Unit 4 - Quadratic Functions and Modeling

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **Full Year**
Status: **Published**

Unit Overview

This unit builds on the previously learned unit by identifying key characteristics and transformations of quadratic functions. Students will also identify important parameters of other functions including absolute value and square/cube root functions. This unit also requires the students use properties of integer exponents to explain and convert between expressions involving radicals and rational exponents.

Enduring Understandings

Radical expressions with like-radicals can be added and subtracted.
Radical expressions must be in simplest form.
The graph of a square root function has unique characteristics.
A quadratic equation can be solved by using a variety of techniques including using a graphing calculator.
The graph of a quadratic function results in a parabola.

Essential Questions

How can you use the properties of real numbers to perform operations with radical expressions?
How do we know if a radical expression is in simplest form?
How can we compare situations using quadratic functions and linear functions?
How can we solve quadratic equations using the quadratic formula, factoring, or the graph of a parabola?
What is the best way to solve a quadratic equation?
How do quadratic functions relate to their graphs

Learning Objectives

Be able to identify the parts of quadratics.
Be able to find the zeros of a quadratic both graphically and algebraically.
Be able to identify the nature of the roots of a quadratic using the discriminant.
Be able to solve application problem using methods for solving quadratic equations.
Be able to solve radical equations.
Be able to apply arithmetic operations to radical expressions and simplify radical expressions.

Standards: Content

F.BF.A.1	Write a function that describes a relationship between two quantities.
N.RN.A.1	Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
F.BF.A.1.a	Determine an explicit expression, a recursive process, or steps for calculation from a context.
A.APR.B	Understand the relationship between zeros and factors of polynomials
N.RN.A.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
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.
N.Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
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.
F.BF.B.4	Find inverse functions.
F.BF.B.4.a	Solve an equation of the form 𝑓(𝑥) = 𝑐 for a simple function 𝑓 that has an inverse and write an expression for the inverse.
A.CED.A.1	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.
F.BF.B.5	Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.
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.
A.REI.B.4.a	Use the method of completing the square to transform any quadratic equation in 𝑥 into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
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.
A.REI.D	Represent and solve equations and inequalities graphically
F.IF.C.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
A.REI.D.10	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
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.
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, e.g., using technology to graph the functions, make tables of values, or find

	successive approximations. Include cases where □(□) and/or □(□) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
F.IF.C.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
F.LE.A	Construct and compare linear and exponential models and solve problems
F.LE.A.1	Distinguish between situations that can be modeled with linear functions and with exponential functions.
F.LE.A.1.a	Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
A.SSE.A.2	Use the structure of an expression to identify ways to rewrite it.
F.LE.A.2	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
A.SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
F.LE.A.3	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
A.SSE.B.3.a	Factor a quadratic expression to reveal the zeros of the function it defines.
F.LE.B	Interpret expressions for functions in terms of the situation they model
F.LE.B.5	Interpret the parameters in a linear or exponential function in terms of a context.

Standards: Interdisciplinary

9.1.8.CDM.4	Evaluate the application process for different types of loans (e.g., credit card, mortgage, student loans).
9.1.8.CP.1	Compare prices for the same goods or services.
8.1.8.DA.1	Organize and transform data collected using computational tools to make it usable for a specific purpose.
8.1.8.DA.4	Transform data to remove errors and improve the accuracy of the data for analysis.
8.1.8.DA.5	Test, analyze, and refine computational models.
8.1.8.AP.1	Design and illustrate algorithms that solve complex problems using flowcharts and/or pseudocode.
8.1.8.AP.2	Create clearly named variables that represent different data types and perform operations on their values.

Assessment Evidence

Formative	Collaborative Activities, Homework, Classwork, Discussion, Independent Class Assignment, Informal Observations of Students, Games, Exit Slips, Pre-Assessments, Math Message – Warm up, Questioning, Teacher Made Pages, Learning Centers, LinkIt, Problem of the Day, Problem of the Week, Entrance Slips, Pre-Assessments
Summative	LinkIt Benchmark Assessments, Tests, Pre-Assessments, Quizzes, Written Responses
Alternative &	Alternative – Reteaching, One on One Conferencing, Learning Centers, Levels Homework,

Benchmark	Higher Order Thinking Problems, Additional leveled practice Benchmark - LinkIt Benchmark Assessments, Totowa TPA
Assessment Evidence Resource	

Instructional Resources

Smartboard, Computers, iPads, websites and digital interactives/models, multi-media presentations, video streaming, Brain Pop, Microsoft 365, Primary and Secondary Source Documents, Assorted Manipulatives, Khan Academy, Crosswalk Coach for the Common Core Standards, Ready Common Core Mathematics Instruction and Practice, Common Core Coach, Calculators, Reveal Math Resources.

Instructional Resource List

Curricular Mandates

Below are the curricular requirements as defined in NJ Administrative Code and Statute

	Amistad		Diversity, Equity, and Inclusion
	Holocaust		LGBT and Disabilities (Grades 6-12)
	Climate Change		Asian American & Pacific Islander

Social Emotional Learning (SEL) Competencies

NJ Social and Emotional Learning Competencies & Sub-Competencies

	Self-Awareness	X	Relationship Skills
X	Responsible Decision-Making		Social Awareness
X	Self-Management		

21st Century Skills & Themes

	Global and Cultural Awareness	X	Technology Literacy		Planning and Budgeting
X	Creativity and Innovation		Financial Institutions		Risk Management and Insurance
X	Information and Media Literacy		Digital Citizenship		Economic and Government Influences
	Critical Thinking and Problem Solving		Credit Profile		Career Awareness and Planning
	Civic Financial Responsibility		Financial Psychology		