They're Multiplying—Like Polynomials!

12.2

Multiplying Polynomials

LEARNING GOALS

In this lesson, you will:

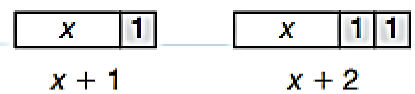
- Model the multiplication of a binomial by a binomial using algebra tiles.
- Use multiplication tables to multiply binomials.
- Use the Distributive Property to multiply polynomials.

PROBLEM 1 Modeling Binomials

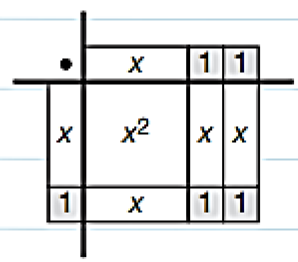
So far, you have learned how to add and subtract polynomials. But what about multiplying polynomials?

Let's consider the binomials $x + 1$ and $x + 2$. You can use algebra tiles to model the two binomials and determine their product.

Represent each binomial with algebra tiles.



Create an area model using each binomial.



1. What is the product of $(x + 1)(x + 2)$?

   $(x + 1)(x + 2) = x^2 + x + x + x + 1 + 1$

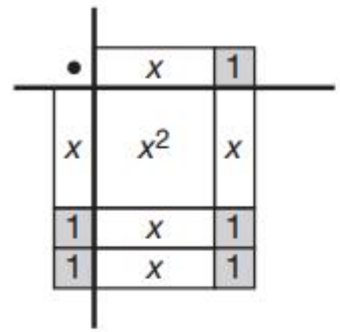
   $= x^2 + 3x + 2$

2. How would the model change if the binomial $x + 2$ was changed to $x + 4$. What is the new product of $x + 1$ and $x + 4$?

   I would add two more 1s to $(x + 2)$ and two x's and two 1s to the area model.

   $(x + 1)(x + 4) = x^2 + 5x + 4$.

3. Jamaal represented the product of $(x + 1)$ and $(x + 2)$ as shown.



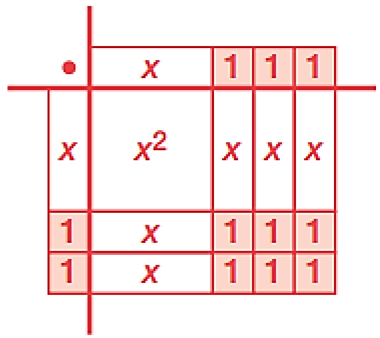
Natalie looked at the area model and told Jamaal that he incorrectly represented the area model because it does not look like the model in the example. Jamaal replied that it doesn't matter how the binomials are arranged in the model.

Determine who's correct and use mathematical principles or properties to support your answer.

Jamaal is correct. The Commutative Property of Multiplication states that expressions can be multiplied in any order.

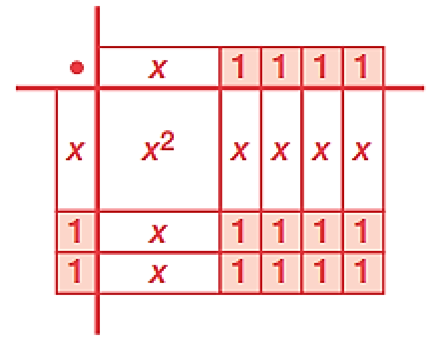
4. Use algebra tiles to determine the product of the binomials in each.

