Richmond Public Schools

Curriculum Framework

Algebra 1

Strand: Expressions and Operations	
A.2 **The student will perform operations on polynomials, including** **a) applying the laws of exponents to perform operations on expressions;** **b) adding, subtracting, multiplying, and dividing polynomials;** **c) factoring completely first- and second-degree binomials and trinomials in one variable.**  **EOC Algebra I assessments will include a Desmos Calculator**	
Suggested Pacing	
First Nine Weeks- Polynomials A.2a 2 blocks A.2b 5 blocks Fourth Nine Weeks - Quadratics Unit A.2c 2 blocks	
Related Standards	
Spiral Down	**Spiral UP** **AII.1** The student will **a)** add, subtract, multiply, divide, and simplify rational algebraic expressions; **b)** add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents; and **c)** factor polynomials completely in one or two variables.

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Essential Questions	Common Misconceptions
A.2a ● Why is it important to understand exponents? *Exponents (powers) represents the number of times the base is repeated to be multiplied together.* **A.2b** ● Can two algebraic expressions that appear to be different be equivalent? *Yes* ● How can we use the polynomial operations in practical situations? *It is used when there is an x amount of an item and the cost is given, the total cost can be found. Usually is done with money, or measurements.* ● How is modeling operations of polynomials with concrete objects, pictures, and symbols useful? *Modeling creates a concrete, tangible way polynomials can be represented and solved for.* ● What are some practical situations that would require operations with polynomials? *Grocery shopping, engineers, taxi driver, etc.* ● What is the difference between a monomial and a polynomial? *A monomial consists of one non-zero term. An algebraic expression consisting of one, two or more terms is called a polynomial*	**A.2a** **Multiplying base and exponent** Incorrect: $2^3 \neq 2 \times 3$ Correct: $2^3 = 2 \times 2 \times 2 = 8$ A negative on an exponent and a negative on a number are equal Incorrect: $-3^2 \neq 9$ Correct: $-3^2 = -9$ Correct: $-3^2 = -(3)^2 = -9$ Correct: $(-3)^2 = 9$ **A.2b** Forgetting to take the opposite of every term of a polynomial being subtracted. **A.2c** Trying to use "FOIL" or the "Box" method in addition or subtraction problems. ● Considerations when Factoring: 1. Greatest Common Factor - 2 or more terms 2. Difference of Squares - only 2 terms 3. Trinomials - only 3 terms 4. Grouping - only 4 terms 5. Check the work by multiplying the factors. ● Some polynomials cannot be factored over the set of real numbers and these are called *prime polynomials*. ● Ensure that students understand the relationship between the factors of a polynomial and the *x*-intercepts/solutions of its related graph.

● How are polynomials added, subtracted, multiplied, and divided? *Adding or subtracting polynomials, the terms must match. Multiplying polynomials, the coefficients will be multiply and the matching variables' exponents will add together. Dividing polynomials, the coefficients will be divided and the matching variables' exponents will be subtracted.* **A.2c** ● Why do we factor polynomials? *Factoring polynomials is done to find roots, and simplify expressions.* ● How is a difference of squares different from other polynomials? *Difference of squares are terms that are being subtracted that are perfect squares. When the terms are factored there is a pattern that will be seen $a^2-b^2= (a-b)(a+b)$.* ● How is it the same? *The process of factoring polynomials is the same.* ● What is the relationship between the factor(s) of a polynomial and the graph of the polynomial? *The relationship between factors of a polynomial and a graph of polynomials are the roots. X-intercepts are found by the factors and are visible on a graph.*	● Students should use a graphing calculator to verify the factors of a polynomial and make the connection between factors and x-intercepts/solutions.

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Understanding the Standard	Essential Knowledge and Skills
• Operations with polynomials can be represented concretely, pictorially, and symbolically. • Polynomial expressions can be used to model practical situations. • Factoring reverses polynomial multiplication. • Trinomials may be factored by various methods including factoring by grouping. Example of factoring by grouping $2x^2 + 5x - 3$ $2x^2 + 6x - x - 3$ $2x(x + 3) - (x + 3)$ $(x + 3)(2x - 1)$ • Prime polynomials cannot be factored over the set of integers into two or more factors, each of lesser degree than the original polynomial. • Polynomial expressions can be used to define functions and these functions can be represented graphically. • The laws of exponents can be applied to perform operations involving numbers written in scientific notation. • For division of polynomials in this standard, instruction on the use of long or synthetic division is not required, but students may benefit from experiences with these methods, which become more useful and prevalent in the study of advanced levels of algebra.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Simplify monomial expressions and ratios of monomial expressions in which the exponents are integers, using the laws of exponents. (a) • Model sums, differences, products, and quotients of polynomials with concrete objects and their related pictorial and symbolic representations. (b) • Determine sums and differences of polynomials. (b) • Determine products of polynomials. The factors should be limited to five or fewer terms (i.e., $(4x + 2)(3x + 5)$ represents four terms and $(x + 1)(2x^2 + x + 3)$ represents five terms). (b) • Determine the quotient of polynomials, using a monomial or binomial divisor, or a completely factored divisor. (b) • Factor completely first- and second-degree polynomials in one variable with integral coefficients. After factoring out the greatest common factor (GCF), leading coefficients should have no more than four factors. (c) • Factor and verify algebraic factorizations of polynomials with a graphing utility. (c)

