9.3 Multiplying Binomials

FOIL only works when you have a binomial times a binomial. That's a very rare case, so we're not going to learn it this year. Instead, we will use the distributive property which works for any polynomial times any polynomial.

We will use the distributive property today just like we did in 9.2. We will also organize our thinking in a table (box) that we will use for the rest of this unit and the next!

Simplify each product:

$(6h - 7)(2h + 3)$

Distribute the $6h$ to the two terms in the other parenthesis.
$6h \cdot 2h$ and $6h \cdot 3$
$12h^2 + 18h$

Distribute the -7 to the two terms in the other parenthesis.
$-7 \cdot 2h$ and $-7 \cdot 3$
$-14h - 21$

Combine like terms: $12h^2 + 4h - 21$

Now you try some:

$(5m + 2)(8m - 1)$

$5m \cdot 8m + 5m(-1)$
$2(8m) + 2(-1)$

$40m^2 - 5m$
$+16m - 2$

$40m^2 + 11m - 2$

$(9a - 8)(7a + 4)$

$9a(7a) + 9a(4)$
$-8(7a) \; -8(4)$

$63a^2 + 36a$
$-56a - 32$

$63a^2 - 20a - 32$

What is possibly a more helpful way to organize your thoughts and make sure each product is calculated, is to use a box. (Get good at this, we're using it A LOT!!)

Multiply $(2x + 3)(-3x - 7)$.

Put your factors on the outside and your products on the inside.

	$2x$	$+3$
$-3x$	$-6x^2$	$-9x$
-7	$-14x$	-21

$-6x^2 - 23x - 21$

Combine like terms. They will normally line up on the diagonal!

Multiplying a trinomial and a binomial also works with distributive property.

$(6n-8)(2n^2 + n + 7)$

$6n \cdot 2n^2$ and $6n \cdot n$ and $6n \cdot 7$
$12n^3 + 6n^2 + 42n$

$-8 \cdot 2n^2$ and $-8 \cdot n$ and $-8 \cdot 7$
$-16n^2 - 8n - 56$

Combine like terms to get
$12n^3 - 10n^2 + 34n - 56$

Or a box.

	$2n^2$	$+n$	$+7$
$6n$	$12n^3$	$6n^2$	$42n$
-8	$-16n^2$	$-8n$	-56

$12n^3 - 10n^2 + 34n - 56$

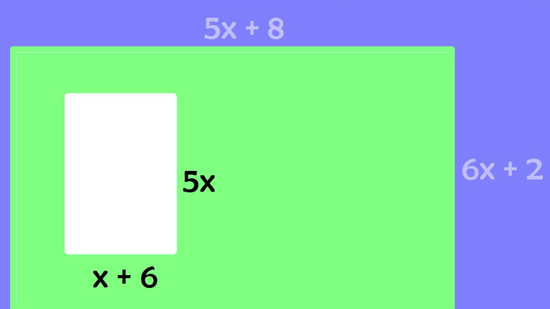
Now you try one:

$(3x^2 - 2x + 3)(2x + 7)$

	$3x^2$	$-2x$	$+3$
$2x$	$6x^3$	$-4x^2$	$6x$
$+7$	$21x^2$	$-14x$	21

$6x^3 + 17x^2 - 8x + 21$

Area of a rectangle is length times width, right? If the length and width are polynomials, now we know enough to figure out the area.
Find the area of the region shaded green:



	$5x$	$+8$
$6x$	$30x^2$	$48x$
$+2$	$10x$	16

$5x(x+6)$
$5x^2 + 30x$

$30x^2 + 58x + 16$
$-5x^2 - 30x$
$25x^2 + 28x + 16$

9.4 Multiplying Special Cases

What do you think the answer to $(3x + 5)^2$ is?

A. $9x^2 + 25$

B. $9x^2 + 30x + 25$

Be very careful!! You cannot "distribute" an exponent over addition, you must always multiply the base by itself as many times as the exponent indicates.

Practice the following binomials squared:

$(t + 6)^2$

	t	$+6$
t	t^2	$6t$
$+6$	$6t$	36

$t^2 + 12t + 36$

$(5y + 1)^2$

	$5y$	$+1$
$5y$	$25y^2$	$5y$
$+1$	$5y$	1

$25y^2 + 10y + 1$

$(7m - 2p)^2$

	$7m$	$-2p$
$7m$	$49m^2$	$-14mp$
$-2p$	$-14mp$	$4p^2$

$49m^2 - 28mp + 4p^2$

Did anyone notice a pattern in his or her last 4 answers?

How could you describe that pattern?

This pattern happens every time you have a binomial squared. The product even has a special name, it is called a *Perfect Square Trinomial.*

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

Use this shortcut to try the following problems:

$(y+11)^2$

$y^2 + 22y + 121$

$(3w-6)^2$

$9w^2 - 36w + 36$

$(p^4 - 8)^2$

$p^8 - 16p^4 + 64$

Find each product.

$(d + 11)(d - 11)$

	d	$+11$
d	d^2	$11d$
-11	$-11d$	-121

$d^2 - 121$

$(c^2+8)(c^2-8)$

	c^2	$+8$
c^2	c^4	$8c^2$
-8	$-8c^2$	-64

$c^4 - 64$

$(h + 15)(h - 15)$

	h	$+15$
h	h^2	$15h$
-15	$-15h$	-225

$h^2 - 225$

There's a pattern here too. Does anyone see it?

$(a+b)(a-b) = a^2 - b^2$ is known as the *Difference of Squares.*

Find the products using the shortcut

$(x + y)(x - y)$

$x^2 - y^2$

$(3y - 5w)(3y + 5w)$

$9y^2 - 25w^2$

homework:
page 469 # 5-25
page 477 # 1-8, 15-20} shortcuts only: $(a+b)^2 = a^2 + 2\mathrm{ab} + b^2$

$$(a-b)^2 = a^2 - 2\mathrm{ab} + b^2$$

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