

LESSON 24 | MEET THE IDEA

Multiplying polynomials

Thursday, January 21, 2027 . 6:00–7:00 PM Central

By the end, I can...

Multiply every term of one polynomial by every term of the other, combine like terms and check the result.

Multiplication uses the distributive property. For $(x + 3)(x + 2)$, each term in the first factor must meet **both** terms in the second factor.

Build $(x + 3)(x + 2)$

	x	2
x	x^2	$2x$
3	$3x$	6

This is an algebra grid, not a scale drawing.

Add the four cells:
 $x^2 + 2x + 3x + 6 = x^2 + 5x + 6.$

Count the products

Two terms multiplied by two terms give **four partial products** before combining. The grid helps you avoid missing one. With three terms in a factor, keep the same every-term-by-every-term rule.

LESSON 24 | DISTRIBUTE, THEN COMBINE

Signs travel with their terms

Multiply $(2x - 3)(x + 4)$

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

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

$$2x^2 + 5x - 12$$

Use the complete signed terms $2x$ and -3 .

Distribute each term to the whole second factor.

Combine the linear terms.

Check with a simple input

At $x = 2$, the original product is $(4 - 3)(2 + 4) = 1 \times 6 = 6$.

The expanded expression gives $2(4) + 5(2) - 12 = 6$.

The values agree. This catches many errors, though one matching input is not a proof of an identity.

A single term also distributes

$$2x(3x + 4)$$

$$6x^2 + 8x$$

Multiply $2x$ by both terms.

Use $x \times x = x^2$; coefficients multiply too.

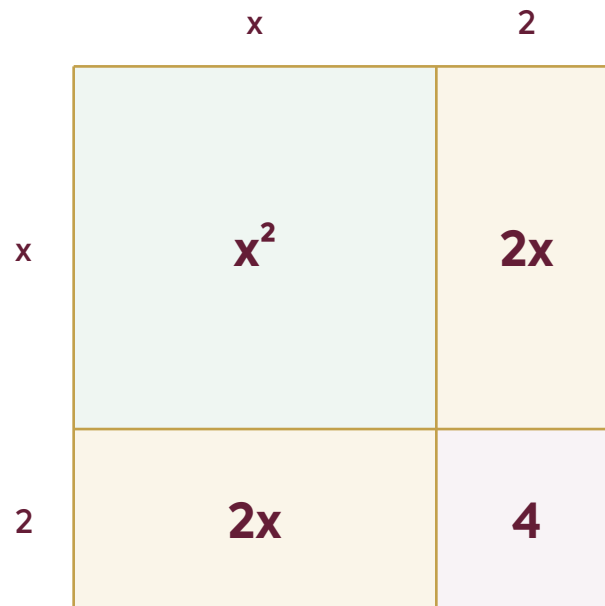
The sign belongs to the whole term

In the first example, $-3 \times 4 = -12$. Do not drop the minus sign or change it just because you are combining other terms.

LESSON 24 | AN AREA MODEL

Why a squared binomial has a middle term

$(x + 2)^2$ means $(x + 2)(x + 2)$. A square with that side length splits into four regions, not two.



$$(x + 2)^2 = x^2 + 2x + 2x + 4$$

Area model for positive x ; illustration uses $x = 4$.

Both rectangles matter: $2x + 2x = 4x$. So

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

The general pattern

$$(a + b)^2 = a^2 + 2ab + b^2.$$

$$(a - b)^2 = a^2 - 2ab + b^2.$$

The identities work algebraically for all real a and b . The area picture uses positive lengths.

For example, $(x - 3)^2 = (x - 3)(x - 3) = x^2 - 6x + 9$. The last term is positive because $(-3)(-3) = 9$.

LESSON 24 | LINEAR AND QUADRATIC FACTORS

The product can have a higher degree

Linear × quadratic | $(x + 2)(x^2 - x + 3)$

$$x(x^2 - x + 3)$$

$$+ 2(x^2 - x + 3)$$

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

$$+ 2x^2 - 2x + 6$$

$$x^3 + x^2 + x + 6$$

Distribute each term across all three terms.

There are six partial products.

Combine like terms. A degree-3 result is expected.

Quadratic × quadratic: $(x^2 + 1)(x^2 + x + 2)$

	x^2	x	2
x^2	x^4	x^3	$2x^2$
1	x^2	x	2

This is an algebra grid, not a scale drawing.

Add the cells: $x^4 + x^3 + 3x^2 + x + 2$.

The factors each have degree 2; their product has degree 4. A factor does not need every possible term to be quadratic.

Today’s input factors have degree 1 or 2, but their products are not restricted to degree 2. The same distributive process handles all these examples.

LESSON 24 | SHORT CHECKS

Your turn

Use a grid or distribution. Show the partial products before combining.

1. Expand $(x + 4)(x - 1)$.

2. Expand $(2x - 1)(x + 3)$.

3. Expand $(x + 1)(x^2 + 2x + 3)$.

4. Expand $(x^2 + 2)(x^2 - 1)$.

5. A square has side $x + 5$ centimeters, with $x > 0$. Write its area as a polynomial. Explain the middle term.

6. A student claims $(x + 3)^2 = x^2 + 9$. Test $x = 1$, then correct the expansion.

LESSON 24 | WORKED ANSWERS

Check every partial product

1. $x^2 - x + 4x - 4 = x^2 + 3x - 4.$

2. $2x^2 + 6x - x - 3 = 2x^2 + 5x - 3.$

3. $x^3 + 2x^2 + 3x + x^2 + 2x + 3 = x^3 + 3x^2 + 5x + 3.$

4. $x^4 - x^2 + 2x^2 - 2 = x^4 + x^2 - 2.$

5. $A = (x + 5)^2 = x^2 + 10x + 25$ square centimeters. Two rectangles each contribute $5x$, so the middle term is $10x$. Keep $x > 0$ for the stated length model.

6. At $x = 1$, the actual square is $4^2 = 16$, but the claimed result is $1 + 9 = 10$. The correct expansion is $x^2 + 6x + 9$. The missing products are $3x$ and $3x$.

A quick product audit

Did every term meet every term? Did each sign stay attached? Did you add only like terms? A final substitution can expose an arithmetic slip.

I can...

- ☐ Multiply linear and quadratic factors systematically.
- ☐ Explain the middle term in a squared binomial.
- ☐ Check a result without treating one test value as proof.

Next class: reverse multiplication with polynomial division. Curriculum focus: A.10B, A.10D.