Factoring Polynomials

Strand: Expressions and Operations

Topic: Factoring polynomials

Primary SOL: A.2 The student will perform operations on polynomials, including
c) factoring completely first- and second-degree binomials and trinomials in one variable.

Related SOL: A.2a, b

Materials

- Algebra tiles
- Teacher Resource for Factoring Polynomials (attached)
- Factoring Polynomials Using Algebra Tiles activity sheet (attached)
- Introduction to Factoring by Grouping activity sheet (attached)
- Factor by Grouping: Find the Mistake activity sheet (attached)
- Factoring Pair Share: Partner A activity sheet
- Factoring Pair Share: Partner B activity sheet
- Graphing calculators
- Scissors
- Squares Factoring Puzzle (attached)

Vocabulary

greatest common factor, prime, factor, factoring, rectangular area, perimeter, denominator, horizontal axis, vertical axis, quadrant, term (earlier grades)
trinomial, binomial (A.2)

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Demonstrate how to factor using algebra tiles and the attached Teacher Resource for Factoring Polynomials. Show and explain that factoring is the inverse of multiplication.
2. Distribute Algebra tiles and the Factoring Polynomials Using Algebra Tiles activity sheet. Encourage students to model each expression with the tiles, factor with the tiles, draw the factored expression, and write the factors mathematically.
3. Students will complete the Introduction to Factoring by Grouping activity. This will give them an understanding of foundations to factoring by grouping. It will also discuss how to find the greatest common factor.
4. Students should complete the partner activity on factoring by grouping. Students must also check their partner's answers by multiplying out the solutions. This is a good collaborative exercise for students to assist one another when needed.
5. Distribute the cut-out Squares Factoring Puzzle, and have students complete it individually or in small groups.

Assessment

- **Questions**
  - Give an example of a binomial that does not factor using algebra tiles. What is it called? Explain why it cannot be factored with algebra tiles.
  - Give an example of a trinomial that does not factor using algebra tiles. What is it called? Explain why it cannot be factored with algebra tiles.
- **Journal/Writing Prompts**
  - Explain why multiplying and factoring are inverse procedures.
- **Other**
  - A triangular sign has a base that is 2 feet less than twice its height. A local zoning ordinance restricts the surface area of street signs to be no more than 20 square feet.
    - Write an inequality involving the height that represents the largest triangular sign allowed. (Answer: $h^2 - h - 20 \leq 0$)
    - Find the length of the base and height in feet of the largest triangular sign that meets the zoning ordinance. (Answer: base = 8 feet and height = 5 feet)

Extensions and Connections (for all students)

- Have students work in pairs or groups to create quizzes on factoring.
- Have groups of students create game activities to help them learn factoring.
- Have students use a pair-checked activity.
- Teacher may use the cut out Square Factoring Activity as an extension for students.

Strategies for Differentiation

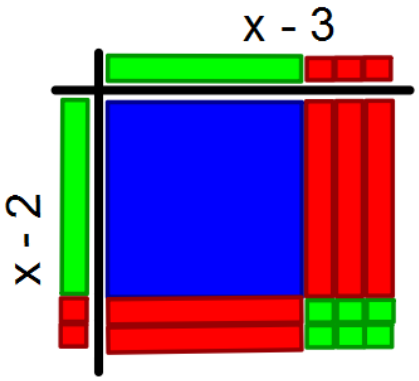
- Color-code the steps in simplifying an expression.
- Reduce the 4 x 4 grid of the Squares Factoring Puzzle to a smaller grid, according to the needs of students.
- Allow for use of manipulatives with all activities based upon student preference.

Teacher Resource for Factoring Polynomials

Factoring Polynomials

- Algebra tiles can be used to factor polynomials. Use tiles and the frame to model factoring polynomials.
- Use the tiles to fill in the array to form a rectangle inside the frame.
- Be prepared to use zero pairs to fill in the frame.
- Draw a picture

Example 1: $x^2 – 5x + 6$



Factoring Polynomials Using Algebra Tiles

Name _____ **Date**_____

Use algebra tiles to factor each binomial. Draw a picture of your result. Write your answer in the space provided.

1. $3x + 9$

x + 3

3

Answer:_____

2. $4x - 10$

Answer:_____

3. $3x^2 + 4x$

Answer:_____

4. $x^2 - 2x - 35$

Answer:_____

5. $3 - 9x$

Answer:_____

6. $x^2 - x - 12$

Answer:_____

7. $2x^2 + 5x - 3$

Answer:_____

8. $x^2 + 5x$

Answer:_____

9. $2x^2 - 2x - 4$

Answer:_____

10. $3x^2 - 27$

Answer:_____

Introduction to Factor by Grouping

Finding the Greatest Common Factor

Numbers	Factors	Common Factors	Greatest Common Factor
6 & 9	**6:** **9:**		
4 & 12	**4:** **12:**		
$8x^2$ & 18x	**$8x^2$:** **18x:**		

