**Unit 10: Introduction to Quadratic Functions**

**(*Combines Algebra 1 Unit 8 and
Algebra 2 Unit 2 Investigations 1 and 2)***

**(5 Weeks)**

**UNIT PLAN**

This unit presents quadratic functions in various forms—vertex form, standard form, and factored form. From different forms of the function, different features of their graphs (zeroes, intercepts, maxima, and minima) may be determined. This leads to the solution of quadratic equations by various method (applying the square root property, factoring, completing the square, using the quadratic formula).

**Essential Questions**

* How do I describe quadratic functions in terms of transformations?
* How do I describe quadratic functions in terms of properties such as concavity and end behavior?
* How do I solve a quadratic equation?
* What can the zeros, intercepts, vertex, maximum, minimum and other features of a quadratic function tell you about real world relationships?
* How is the polynomial system analogous to the system of integers?
* How can technology support investigation and experimentation of the way that parameters affect functions?

**Enduring Understandings**

* Quadratic functions can be used to model real world relationships and the key points in quadratic functions have meaning in the real world context.
* Polynomials are closed under addition, subtraction, and multiplication.
* Dynamic software, graphing calculators, and other technology can be used to explore and deepen our understanding of mathematics.

**Unit Contents**

Investigation 1: Another Nonlinear Family: Parabolas Everywhere (3 days)

Investigation 2: Quadratic Functions in Vertex Form (3 days)

Investigation 3: Solving Quadratic Equations Using the Square Root Property (3 days)

Mid-Unit Quiz (1 day review +1 day test)

Investigation 4: Transforming Quadratic Functions (3 days)

Investigation 5:Quadratic Functions in Factored Form (3 days)

Investigation 6: Factoring Quadratic Trinomials (4 days)

Investigation 7: Solving Quadratic Equations by Completing the Square and the Quadratic Formula (3 days)

Performance Task: Stopping Distance (1 day)

End-of-Unit Test (1 day review + 1 day test)

**Common Core Standards**

*Mathematical Practices #1 and #3* *describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. Practices in bold are to be emphasized in the unit.*

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

**4. Model with mathematics.**

**5. Use appropriate tools strategically.**

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

**Standards Overview**

* Write expressions in equivalent forms to solve problems.
* Solve equations and inequalities in one variable.
* Perform arithmetic operations on polynomials.
* Create equations that describe numbers or relationships.
* Interpret functions that arise in applications in terms of the context.
* Analyze functions using different representations.
* Build new functions from existing functions.

**Common Core State Standards**

8EE 2. Use square root and cube root symbols to represent solutions to equations of the form *x*2 = *p* and *x*3 = *p*, where *p* is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.

A-SSE 3. a Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

A-REI 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. 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.

A-APR 1. 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.

A-CED 1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from ...quadratic functions ...*

A-CED 2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

F-IF 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. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries... \*

F-IF 7a. Graph ... quadratic functions and show intercepts, maxima, and minima.

F-IF 8a. 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 3. Identify the effect on the graph of replacing *f*(*x*) by *f*(*x*) + *k*, *kf*(*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...

**Vocabulary**

Algorithm

Binomial

Coefficient

Completing the Square

Constant Term

Decreasing

Δ (Delta)

ΔΔ (Delta-Delta)

Expanded Form

Factored Form

First Differences

Increasing

Leading Coefficient

Line of Symmetry

Linear Term Opens Up

Monomial

Opens Down

Quadratic Formula

Quadratic Function

Quadratic Equation

Quadratic

Second Differences

Parabola

Parameter

Quadratic

Square Root Property

Standard Form

Trinomial

Vertex

Vertex Form

Vertex Formula

x-intercepts

y-intercepts

Zero Product Property

**Assessment Strategies**

**Performance Task: Stopping Distance**

Students work in groups to analyze a real world scenario that can be modeled by a quadratic function. They investigate the effects of distance, speed, and reaction time to determine the safety of a turn in the road that leads to a railroad crossing. The groups will write a letter to the local transit authority to recommend road signs that can increase the safety of drivers approaching the turn.

**Other Evidence (Formative and Summative Assessments)**

* Exit slips
* Class work
* Homework assignments
* Math journals
* Mid-unit test from Algebra 1 Unit 8
* Unit Test for IM Unit 10