

FUNCTION JUNCTION The Families of Functions		
<b>Instructional Time and Investigations</b>	26 days	<ul style="list-style-type: none"> <li>• Inv. 1: The Families of Functions (5 Problems)</li> <li>• Inv. 2: Arithmetic and Geometric Sequences (2 Problems)</li> <li>• Inv. 3: Transforming Graphs, Equations, and Functions (4 Problems)</li> <li>• Inv. 4: Solving Quadratic Equations Algebraically (4 Problems)</li> <li>• Inv. 5: Polynomial Expressions, Functions, and Equations (4 Problems)</li> </ul>
<b>Goals</b>	<p><b>Functions:</b> Understand equivalence of algebraic expressions and functions.</p> <ul style="list-style-type: none"> <li>• Reasoning strategies for linear and exponential functions can be applied to step functions, absolute value functions, piecewise functions, and polynomial functions.</li> <li>• Arithmetic sequences can be represented with linear functions, and geometric sequences can be represented with exponential functions.</li> <li>• By examining the algebraic form of a function, one can predict the shape and position of a function.</li> </ul>	<p><b>Equivalence:</b> Understand equivalence of algebraic expressions and functions.</p> <ul style="list-style-type: none"> <li>• Quadratic equations can be solved graphically, algebraically, by completing the square, and by using the Quadratic Formula. Selecting the most efficient method is dependent on how the situation is presented, as well as on whether an exact or approximate answer is needed. A quadratic equation has either 1 real number solution (the vertex lies on the x-axis), 2 real number solutions (the x-intercepts), or 2 complex number solutions (no x-intercepts; solutions are expressed in the form <math>a + bi</math>).</li> <li>• The reasoning for addition, subtraction, and multiplication of whole numbers can be applied to the operations used to combine polynomial functions.</li> </ul>
<b>Common Core Standards</b>	<p><b>Common Core Standards for Mathematical Practice</b></p> <p><b>MP.1:</b> Make sense of problems and persevere in solving them.</p> <p><b>MP.2:</b> Reason abstractly and quantitatively.</p> <p><b>MP.3:</b> Construct viable arguments and critique the reasoning of others.</p> <p><b>MP.4:</b> Model with mathematics.</p> <p><b>MP.5:</b> Use appropriate tools strategically.</p> <p><b>MP.6:</b> Attend to precision.</p> <p><b>MP.7:</b> Look for and make use of structure.</p> <p><b>MP.8:</b> Look for and express regularity in repeated reasoning.</p>	<p><b>Common Core Content Standards</b></p> <p><b>A-APR.A.1:</b> Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.</p> <p><b>A-REI.B.4b:</b> Solve quadratic equations by inspection, taking square roots, completing the square, the quadratic formula, and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as <math>a \pm bi</math> for real numbers <math>a</math> and <math>b</math>.</p> <p><b>F-IF.C.7b:</b> Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.</p> <p><b>F-BF.A.2:</b> Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.</p> <p><b>F-BF.B.3:</b> Identify the effect on the graph of replacing <math>f(x)</math> by <math>f(x)+k</math>, <math>kf(x)</math>, <math>f(kx)</math>, and <math>f(x+k)</math> for specific values of <math>k</math> (both positive and negative); find the value of <math>k</math> given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.</p> <p><b>Also A-SSE.A.1b, A-SSE.B.3, A-SSE.B.3b, A-REI.B.4, A-REI.B.4a, N-Q.A.1, N-Q.A.2, F-IF.A.1, F-IF.A.2, F-IF.A.3, F-IF.B.4, F-IF.B.5, F-IF.B.6, F-IF.C.7a, F-IF.B.8a, F-IF.C.9, F-BF.A.1a, F-BF.A.1b, F-BF.B.4a, F-LE.A.2</b></p>

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**Content Connections to Other Units**

Goals of the Unit	Prior Work	Future Work
<p><b>Functions:</b> Understand equivalence of algebraic expressions and functions.</p>	<ul style="list-style-type: none"> <li>Understanding different function types (<i>Moving Straight Ahead; Thinking With Mathematical Models; Growing, Growing, Growing; Frogs, Fleas, and Painted Cubes</i>)</li> <li>Identifying and symbolizing patterns (<i>Variables and Patterns; Comparing and Scaling; Thinking With Mathematical Models; Say It With Symbols</i>), linear Relationships (<i>Moving Straight Ahead</i>), and exponential Relationships (<i>Growing, Growing, Growing</i>)</li> <li>Stretching and transforming geometric figures (<i>Stretching and Shrinking; Comparing and Scaling; Butterflies, Pinwheels, and Wallpaper</i>)</li> <li>Connecting algebraic expressions with graphs (<i>Variables and Patterns; Moving Straight Ahead; Thinking With Mathematical Models; Growing, Growing, Growing; Frogs, Fleas and Painted Cubes; It's In the System</i>)</li> <li>Working with quadratic functions (<i>Frogs, Fleas and Painted Cubes; Say It With Symbols</i>)</li> <li>Understanding the number system (<i>Comparing Bits and Pieces, Let's Be Rational; Decimal Ops; Accentuate the Negative; Looking for Pythagoras</i>)</li> </ul>	<ul style="list-style-type: none"> <li>Applying function notation in composition of functions; extending function language and notation to new functions such as trigonometric and logarithmic (<i>High School</i>)</li> <li>Using summation and product notation for finite sums and products (<i>High School</i>); and for infinite sums and products (<i>High School; College</i>); working with the Binomial Theorem (<i>High School; College</i>)</li> <li>Using matrices to transform graphs and functions; transforming polynomial functions and their graphs (<i>High School</i>)</li> <li>Understanding how a transformation on a function affects the corresponding derivative and integral functions (<i>High School; College</i>)</li> <li>Solving systems of quadratic equations and inequalities; modeling real-world data using a quadratic functions; understanding properties of parabolas as a conic section; representing complex numbers and their operations on the complex plane; using complex numbers in polynomial identities and equations (<i>High School</i>)</li> </ul>
<p><b>Equivalence:</b> Understand equivalence of algebraic expressions and functions.</p>	<ul style="list-style-type: none"> <li>Developing symbolic notation (<i>Variables and Patterns; Comparing and Scaling; Thinking with Mathematical Models; Frogs, Fleas and Painted Cubes; Say It with Symbols; It's in the System</i>)</li> </ul>	<ul style="list-style-type: none"> <li>Applying function notation in composition of functions, extending function language and notation to new functions such as trigonometric and logarithmic (<i>High School</i>)</li> </ul>