Algebra II: Power Functions

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies:

- ***Students will demonstrate the ability to simplify algebraic expressions and equations by applying the properties of operations and arithmetic of complex numbers.***
- ***Students will demonstrate the ability to solve equations, inequalities and systems by analyzing structure and applying the properties of equality and rational expressions.***
- ***Students will demonstrate the ability to apply functions to solve problems in a variety of contexts by interpreting and analyzing multiple representations of functions.***
- ***Students will demonstrate the ability to model real world problems by building and analyzing the appropriate expression, equation, or function.***
- ***Students will demonstrate the ability to analyze and summarize text and integrate knowledge to make meaning of discipline-specific materials.***
- ***Students will demonstrate the ability to produce coherent and supported writing in order to communicate effectively for a range of discipline-specific tasks, purposes, and audiences.***
- ***Students will demonstrate the ability to speak purposefully and effectively by strategically making decisions about content, language use, and discourse style.***

Content Standards:

- A.SSE.A.1.A Interpret parts of an expression, such as terms, factors, and coefficients
- A.SSE.A.1.B Interpret complicated expressions by viewing one or more of their parts as a single entity.
- A.SSE.A.2 Use the structure of an expression to identify ways to rewrite it.
- A.CED.A.1 Create equations and inequalities in one variable and use them to solve problems.
- A.CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales
- A.APR.B.2 Know and apply the Remainder Theorem
- A.APR.B.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
- A.APR.C.4 Prove polynomial identities and use them to describe numerical relationships.
- A.APR.D.6 Rewrite simple rational expressions in different forms;

Transfer

*Students will be able to independently use their learning to **represent relationships between quantities, manipulate and analyze the representation, and interpret its meaning.***

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- equivalent expressions can be created by using multiple strategies and the guiding rules of mathematics.
- the graph and equation of a function communicate information that can be used to answer questions about real world problems.

ESSENTIAL QUESTIONS

- How can the multiple representations of a function be used to best analyze the relationship between the two quantities that it models?

Acquisition

Students will know…

- *the parent function for quadratic functions.*
- *the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x+k).*
- *that a function can be represented in many ways, including as a graph, table, and equation.*
- *the vertex form of a quadratic function is* $f(x) = a(x-h)^2 + k$.
- *the standard form of a quadratic function is* $f(x) = ax^2 + bx + c$.
- *that the zeroes of a function are the roots of the equation when set equal to zero and are the x-coordinate of the x-intercepts.*
- *that complex numbers can be used to describe the zeros of quadratic functions that have no real zeros.*
- *the Quadratic Formula.*
- *that the solution to a system of equations or inequalities is the point(s) that they have in common.*
- *that the graph of an inequality in two variable consists of all points in the coordinate plane that represent solutions.*

Students will be skilled at…

- *evaluating quadratic functions.*
- *describing and performing transformations to quadratic functions including vertical and horizontal translations, reflections, stretches, and compressions using the vertex form of the equation.*
- *determining the axis of symmetry of a parabola from an equation and from a graph.*
- *determining the vertex of a parabola from an equation and from a graph.*
- *determining a quadratic function's minimum or maximum value.*
- *finding the roots of a quadratic equation by factoring, using technology, and using the quadratic formula.*
- *factoring special cases, including the difference of two squares and perfect square trinomials.*
- *writing a quadratic function with a given set of zeros.*
- *completing the Square (where a=1) in order to solve a quadratic equation.*
- *deriving the Quadratic Formula.*
- *using the discriminant to determine the number*

write a(x)/b(x) in the form q(x) +r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system. • A.REI.A.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. • A.REI.C.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. • A.REI.D.11 Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately • N.CN.A.1 Know there is a complex number i such that i2 = -1, and every complex number has the form a + bi with a and b real. • N.CN.A.2 Use the relation i2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. • N.CN.C.7 Solve quadratic equations with real coefficients that have complex solutions. • F.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. • F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. • F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. • F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases • F.IF.C.7.A Graph linear and quadratic functions and show intercepts, maxima, and minima. • F.IF.C.7.B Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. • F.IF.C.7.C Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. • F.IF.C.8.A Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. • F.BF.A.1.B Combine standard function types using arithmetic operations. • F.BF.B.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. • MP2 Reason abstractly and quantitatively. • MP4 Model with mathematics. • MP5 Use appropriate tools strategically. • MP7 Look for and make use of structure. • MP8 Look for and express regularity in repeated reasoning.	• *that any number can be written as a complex number.* • *the Remainder Theorem.* • *the Factor Theorem.* • *that, when a real root has even multiplicity, the graph of $y = P(x)$ touches the x-axis but does not cros it.* • *that, when a real root has an odd multiplicity greater than one, the graph bends as it crosses the x-axis.* • *that the degree and leading coefficient of a polynomial function determine its end behavior* • *that a rational expression is simplified when the numerator and denominator have no common factors other than 1.* • *that extraneous solutions can occur when both sides of an equation are multiplied by an expression that can equal zero.* • *that in order for a radical to be in simplest form, the properties of radicals must be applied, perfect nth powers must be removed, the root index should be as small as possible, and the denominator must be rationalized.* *<u>vocabulary:</u> transformation, translation, vertex, axis of symmetry, parabola, power (and root), intercepts (x and y), zeroes of a function, imaginary number, discriminant, complex number, polynomial function, leading coefficient, end behavior, even and odd functions, relative maximum and minimum, synthetic division, turning point, rational expression, rationalize*	*and type of solutions to a quadratic equation.* • *solving and graphing quadratic inequalities.* • *solving a system of a linear and quadratic equation graphically and algebraically.* • *modeling real world situations with quadratic functions.* • *adding, subtracting, and multiplying complex numbers.* • *adding, subtracting, multiplying polynomials* • *dividing polynomials using long division and synthetic division.* • *determining whether a binomial is a factor of a polynomial .* • *factoring polynomials, including the sum and difference of two cubes.* • *identifying zeros of polynomials when suitable factorizations are available.* • *using the Factor Theorem to determine factors of a polynomial.* • *determining a polynomial function's end behavior.* • *sketching graphs of polynomial functions .* • *utilizing technology to graph functions and to explore their key properties.* • *simplifying rational expressions.* • *solving simple rational equations.* • *evaluating expressions with positive and negative rational exponents.* • *solving simple radical equations.* • *graphing square root and cube root functions.* • *graphing piecewise functions* • *combining functions using arithmetic operations*

Content Area Literacy Standards	***21st Century Skills***
• RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. • RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. • RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.	• *reason effectively* • *use systems thinking* • *make judgments and decisions* • *solve problems* • *access and evaluate information* • *apply technology effectively*

Stage 2 - Evidence	
Evaluative Criteria	***Assessment Evidence***
	PERFORMANCE TASK(S):
	OTHER EVIDENCE:

Stage 3 – Learning Plan	
Summary of Key Learning Events and Instruction	
Language Arts Integration	***Mathematics Integration***
• 1.OA.1 Use	• 1.OA.1 Use
Technology Integration	***District Materials***
• 1.OA.1 Use	