a. $x + 2$ and $x + 3$



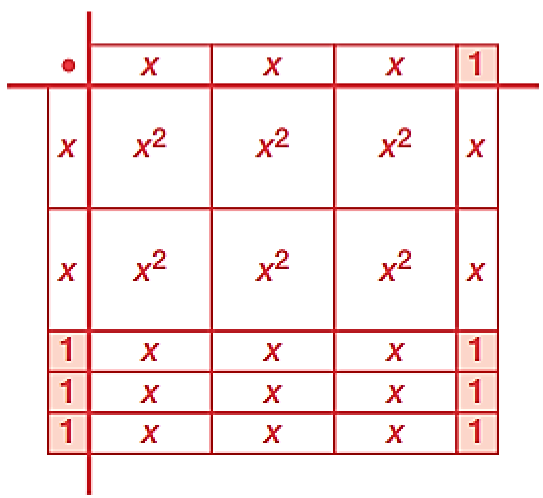
$x^2 + 5x + 6$

b. $x + 2$ and $x + 4$



$x^2 + 6x + 8$

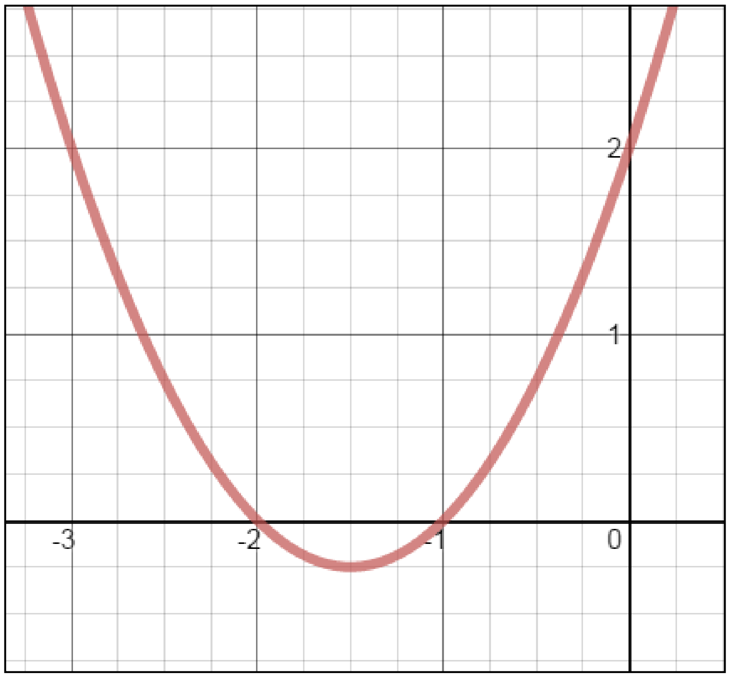
c. $2x + 3$ and $3x + 1$



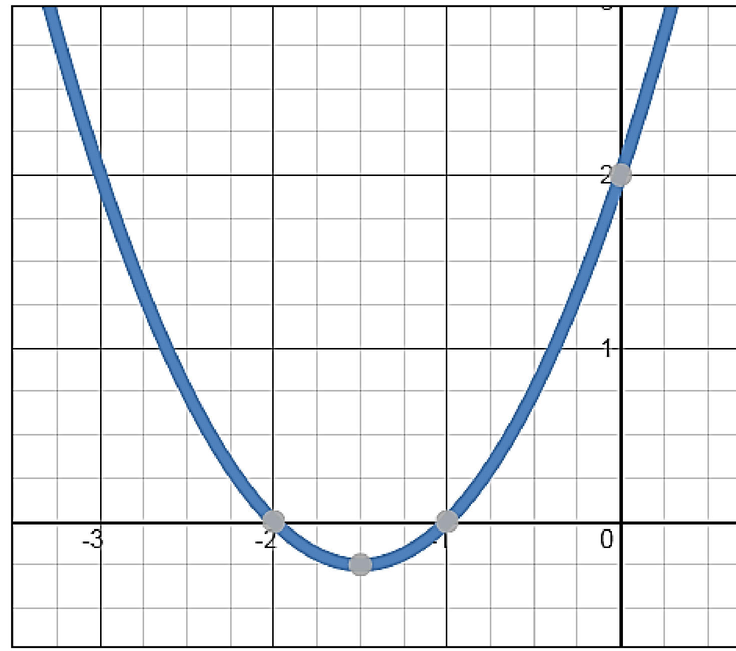
$6x^2 + 11x + 3$

You can use a graphing calculator to check if the product of two binomials is correct.

$y = (x + 1)(x + 2)$



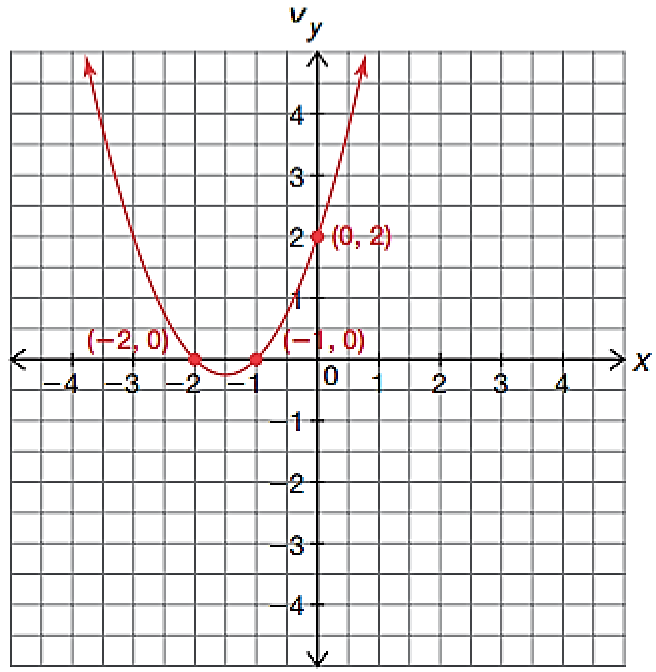
$y = x^2 + 3x + 2$



Don’t sketch the graphs. Take a moment to figure out what they have in common?

