
| c. $-15(2x + y)$ | <u>Answer:</u> $-30x - 15y$ |
| d. $20x + 40$ | <u>Possible Answer:</u> $20(x + 2)$ |
| e. $ac + dc$ | <u>Answer:</u> $c(a + d)$ |
| f. $-10xy + 20y$ | <u>Possible Answer:</u> $10y(-x + 2)$ |

Teacher Tip: Students might use the .tns file to answer some of these questions. Other questions are designed so that students cannot use the .tns file.



TI-Nspire Navigator Opportunities

After the discussion from the questions, give a similar Quick Poll question(s) to verify that students understand the concepts presented in the lesson.

You might want to delete students' files from their handhelds and send a fresh file for the next class.

Wrap Up

Upon completion of the discussion, the teacher should ensure that students understand:

- Both expressions are equivalent no matter the values of a , b , and c .
- How to evaluate the expressions for values of a , b , and c .
- The rules for order of operations for both expressions.