Roanoke Valley Governor's School for Science and Technology
Algebra II Competencies

Course Description:

Roanoke Valley Governor's School of Science and Technology (RVGS) Algebra II provides a thorough treatment of advanced algebraic topics through the study of function families and their properties by simplifying expressions, solving equations, graphing and analyzing functions and their inverses. Function families include absolute value, quadratics, power and polynomials, rational, radical, exponential and logarithmic, and sequences and series. Applications, modeling, and technology are incorporated into each instructional unit. The course also includes the study of statistics, probability, and data analysis to support the research elective courses at RVGS. Emphasis is placed on concept development and the proper use of mathematical vocabulary.

Virginia Algebra II Standards of Learning (SOL) are covered in this course.
http://www.doe.virginia.gov/testing/sol/standards_docs/mathematics/2009/stds_algebra_2.pdf.

This course is taught using best practices in gifted education. Each competency is aligned with Hockett's five principles of gifted education:

1. High-quality curriculum for gifted learners uses a conceptual approach to organize or explore content that is discipline based and integrative.
2. High-quality curriculum for gifted learners pursues advanced levels of understanding beyond the general education curriculum through abstraction, depth, breadth, and complexity.
3. High-quality curriculum for gifted learners asks students to use processes and materials that approximate those of an expert, disciplinarian, or practicing professional.
4. High-quality curriculum for gifted learners emphasizes problems, products, and performances that are true to life, and outcomes that are transformational.
5. High-quality curriculum for gifted learners is flexible enough to accommodate self-directed learning fueled by student interests, adjustments for pacing, and variety.

Hockett, J.A. (2009). Curriculum for highly able learners that conforms to general education and gifted education quality indicators. *Journal of Education for the Gifted*, *32*(3), 394-440.

Competencies followed by an asterisk * exceed the requirements of the Virginia SOL.

Unit 0 Prerequisite Algebra Skills
1 Week

- Simplify and evaluate algebraic expressions.
- Solve linear and literal equations.
- Simplify polynomial expressions.
- Graph and write equations of linear functions.

Unit 1 Probability, Data Analysis, and Statistics 3 Weeks

Virginia SOL: 9, 11, 12

- Apply the Fundamental Counting Principle to determine the number of outcomes of an event.
- Determine the number of permutations and combinations of *n* objects taken *r* at a time.
- Solve real-world problems using permutations and combinations.
- Determine the sample space of an event.*
- Determine the probability of simple and compound events.
- Distinguish between a population and a sample.*
- Classify random variables.*
- Graphically represent and interpret data distributions using dot plots, stem-and-leaf plots, box plots, frequency tables, and histograms.
- Determine whether a distribution is symmetric or skewed.
- Describe a data set using measures of central tendency and dispersion.
- Define and apply the properties of normal distributions.
- Describe how the standard deviation and mean affect the graph of a normal distribution.
- Calculate and interpret the z-score for a given data value.
- Compare two sets of normally distributed data using a standard normal distribution and z-scores.
- Construct and interpret a relative frequency histogram for a given data set.*
- Understand the relationship between a relative frequency histogram and a probability density function.*
- Represent and apply the concept of area under the standard normal curve to determine probabilities and z-scores.

Unit 2 An Introduction to Functions and Their Properties 2 Weeks

Virginia SOL: 6, 7

This introductory unit introduces function properties using multiple representations. Linear, quadratic, and square root parent functions are emphasized.

- Define and distinguish between a relation and a function.
- Represent a function using a list of ordered pairs, a table, a mapping, a graph, and an equation.
- Evaluate a function using function notation.
- Determine the domain, range, zeros, and intercepts of a function.
- Describe the domain and range of a function using interval and set-builder notation.*
- Describe the intervals of the domain on which a function increases, decreases, or is constant.
- Determine whether a function is continuous or discontinuous.
- Describe the end behavior of a function as a mapping and limit notation.*
- Determine the local extrema of a function.*
- Perform function operations including composition.
- Decompose composite functions.*
- Determine whether a function is one-to-one.
- Determine and graph inverse functions.

Unit 3 Absolute Value Equations, Inequalities, and Functions 3 Weeks

Virginia SOL: 4, 6, 7, 8

- Simplify and evaluate expressions.
- Express the relationship among the verbal, symbolic, and graphic representations of an equation and an inequality.
- Solve absolute value equations and inequalities in one variable using the distance model and algebraically.
- Define the parent absolute value function as a piecewise function.
- Identify and apply transformations including shifts, reflections, compressions, and stretches to graph and write equations.

