Lesson Notes: Multiplying Polynomials – Monomials and Binomials (Day1)

Review: Gr. 9 Material Talk about what is a polynomial vs non polynomial? (have student brainstorm and create their own examples)

Ex./ **Polynomials** 4x+6 , $-6x^2+8x-1$, 3x, 5

Polynomial non – examples $\sqrt{x}+6(RADICALEXPRESSION)$ $\frac{5}{x+6} or \frac{6}{x^2}-8$ (rational expressions)

Vocabulary: What is a variable? What is the degree of a polynomial? Coeffcient? Constant? Binomial? Trinomial ? and monomial?

Have students create examples of monomials, binomials and trinomials. Then find the coefficients and constant .

Review what each algebra tile represents:

The terms of a polynomial can be represented by using Algebra Tiles.

These are what each tile represents
Note: The x can be ANY letter!

Question #1) Represent the following polynomials using algebra tiles

a) $3x^2-4x+2$ b) $-2x^2+7$ c) $4x^2-3x+4-2x^2+5x+3$ (simplify combine like terms and create zero pairs)

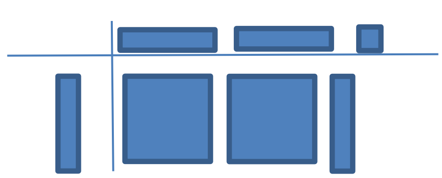
Question #2) Solve and represent this product concretely and pictorially (using algebra tiles) Need to make a rectangle with dimension 4 x 3

3 x 4

Concretely	**Pictorially**	**Symbolically**
(using algebra tiles or counters)	(Draw algebra tiles or a rectangle)	(Only using numbers and operations)

Question #3) Using algebra tiles represent and solve these products

a) 4(3x) b) x(2x+1) " to help build the rectangle place guiding tiles c)-4(3x)



d) -x(2x-1) “What is negative area?” Represents a hole in an objects area or an area you would subtract.

e) (x-3)(2x-1)” Rearrange tiles to combine like terms”

f) (3x-1)(2x+3)

“ Rearrange tiles to put like terms together and combine zero pairs (rewrite your trinomial with like terms combined in simplest form)

Have students make up questions on whiteboards /paper and pass to another set of partners. Have students complete each question and pass back to check.

3.5/3.6 Multiplying Polynomials – Monomials and Binomials (Day1)

Concept #18: 3.5/3.6 Correctly multiply two binomials **(NC) (Skill)**

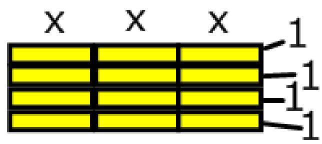
The terms of a polynomial can be represented by using Algebra Tiles.

x^2 x 1 $-x^2$ - x - 1 These are what each tile represents

Note: The x can be ANY letter!

This represents the product of the constant 4 and the monomial,3x. We can model the product as 4 rows of three "x" tiles.

4(3x)



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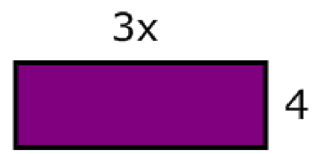
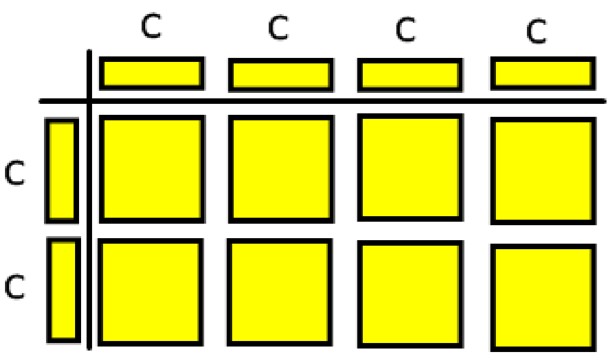


We can Model 4(3x) as the area of a rectangle with dimensions 4 and 3x.

The expression (2c)(4c) is the product of two monomials.
We interpret the product with algebra tiles arranged to form a rectangle with dimensions 2c and 4c.



To help build the rectangle, we place guiding tiles to represent each dimension. Then we fill in the rectangle with tiles.

We need eight c tiles to build the rectangle.
So, $(2c)(4c) = 8c^2$

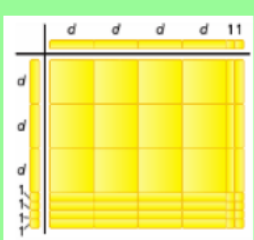
Solving products of all polynomials with degree 1 or less can be represented **concretely** (Using algebra tiles) , **pictorially** (Drawing algebra tiles or rectangles) or **symbolically** (Using numbers and operations).

Here are three strategies to determine the product of binomials

Strategy 1: Use algebra tiles

Expand (3d + 4)(4d + 2)

Make a rectangle with dimensions 3d + 4 and 4d + 2. Place tiles to represent each dimension, then fill in the rectangle with tiles.