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Vocabulary	Instructional Activities Organized by Learning Objective
ACADEMIC Identify, Demonstrate, Apply, Analyze, Differentiate, Use, Develop, Calculate, Create, Describe, Recognize, Repeat **CONTENT** Polynomial Operations Factor Term Coefficient Prime Polynomial GCF Difference of Two Squares Factor by Grouping Law of Exponents Binomial Trinomial Polynomial Integral Coefficients X- and Y- Intercepts	**A.2a** **Apply:** I can simplify monomial expressions in which the exponents are integers, using the laws of exponents. **Apply:** I can simplify ratios of monomial expressions in which the exponents are integers, using the laws of exponents. **A.2b** **Apply:** I can model sums and differences of polynomials with concrete objects, pictures, and symbols. **Apply:** I can model products and quotients of polynomials with concrete objects , pictures, and symbols. **Understand:** I can determine sums and differences of polynomials. **Understand:** I can determine products of polynomials. **Understand:** I can determine the quotient of polynomials. **A.2c** **Apply:** I can factor out a GCF. **Apply:** I can factor completely first- and second-degree polynomials in one variable. **Apply:** I can factor and verify algebraic factorizations by graphing.
Assessment	
Mastery Check: Laws of Exponents A Laws of Exponents B Polynomials A Polynomials B Factoring A	**Virginia Department of Education** Exploring Exponents **Textbook** ● **Eureka** **Eureka - (Insert Lesson Title)**

Factoring B
Factoring C
Factoring D

Student Performance Analysis

Eureka Grade	Module	Topic	Lesson(s)

- **Glencoe**
  A.2a: Virginia Glencoe, Algebra I, ©2012, Carter, et al, McGraw-Hill School Education Group, page(s) 401 - 422

  A.2b: Virginia Glencoe, Algebra I, ©2012, Carter, et al, McGraw-Hill School Education Group, page(s) 423 - 458**(in part)**

  A.2c: Virginia Glencoe, Algebra I, ©2012, Carter, et al, McGraw-Hill School Education Group, page(s) 469 – 505

Notes

Using Depths of Knowledge (DOK) **Polynomials**

Resources

- **Print**
  - Coach Book
    - A.2a: *Virginia End-of-Course Coach*, © 2012, Triumph Learning, Algebra I, page(s) 16 - 20
    - A.2b: *Virginia End-of-Course Coach*, © 2012, Triumph Learning, Algebra I, page(s) 21 - 32, 39 - 44
    - A.2c: Coach book, Virginia edition, page(s) 33- 38, 141 - 146
  - Mulligan Math in Minutes A.2

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- **Technology-based**
  - Quizizz
    - Adding and Subtracting Polynomials
    - Multiplying and Dividing Polynomials
  - Gizmo
    - Adding and Subtracting Polynomials
    - Dividing Polynomials

Station Activities

Station 1
Adding And Subtracting Polynomials

Station 2
The Golden Ticket - Polynomials

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<tr><th>Cross-Curricular Connections</th><th>Tiered Differentiations</th></tr>
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Science: Working with scientific notation uses the law of exponents.

History: Research on the discovery of polynomials and how they were first used.

Writing: Explain the steps to factor a polynomials in the form of a letter to a friend who needs help.

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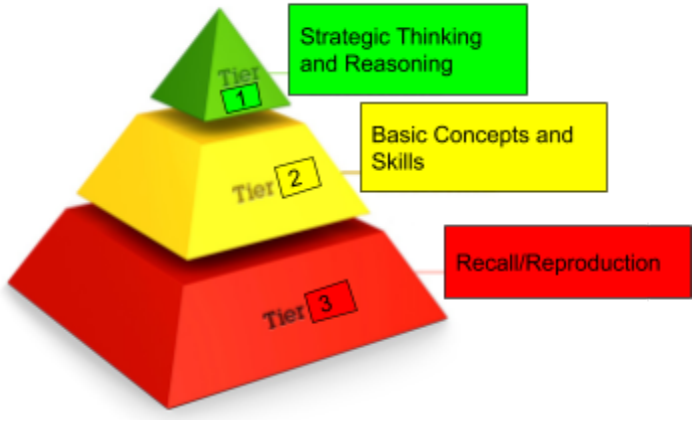

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	Tier 3 Activity: **Recall and Reproduction** Teacher will create a set of polynomial task cards with rules and terms. Students will match the rules and terms and place on a graphic organizer. **Tier 2 Activity: Basic Concepts and Skills** Example 1 Polynomials Drills Polynomials with perimeter/area Example 2 Teacher will create polynomial task 10-12 problems are posted around the room, each page having the solution to a different problem. It functions like a loop. Students are paired (or in a trio) and move from problem to problem solving it, identifying the solution in the room, and then working that problem. Students are finished when they return to their original problem. **Tier 1 Activity: Strategic Thinking and Reasoning** Teacher will create geometrical shapes including, rectangles, squares and or irregular polygons to determine the perimeter and area.