Unit 4: Quadratic Equations and Functions

Content Area: **Mathematics**
Course(s): **Mathematics**
Time Period: **Week 14**
Length: **5 Weeks**
Status: **Published**

Unit Overview

In this unit, students graph quadratic functions and compare them to the parent graph (y = x2). They find the axis of symmetry, the vertex, and minimum or maximum values. They solve quadratic equations by factoring, graphing, using square roots, completing the square, and using the quadratic formula. Students use the discriminant to determine the number and type of solutions of a quadratic equation. They will use quadratic equations to solve vertical motion problems. Finally, students determine whether a linear, exponential, or quadratic function best models a set of data.

Standards

MA.A-SSE.B.3a	Factor a quadratic expression to reveal the zeros of the function it defines.
MA.A-SSE.B.3b	Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
MA.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.
MA.F-IF.C.7a	Graph linear and quadratic functions and show intercepts, maxima, and minima.
MA.F-IF.C.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.
MA.F-IF.C.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
MA.F-BF.B.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.
MA.A-REI.B.4	Solve quadratic equations in one variable.
MA.A-REI.B.4a	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.
MA.A-REI.B.4b	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 $a \pm bi$ for real numbers a and b.
MA.F-LE.A.1b	Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
MA.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.

MA.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).

Essential Questions

1. How do linear, exponential, and quadratic models differ from each other?
2. How can mathematical models be used to describe physical relationships?
3. How can quadratic equations be used to solve real-world problems?

Application of Knowledge and Skills...

Students will know that...

- 1. the most basic quadratic function is called the parent quadratic function
- 2. every quadratic function has a U-shaped graph called a parabola
- 3. the lowest or highest point on a parabola is the vertex
- 4. the line that passes through the vertex and divides the parabola into 2 symmetric parts is called the axis of symmetry
- 5. quadratic functions have either a minimum or maximum value
- 6. the sign of the leading coefficient of a quadratic function determines whether it opens up or down
- 7. quadratic functions can be solved by graphing, finding square roots, completing the square, using the quadratic formula, and factoring
- 8. the discriminant is used to determine the number of solutions of a quadratic equation

Students will be able to:

- a. graph simple and general quadratic functions
- b. solve quadratic equations by graphing
- c. solve a quadratic equation by finding square roots
- d. solve quadratic equations by completing the square
- e. solve quadratic equations by using the quadratic formula
- f. solve quadratic equations by factoring
- g. use quadratic equations to solve vertical motion problems
- h. use the value of the discriminant
- i. compare linear, exponential, and quadratic models

Assessments

- Communicator Practice Diagnostic: Other written assessments Students will solve practice problems on communicators to receive immediate feedback
- Daily Warm-Up Problems Diagnostic: Other written assessments Students will complete daily warm-up problems to assess readiness
- Graphing Quadratic Functions Quiz Formative: Written Test Students will solve quadratic equations by graphing
- Solving Quadratic Equations Quiz Formative: Written Test Quiz will include solving quadratic equations by factoring, taking square roots, completing the square, and the quadratic formula
- Ticket to Leave Problems Formative: Other visual assessments Students will complete one or two problems to assess knowledge and skills learning during the class period
- Unit Test Summative: Written Test Test will include all topics covered in the unit

Activities

Graphing Investigation
Students will graph quadratic functions by hand and by using the graphing calculator.

Find a Minimum or Maximum Value of a Graph
Students will use the graphing calculator to find the minimum or maximum value of a quadratic function.

Enrichment Project: How Warm is it in Your City?
Students will compare the normal daily mean temperature of a city where they live to the coldest city in the United States. This project will incorporate technology.

Vertical Motion Investigation and Problem Solving Activity

Activities to Differentiate Instruction

Mixed-ability grouping

Interactive Smart Board activities

Multi-Step Problem Solving

Math stations

Cooperative learning

Study guides (teacher and student completed)

Modify tests and homework as needed

Modified grading rubrics

Graphic organizers

Communicator response boards

Extended response questions

Challenge and enrichment homework assignments, worksheets, and project

Optional weekly challenge problems

Integrated/Cross-Disciplinary Instruction

Resources

McDougal Littell Algebra 1 textbook and resource materials

Website: www.classzone.com (see link)

Kuta Software

Algebra with Pizzazz

Punchline Algebra

Smart Exchange Website (see link)

NJ Ask Review Workbook Grade 8

American Diploma Project Algebra 1 End-of-Course Exam Workbook

www.classzone.com
exchange.smarttech.com

21st Century Skills

CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.

CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.
CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
CRP.K-12.CRP12.1	Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.