The tiles that form the product are:
12 d^2-tiles, 22 d-tiles, and eight 1-tiles.

So $(3d + 4)(4d + 2) = 12d^2 + 22d + 8$

Strategy 2: Area Model

Expand (h + 11)(h + 5)

Sketch a rectangle with dimensions h + 11 and h + 5. Divide the rectangle into 4 smaller rectangles and calculate the area of each.

	h	11
h	$(h)(h)=h^2$	$(h)(11) = 11h$
5	$(5)(h)=5h$	$(5)(11) = 55$

So, $(h + 11)(h + 5) = h^2 + 5h + 11h + 55$ Combine like terms

$= h^2 + 16h + 55$

Note that (h + 11)(h + 5) = (h + 5)(h + 11) since both products represent the area of the same rectangle.

Strategy 3: The Distributive Property

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

$$\begin{aligned}(x - 3)(2x + 1) &= x(2x + 1) - 3(2x + 1)\\ &= (x)(2x) + (x)(1) + (-3)(2x) + (-3)(1)\\ &= 2x^2 + x - 6x - 3\\ &= 2x^2 - 5x - 3\end{aligned}$$

To multiply polynomials of larger degrees we can use the distributive property and exponent laws

Recall:
Exponent Law - What do you do when you are multiplying same bases?
ie. $a^3 \times a^4$

You add the exponents

$x^m x^n = x^{m+n}$

Example #1) Simplify (Use method/strategy of choice)

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

b) $5m(-2m-3)$

c) $-5x^2y(2x + 3y)$

d) $3m^2n^3p^2(-5m^2n + 2mp^3 - 4n^2p^6)$

Example #2) Multiply two binomials. Expand and simplify. Use algebra tiles and sketch the tiles you used.

a) $(c+4)(c+2)$

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

Example #3) Expand and simplify. Use the distributive property.

a) $(3d + 4)(4d + 2)$

b) $(-2g + 8)(7 - 3g)$

c) $(8 - b)(3 - b)$

Day 1 Assignment: Polynomial Practice Assignment#1- Multiplying Polynomials

3.5/3.6 Multiplying Polynomials – Monomials, Binomials and Trinomials (Day 2)

Concept #19: 3.7 Correctly multiply a binomial by a trinomial and a trinomial by a trinomial **(NC)(Skill)**

The *distributive property* can be used to perform any polynomial multiplication. Each term of one polynomial must be multiplied by each term of the other polynomial.

Example #1) Using the Distributive Property to Multiply Two Polynomials (NO CALCULATORS)

Expand and simplify

a) $(2h + 5)(h^2 + 3h - 4)$

b) $(-3f^2 + 3f - 2)(4f^2 - f - 6)$

Example #2) Multiplying Polynomials in More Than One Variable

Expand and Simplify

a) $(2r + 5t)^2$

Check solution for t=2 and r =3

b) $(3x - 2y)(4x - 3y + 5)$

Example #3) Expand and Simplify

a) $(x+5)^3$

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

Example #4) Add or subtract

a) $(5a - 8) - (2a + 3)$

b) $(2x^2 + 6x + 5) + (-4x^2 - 3x + 7)$

c) $(3a^2 - 2a + 6) - (-2a^2 + 7a - 9)$

Example #5) Simplifying Sums and Differences of Polynomial Products

Note: Use order of operations. Multiply before adding and subtracting. Then combine like terms.

Expand and Simplify

a) $(3x - 1)(2x - 4) - (3x + 2)^2$

b) $2b(2b - c)(b + c)$

Day 2 Assignment: Polynomial Practice Assignment #2 – Multiplying Polynomials

3.3 Greatest Common Factors(GCF) of Polynomials (Day3)

Greatest common factor of variables: The smallest common exponent of each variable in each term Ex. $x^5y^3 and x^8y$ The GCF = x^5y between the two monomials

Note: Take a negative GCF out if the first term is negative.

Concept #20: 3.3 Correctly factor polynomials with a GCF **(NC)(Skill)**

Example #1) Factor out the GCF from a polynomial by dividing each term by the GCF.

a) $6n+9$ b) $-c^2+4c$ c) $5-10z-5z^2$

Example #2) Factor. Verify that the factors are correct by expanding.

a) $-12x^3y-20xy^2-16x^2y^2$ b) $-20c^4d-30c^3d^2-25cd$

Example #3) Factor.

a) $16x^2y + 24x^2y^3$ b) $7a^2b - 28ab + 14ab^2$ c) $-16x^2y^2 + 24x^3y^3$

Day 3 Assignment: Polynomial Practice Assignment #3 - Factoring Polynomials with a GCF

3.5 Factoring Polynomials of the form x^2+bx+c and GCF (Day 4)

Concept # 21- 3.5 Factor trinomials with an initial GCF resulting in the form x^2+ bx + c (by method of choice) **(NC) (Skill)**

(2x + 3)(x + 1) ← FACTORS

$2x^2$ + 5x + 3 ← EXPANDED FORM

Factoring and multiplying/expanding are inverse processes. We can use this to factor a trinomial.

