Algebra I
Lesson 8.2 – Factoring by GCF
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Way, way back in the text book on page 47, we had a definition for the **distributive property**:
$\boldsymbol{a(b+c)=ab+ac}$ rewriting as $\boldsymbol{ab+ac=a(b+c)}$, we see the left side terms have a common factor of **a**. If we factor out the "**a**" or "undistribute" the "**a**" we get the right side of the equation which is the factored form!

This is how we factor polynomials. The GCF of a polynomial is a **monomial factor.** The factored polynomial we end up with will look like a distribution problem. In essence*, factoring a polynomial is the inverse process of distribution*. We follow the same process as in 8.01 finding the GCF; now terms are separated with plus and minus sign! Using our "Lunch and Leftover Method," the GCF is the lunch and the leftovers are the remaining parts of each term that are not common values.

Factor: $6x+12$ $6 \quad x \qquad\qquad 12$ $2\cdot 3 \qquad\qquad 2\cdot 6$ $\qquad\qquad\qquad 2\cdot 3$ (lunch) (leftovers) $=(2\cdot 3)\ \ (x+2)$ $=6(x+2)$	1. What do both terms have in common? 2. Break the term into the factors using the "L" method 3. Factor out with multiplication the greatest common factor using the "Lunch and Leftover Method"
$4x^2+20x$ $4 \quad x \qquad 10 \quad x$ $2\cdot 2 \ x \qquad 2\cdot 10$ $\qquad\qquad 2\cdot 5$ (lunch) (leftovers) $(2\cdot 2x)\ \ (x+5)$ $=4x(x+5)$	**Common factors can also be in the form of variables:** 1. What do both terms have in common? 2. Break each term down into common factors, using the "L" method 3. Factor out with multiplication the greatest common factor using the "Lunch and Leftover Method"

Note how the factored polynomial is an expression that when the distribution property is used, will take you back to the original polynomial!

Factor the following polynomials:

$5b+9b^3$	$-18y^3-7y^2$	$9d^2-8^2$	$8x^4+4x^3-2x^2$

When the terms of a polynomial have a binomial in common, the GCF is called a **binomial factor** and may be factored out the same way we factored out a monomial factor.

$4s\boxed{(s+6)} - 5\boxed{(s+6)}$	$3x\boxed{(y+4)} - 2y\boxed{(y+4)}$	$7x\boxed{(2x+3)} + \boxed{(2x+3)}$	$5x(5x-2) - 2(5x-2)$

Even when there is not an obvious common factor, consider grouping terms of the polynomial together to factor then use the "lunch and leftovers" to factor:

$12a^3 - 9a^2 + 20a - 15$ $= (12a^3 - 9a^2) + (20a - 15)$ $= 3a^2(4a-3) + 5(4a-3)$ $= (4a-3)(3a^2+5)$	1. Look at the terms and see if grouping allows you to factor something out of the terms 2. Now factor each binomial 3. Can the factored expression be factored anymore??? (yes!) 4. Now check by multiplying the binomials together using double distribution.
$6b^3 + 8b^2 + 9b + 12$	$4r^3 + 24r + r^2 + 6$
 *If a binomial needs to have opposite signs to be factorable, factor out a* (-1) $15x^2 - 10x^3 + 8x - 12$	$8y - 8 - x + xy$