5. Use a graphing calculator to verify the product from the worked example: $(x + 1)(x + 2) = x^2 + 3x + 2$.

a. Sketch both graphs on the coordinate plane.



b. How do the graphs verify that $(x + 1)(x + 2)$ and $x^2 + 3x + 2$ are equivalent?

The graphs are the same.

c. Plot and label the x-intercepts and the y-intercept on your graph. How do the forms of each expression help you identify these points?

The Factored Form, $(x + 1)(x + 2)$, tells us the x-intercepts are (-2, 0) and (-1, 0).

Standard Form, or $x^2 + 3x + 2$, tells us the y-intercept is (0, 2).

Skip #6 and #7. Go to Page 723.

PROBLEM 2 I'm Running Out of Algebra Tiles!

While using algebra tiles is one way to determine the product of polynomials, they can also become difficult to use when the terms of the polynomials become more complex.

Todd was calculating the product of the binomials $4x + 7$ and $5x - 3$. He thought he didn't have enough algebra tiles to determine the product. Instead, he performed the calculation using the model shown.

1. Describe how Todd calculated the product of $4x + 7$ and $5x - 3$.

   It's like using a Punnett square. Then, combining like terms at the end.

Todd

$\cdot$	$5x$	-3
$4x$	$20x^2$	$-12x$
7	$35x$	-21

$20x^2 + 23x - 21$

2. How is Todd's method similar to and different from using the algebra tiles method?

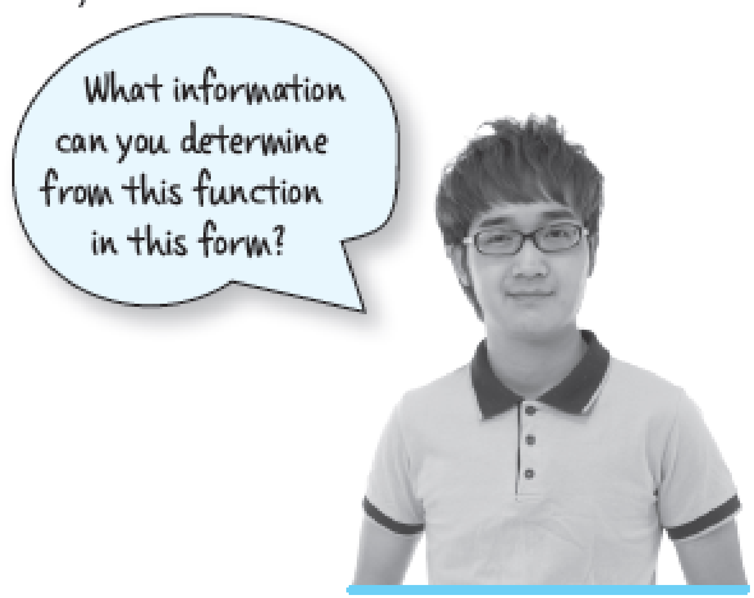
   You're distributing with both methods, but Todd's method is an easier way to represent large numbers.

Todd used a multiplication table to calculate the product of the two binomials. By using a multiplication table, you can organize the terms of the binomials as factors of multiplication expressions. You can then use the Distributive Property of Multiplication to multiply each term of the first polynomial with each term of the second polynomial.

3. Determine the product of $(50 - x)$ and $(100 + 10x)$ using a multiplication table.

$\cdot$	100	$10x$
50	5000	$500x$
$-x$	$-100x$	$-10x^2$

$$-10x^2 + 400x + 5000$$



4. Determine the product of the binomials using multiplication tables. Write the product in standard form.

a. $3u + 17$ and $4u - 6$

$12u^2 + 50u - 102$

$\cdot$	$4u$	-6
$3u$	$12u^2$	$-18u$
17	$68u$	-102

b. $8x + 16$ and $6x + 3$

$48x^2 + 120x + 48$

$\cdot$	$6x$	3
$8x$	$48x^2$	$24x$
16	$96x$	48

c. $7y - 14$ and $8y - 4$

$56y^2 - 140y + 56$

$\cdot$	$8y$	-4
$7y$	$56y^2$	$-28y$
-14	$-112y$	56

d. $9y - 4$ and $y + 5$

$9y^2 + 41y - 20$

$\cdot$	y	5
$9y$	$9y^2$	$45y$
-4	$-4y$	-20