Method #1 – Using Algebra Tiles concretely and pictorially factor binomials and trinomials

Step 1 – Get a bag of algebra tiles
Step 2 – From your bag, collect tiles that represent the given polynomial
Step 3 – Rearrange the collected tiles into a rectangle (draw the rectangle)
Step 4 – Determine the dimensions of the rectangle (These are your factors)

Example #1) Factor using algebra tiles.

a) $x^2 + 3x$

b) $2x^2 + 4x$

c) $x^2 + 5x + 4$

d) $2x^2 + 7x + 6$

e) $x^2 + x - 2$

Method #2 – Symbolically Factor Binomials and Trinomials

Note: 1) REMEMBER TO ALWAYS LOOK TO FACTOR OUT A GCF FIRST
2) Rearrange polynomials in descending order
3) There are other methods when factoring a trinomial. If you'd like to try a different method let me know.

Example #2) Factor by guess and check (a.k.a Window method)

a) $x^2 - 2x - 8$

b) $z^2 - 12z + 35$

b) **Factor** (Note: Show factoring in ascending vs descending order)

$-24 - 5d + d^2$

d) Factor and verify your answer

$m^2 - 7m - 60$

Does the order we write the terms of the binomial matter?

Example #3) Factor $-4t^2 - 16t + 128$

b) $-5h^2 - 20h + 60$

Do you see any patterns? Did anyone find a more efficient/quicker way to factor the previous trinomials? Can you use this explanation to show how the following questions can be quickly factored?

$x^2+8x+12$ = (x + 6)(x + 2)	$x^2+7x+10$ = (x + 5)(x + 2)	$x^2+8x+15$ (x + 5)(x + 3)
q^2+6q+8 = (q + 4)(q + 2)	$m^2+7m+12$ = (m + 3)(m + 4)	$r^2+13m+12$ = (r + 12)(r + 1)
$49+14h+h^2$ = (7 + h)(7 + h)	$144+24x+x^2$ = (12 + x)(12 + x)	$81+18w+w^2$ = (9 + w)(9 + w)
$m^2-7m+12$ (m - 4)(m - 3)	$x^2-8m+12$ (x - 6)(x - 2)	$u^2-12u+27$ (u - 9)(u - 3)

Day 4 Assignment: Polynomial Practice Assignment #4-Factoring Polynomials of the form x2+bx+c

3.6 Factoring Polynomials ax^2+bx+c and GCF (Day 5)

Concept # 22 3.6 Correctly factor using GCF and then factor a trinomial ax^2+bx+c, where a > 1 by method of choice

ALWAYS LOOK FOR A GREATEST COMMON FACTOR (GCF) BETWEEN ALL TERMS FIRST

Example #1) Factor

a) $4h^2+20h+9$

b) $12k^2-22k-70$

c) $4g^2+11g+6$

d) $18m^3-21m^2-30m$

Example #2) a) Evaluate $3x^2 - 14x + 15$ when x = 2

b) Factor $3x^2 - 14x + 15$, then evaluate x = 2

c) Did you get the same answer for a & b? Why or why not?

Example #3) Factor

a) $x^2 - 25$

b) $4x^2 - 49$

c) $25x^2 - 16$

d) $9m^2 - 100n^2$

Can you find an easier way to factor the above "DIFFERENCE OF SQUARES" questions? What criteria must be present in order for this method to work?

Example #4) Use your new method to factor the following. If you can't factor them – explain why?

a) $36x^2 - 25y^2$

b) $x^2 + 81$

c) $-100 + r^2$

d) $\frac{4}{9}x^2 - 25$

e) $1.21x^2 - 0.36$

f) $\frac{x^2}{16} - \frac{y^2}{49}$

g) $2x^2 - 14$

h) $81a^4 - 16b^4$

i) $49a^2b^2 - 1$

Note: A binomial is only factorable if there is a ____________ or the bionomial is a ___________________________.

Example #5)

a) **Create a binomial that is PRIME (Not factorable): ______________________________**

b) **Create a binomial that is a difference of squares and factor it:**

   ____

Day 5 Assignment: Polynomial Practice Assignment #5 - Factoring Polynomials

3.8 Factoring ALL Polynomials (Day 6)

Concept # 23: 3.8 Factoring using GCF and/or all of the above (including perfect square trinomials, trinomials in two variables, difference of squares)

Ex1): Factor $20r^2 + 70r + 60$

Ex2): Factor $-5h^2 - 20h + 60$

Ex3): Factor $x^2 + 5x + 1$

Ex4): Factor $4x^2+12x+9$

Ex5): Factor $x^4 - 81y^4$

Day 6 Assignment: Polynomial Practice Assignment #6- Factoring Polynomials(All types)