Products and Sums

Which two numbers…	Product	Sum
Multiply to 12 & add to13?		**_____ + _____ = 13**
Multiply to 36 & add to 15?		**_____ + _____ = 15**
Multiply to –8 & add to –7?		**_____ + _____ = -7**
Multiply to 24 & add to10?		**_____ + _____ = 10**
Multiply to –24 & add to –5?		**_____ + _____ = -5**
Multiply to 15 & add to 8?		**_____ + _____ = 8**
Multiply to –5 & add to 6?		**_____ + _____ = 6**
Multiply to –18 & add to –7?		**_____ + _____ = -7**
Multiply to –36 & add to 0?		**_____ + _____ = 0**
Multiply to –15 & add to –2?		**_____ + _____ = -2**
Multiply to 9 & add to 6?		**_____ + _____ = 6**
Multiply to –25 & add to 0?		**_____ + _____ = 0**

Factor by Grouping: Find the Mistake

Directions: Each partner factored the same quadratic expression. Decide which partner is correct and explain where the other partner went wrong.

Problem 1

Partner A	Partner B
$3x^2 + 10x – 25$	$3x^2 + 10x – 25$
$3x^2 + 5x + 15x – 25$	$3x^2 – 5x + 15x - 25$
$x(3x + 5) – 5(3x + 5)$	$x(3x – 5) + 5(3x – 5)$
$(x - 5) (3x + 5)$	$(x + 5) (3x – 5)$

Problem 2

Partner A	Partner B
$7x^2 – x – 6$	$7x^2 – x – 6$
$7x^2 – 7x + 6x – 6$	$7x^2 – 14x + 3x – 6$
$7x(x – 1) + 6(x – 1)$	$7x(x – 2) + 3(x – 2)$
$(7x + 6) (x – 1)$	$(7x + 3) (x – 2)$

Problem 3

Partner A	Partner B
$6x^2 – 2x – 20$	$6x^2 – 2x – 20$
$6x^2 – 12x + 10x – 20$	$2(3x^2 – x – 10)$
$6x(x – 2) 10(x – 2)$	$3x^2 – 6x + 5x – 10$
$(6x + 10) (x – 2)$	$3x(x – 2) + 5(x – 2)$
	$2(3x + 5) (x – 2)$

Factoring Pair Share: Partner A

Directions: Partner A factors the given trinomial, then checks Partner B's factors by multiplying the two binomials together (and vice versa).

1. $x^2 + 9x + 18$	
2. $x^2 + 14x + 40$	
3. $x^2 – 8x + 7$	
4. $x^2 – 4x – 60$	
5. $3x^2 + 21x + 30$	
6. $2x^2 – 16x + 30$	
7. $8x^2 + 20x + 8$	
8. $3x^2 – 8x + 4$	

Factoring Pair Share: Partner B

Directions: Partner B factors the given trinomial, then checks Partner A's factors by multiplying the two binomials together (and vice versa)

1. $y^2 + 10y + 16$	
2. $y^2 + 14y + 48$	
3. $y^2 – 8y + 15$	
4. $y^2 – 2y – 15$	
5. $2y^2 + 14y + 24$	
6. $3y^2 – 9y + 6$	
7. $6y^2 – 4y - 10$	
8. $4y^2 – 17y + 4$	

- **Squares Factoring Puzzle**

Directions

- Below is the solution to the puzzle.
- Copy and cut the squares apart on the dotted lines.
- Students should match each polynomial to its factors by placing them adjacent to each other.
- Have students complete it individually or in small groups. They should get the 4 x 4 square below.

	$(x-2)(x+2)$			$(4x-1)^2$			$(6x+1)(x-2)$			$(x+1)(x-1)$	
$(5x-4)^2$		$x^2-4x-12$	$(x+2)(x-6)$		x^2-16	$(x+4)(x-4)$		$6x^2+13x+6$	$(3x+2)(2x+3)$		$x^2-14x+24$
	x^2+6x+9			$x^2-10x+24$			$25x^2-16$			$6x^2+41x+30$	
	$(x+3)^2$			$(x-4)(x-6)$			$(5x-4)(5x+4)$			$(x+6)(6x+5)$	
$(x-2)(x-6)$		$x^2+3x-18$	$(x+3)(x-6)$		$x^2+6x-16$	$(x-2)(x+8)$		$9x^2+12x+4$	$(3x+2)^2$		$x^2+7x-18$
	$4x^2-25$			x^2-9			$16x^2-1$			$x^2-7x+12$	
	$(2x+5)(2x-5)$			$(x+3)(x-3)$			$(4x-1)(4x+1)$			$(x-4)(x-3)$	
$(x-2)(x+5)$		$(x^2-6x-16)$	$(x+2)(x-8)$		$x^2-2x-15$	$(x+3)(x-5)$		$4x^2+x-5$	$(4x+5)(x-1)$		$6x^2-x-2$
	x^2+4x+3			$7x^2-19x+10$			$9x^2-4$			$x^2-8x+16$	
	$(x+3)(x+1)$			$(7x-5)(x-2)$			$(3x-2)(3x+2)$			$(x-4)^2$	
$(2x-5)(2x+1)$		$4x^2+20x+25$	$(2x+5)^2$		$3x^2+2x-1$	$(3x-1)(x+1)$		x^2-x-12	$(x+3)(x-4)$		x^2+16
	$25x^2+20x+4$			x^2+9			$x^2+3x-10$			x^2-15	