



Algebra 2 Level 1 - Unit 3 - Quadratics Equations and Complex Numbers

Unit Focus

The goal of this unit is for students to become fluent in interpreting, solving, and graphing quadratic functions with rational and irrational solutions as well as complex roots. The connection between completing the square and equations of circles is made. Students model using quadratic functions.

Stage 1: Desired Results - Key Understandings

Standard(s)	Transfer	
Common Core Mathematics: 9-12 - Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. (CCSS.MATH.CONTENT.HSN.RN.B.3) - Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real. (CCSS.MATH.CONTENT.HSN.CN.A.1) - Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. (CCSS.MATH.CONTENT.HSN.CN.A.2) - Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. (CCSS.MATH.CONTENT.HSN.CN.A.3) - Solve quadratic equations with real coefficients that have complex solutions. (CCSS.MATH.CONTENT.HSN.CN.C.7) - Extend polynomial identities to the complex numbers. For example, rewrite $x^2 + 4$ as $(x + 2i)(x - 2i)$. (CCSS.MATH.CONTENT.HSN.CN.C.8) - Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. (CCSS.MATH.CONTENT.HSN.CN.C.9) - Factor a quadratic expression to reveal the zeros of the function it defines. (CCSS.MATH.CONTENT.HSA.SSE.B.3.A) - Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. (CCSS.MATH.CONTENT.HSA.SSE.B.3.B) - Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. (CCSS.MATH.CONTENT.HSA.CED.A.1) - Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (CCSS.MATH.CONTENT.HSA.CED.A.2)	<i>Students will be able to independently use their learning to...</i> T1 model relationships among quantities. T2 manipulate equations/expressions or objects to create order and establish relationships. T3 draw conclusions about graphs, shapes, equations, or objects.	
	Meaning	
	Understanding(s)	Essential Question(s)
	<i>Students will understand that...</i> U1 Mathematicians examine relationships to discern a pattern, generalizations, or structure. U2 Mathematicians can describe patterns, relations, and/or functions to access strategies to solve problems. U3 Mathematicians use models to represent and make meaning of quantitative relationships. U4 Mathematicians analyze change and make predictions in various contexts.	<i>Students will keep considering...</i> Q1 What is the most efficient way to solve this problem? Q2 What can we learn about the relationship from the function and its graph? Q3 How do quadratic equations model real world phenomena? Q4 How do you express and describe a pattern and use it to make predictions and solve a problem?
	Acquisition of Knowledge and Skill	
	Knowledge	Skill(s)
	<i>Students will know...</i> K1 The Fundamental Theorem of Algebra K2 $i = \sqrt{-1}$ and the cyclical nature of i K3 $a + bi$ form of a complex number K4 The general and standard form of a circle	<i>Students will be skilled at...</i> S1 combining and simplifying radical expressions including those with rational fractions and cube roots

Stage 1: Desired Results - Key Understandings

- Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. (CCSS.MATH.CONTENT.HSA.REI.A.2)
- Solve quadratic equations by inspection (e.g., for $x^2 = 49$), 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 $a + bi$ for real numbers a and b . (CCSS.MATH.CONTENT.HSA.REI.B.4.B)
- 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. (CCSS.MATH.CONTENT.HSF.IF.B.4)
- Graph linear and quadratic functions and show intercepts, maxima, and minima. (CCSS.MATH.CONTENT.HSF.IF.C.7.A)
- Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. (CCSS.MATH.CONTENT.HSF.IF.C.7.B)
- 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. (CCSS.MATH.CONTENT.HSF.BF.B.3)
- Make sense of problems and persevere in solving them. (CCSS.MATH.MP.1)
- Model with mathematics. (CCSS.MATH.MP.4)
- Attend to precision. (CCSS.MATH.MP.6)
- Look for and make use of structure. (CCSS.MATH.MP.7)

Madison Public Schools Profile of a Graduate

- Analyzing: Examining information/data/ evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2)

K5 Vocabulary: complex number, imaginary unit, conjugates, zeros, discriminant

S2 solving quadratic equations by factoring, completing the square, graphing and the quadratic formula
S3 writing quadratic equations in standard form or vertex form
S4 finding the axis of symmetry, domain, range, min or max, intercepts of a quadratic function
S5 using the discriminant to find the number and type of solutions
S6 identifying real and imaginary components of complex numbers
S7 adding, subtracting, multiplying, and dividing complex numbers
S8 graphing a circle given the equation or vice versa
S9 determining tangent lines to a circle
S10 using transformations on the parent quadratic function to graph
S11 graphing and solving nonlinear systems of equations and inequalities
S12 solving, graphing, and transforming radical functions