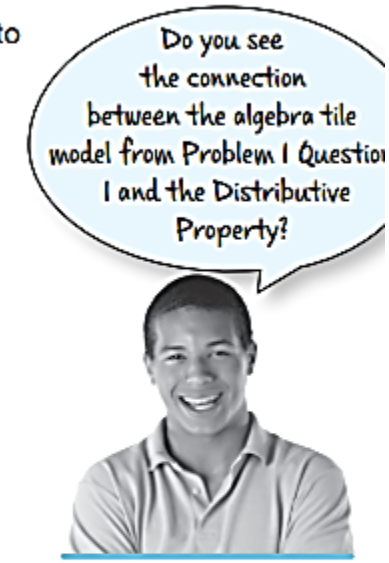
PROBLEM 3 You *Have Been* Distributing the Whole Time!

So far, you have used both algebra tiles and multiplication tables to determine the product of two polynomials.

Let's look at the original area model and think about multiplying a different way. The factors and equivalent product for this model are:



$x + 1$ and $x + 2$

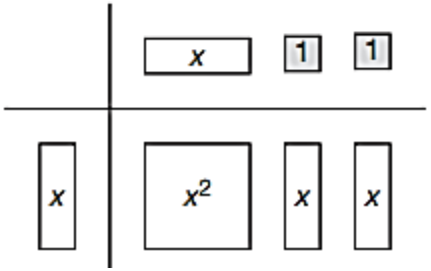
•	x	2
x	x^2	2x
1	1x	2

•	x	1	1
x	x^2	x	x
1	x	1	1

$(x + 1)(x + 2) = x^2 + 3x + 2$

We can also use the Distributive Property to write (x + 1)(x + 2) in Standard Form.

The model can also be shown as the sum of each row.



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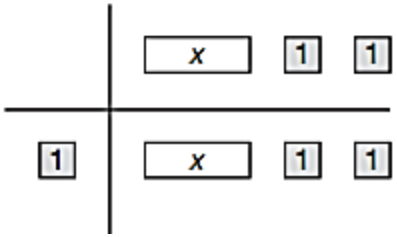


$(x + 1)(x + 2) =$

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

Distribute the x!

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

Distribute the 1!

1. Write the factors and the equivalent product for each row represented in the model.

2. Use your answers to Question 1 to rewrite $(x + 1)(x + 2)$.

   a. Complete the first equivalent statement using the factors from each row.

   b. Next, write an equivalent statement using the products of each row.

$(x + 1)(x + 2) =$ $x(x+2)+1(x+2)$ *Distributive Property*

$=$ $x^2+2x+1x+2$ *Distributive Property*

$=$ $x^2 + 3x + 2$ *Combine like terms*

   c. Write the justification for each step.

The Distributive Property can be used to multiply polynomials. The number of times that you need to use the Distributive Property depends on the number of terms in the polynomials.

3. How many times was the Distributive Property used in Question 2?

   Twice.

4. Use the Distributive Property to multiply a monomial by a binomial.

$(3x)(4x + 1) = (\underline{3x})(\underline{4x}) + (\underline{3x})(\underline{1})$

$= \underline{12x^2+3x}$

Another method that can be used to multiply polynomials is called the FOIL method. The word FOIL indicates the order in which you multiply the terms. You multiply the First terms, then the Outer Terms, then the Inner terms, and then the Last terms. FOIL stands for First, Outer, Inner, Last.

You can use the FOIL method to determine the product of $(x + 1)$ and $(x + 2)$.

First

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

Outer

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

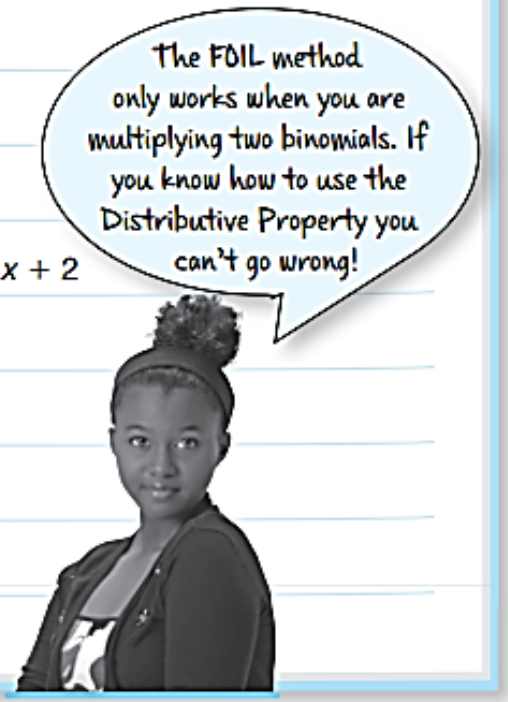
Inner

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

Last

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

$x^2 + 2x + x + 2$



Collect the like terms and write the solution in standard form.

$x^2 + 3x + 2$

Warning: The FOIL method only works when you have 2 binomials.

You get the same results when you use a Multiplication Table. Choose what method works best for you!

•	x	2
x	x^2	2x
1	1x	2

$x^2 + 2x + 1x + 2$

$x^2 + 3x + 2$

5. Determine each product.

a. $2x(x + 3)$

$2x^2 + 6x$

b. $5x(7x - 1)$

$35x^2 - 5x$

c. $(x + 1)(x + 3)$

•	x	1
x	x^2	1x
3	3x	3

$x^2 + 4x + 3$

d. $(x - 4)(2x + 3)$

$2x^2 + 3x - 8x - 12$

$2x^2 - 5x - 12$

You can use the Distributive Property to determine the product of a binomial and a trinomial.

Consider the polynomials $x + 1$ and $x^2 - 3x + 2$. You need to use the Distributive Property twice to determine the product.

First, use the Distributive Property to multiply each term of $x + 1$ by the polynomial $x^2 - 3x + 2$.

★ $(x + 1)(x^2 - 3x + 2) = (x)(x^2 - 3x + 2) + (1)(x^2 - 3x + 2)$

Now, distribute x to each term of $x^2 - 3x + 2$, and distribute 1 to each term of $x^2 - 3x + 2$.

★ $(x + 1)(x^2 - 3x + 2) = (x)(x^2) + (x)(-3x) + (x)(2) + (1)(x^2) + (1)(-3x) + (1)(2)$

Finally, multiply and collect the like terms and write the solution in standard form.

★ $x^3 - 3x^2 + 2x + x^2 - 3x + 2$

★ $x^3 - 2x^2 - x + 2$

3. You can also use a multiplication table to multiply a binomial by a trinomial. Complete the table to determine the product.

•	x^2	$-3x$	2
x	x^3	$-3x^2$	$2x$
1	x^2	$-3x$	2

$x^3 - 2x^2 - x + 2$

4. Determine each product.

a. $(x - 5)(x^2 + 3x + 1)$

•	x^2	$3x$	1
x	x^3	$3x^2$	$1x$
-5	$-5x^2$	$-15x$	-5

$x^3 - 2x^2 - 14x - 5$

b. $(x + 5)(2x^2 - 3x - 4)$

•	$2x^2$	$-3x$	-4
x	$2x^3$	$-3x^2$	$-4x$
5	$10x^2$	$-15x$	-20

$2x^3 + 7x^2 - 19x - 20$

c. $(x - 4)(x^2 - 8x + 16)$

You can also use the Distributive Property!

$x^3 - 8x^2 + 16x - 4x^2 + 32x - 64$

$x^3 - 12x^2 + 48x - 64$