Unit 4 Quadratic Equations and Functions
4 Weeks

Virginia SOL: 1, 3, 4, 6, 7, 8, 9

- Apply patterns to determine special products.
- Factor polynomials completely over the set of complex numbers.
- Use the discriminant to determine the number and nature of solutions to an equation.
- Solve equations over the set of real numbers using Zero Product Property, square root method, completing the square, the Quadratic Formula then verify the solutions.
- Define and operate in the complex number system.
- Solve equations over the set of complex numbers and verify the solutions.
- Write an equation when given its solutions.
- Graph functions in standard form using axis, vertex, zeros, and *y*-intercept.
- Apply transformations of the parent function to graph and write equations.
- Analyze quadratic functions and their graphs.
- Determine the inverse function of a quadratic function algebraically and graphically.
- Solve quadratic inequalities graphically and using a sign chart.*
- Use least squares regression to determine an equation of best fit.*

Unit 5 Power and Polynomial Functions
2 Weeks

Virginia SOL: 1, 6, 7, 8, 9

- Graph and analyze power functions, including symmetry.
- Apply transformations of parent power functions to graph and write equations.
- Determine the inverse function of a power function algebraically and graphically.
- Determine whether a function is a polynomial.
- Identify degree, terms, leading coefficient, constant, and standard form.
- Determine products using horizontal and vertical formats.
- Determine quotients using long and synthetic division.
- Describe the relationships among solutions of an equation, zeros of a function, *x*-intercepts of a graph, and factors of a polynomial expression.
- Apply the Fundamental Theorem of Algebra, Descartes Rule of Signs, Bounds on Zeros Theorem, Rational Roots Theorem, Remainder and Factor Theorems.*
- Graph and analyze polynomial functions, including multiplicity of zeros and maximum number of turning points.

- Solve polynomial inequalities graphically and using a sign chart.
- Use regression to model real-life relationships and to determine an equation of best fit.

Unit 6 Rational Equations and Functions
3 Weeks

Virginia SOL: 1, 4, 6, 7, 10

- Define a rational function.
- Simplify and operate on rational expressions.
- Simplify complex rational expressions.
- Solve rational equations.
- Graph and analyze the parent rational function, including asymptotes.
- Apply transformations of the parent function to graph and write equations.
- Graph and analyze rational functions, including discontinuity.
- Determine the number and type of discontinuity.
- Determine the inverse function of a rational function algebraically and graphically.
- Determine the constant of proportionality for rational relationships.
- Determine and apply variation equations.
- Model real-life situations using direct, inverse, and joint variation.

Unit 7 Radical Equations and Functions
2 Weeks

Virginia SOL: 1, 4, 6, 7

- Define and determine nth roots of constants and variable expressions.
- Define rational exponents.
- Convert between radical and exponential notation.
- Evaluate and simplify expressions in radical and exponential form.
- Perform operations on expressions in radical and exponential form.
- Factor algebraic expressions that contain rational exponents.
- Solve equations in radical and exponential form.
- Determine if a solution is extraneous.
- Graph and analyze radical functions, including bounded domain.
- Apply transformations of the parent function to graph and write equations.
- Determine the inverse function of a radical algebraically and graphically.

Unit 8 Exponential and Logarithmic Equations and Functions 3 Weeks

Virginia SOL: 6, 7, 9

- Simplify and factor expressions that contain variable exponents.
- Solve exponential equations by equating bases.
- Define an exponential function.
- Develop a definition of *e* using a limit.*
- Graph and analyze exponential growth and decay functions.
- Define a logarithmic function as the inverse of an exponential function.
- Convert expressions between exponential and logarithmic form.
- Solve exponential and logarithmic equations using inverses.
- Graph and analyze common and natural logarithmic functions, including asymptotes.
- Apply transformations of parent functions to graph and write equations.
- Use regression to model real-life relationships and to determine an equation of best fit.

Unit 9 Sequences and Series
2 Weeks

Virginia SOL: 2

- Define and analyze a sequence as a function.
- Determine if a sequence is arithmetic, geometric, or neither.
- Determine the common difference or ratio.
- Determine recursive and explicit rules for a given sequence.
- Apply and use rules to determine terms, term numbers, and means.
- Use sigma notation to express partial and infinite sums.
- Determine whether a series converges or diverges.
- Determine the sum of an infinite series.
- Solve real-life problems using sequences and series.