Unit #05: Quadratic Equations and Functions

Content Area: **Mathematics**
Course(s): **Algebra II**
Time Period: **January**
Length: **8 weeks**
Status: **Published**

Unit Overview

In this unit, students are introduced to roots and principal roots of real numbers. Students learn to use various properties to simplify, add, subtract, multiply, and divide radical expressions. The theme of solving equations is continued in this chapter by consideration of radical equations. This unit concludes with a study of roots of negative numbers and the arithmetic of complex numbers.

Enduring Understandings

Students will understand there are different methods to solving quadratic functions.

Changing the parameters of quadratic function changes the graph in predictable ways.

Essential Questions

- How are quadratic equations and their graphs useful in solving real-world problems?
- How do graphs of mathematical models help us better understand the world in which we live?
- How do you develop a method for solving equations in quadratic form?
- Why is it important to have more than one way to solve a problem?

Standards/Indicators/Student Learning Objectives (SLOs)

Student Learning Objectives:

- SWBAT analyze a quadratic function, draw its graph, and find its maximum or minimum value.
- SWBAT find the vertices and axis of symmetry of quadratic equations.
- SWBAT graph quadratic equations.
- SWBAT graph quadratic inequalities.
- SWBAT recognize equations in quadratic form.
- SWBAT solve equations in quadratic form.
- SWBAT solve quadratic equations by completing the square.
- SWBAT solve quadratic equations by taking square roots.

- SWBAT solve quadratic equations by using the quadratic formula.
- SWBAT solve quadratic equations using technology (graphing calculator).
- SWBAT solve systems of quadratic and linear equations.
- SWBAT solve systems of quadratic inequalities.
- SWBAT solve systems of two quadratic equations.
- SWBAT use the discriminant to determine the nature of the roots of a quadratic equation.
- SWBAT write a quadratic equation or function using information about the roots or the graph.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.7	Look for and make use of structure.
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.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
MA.N-CN.C	Use complex numbers in polynomial identities and equations.
MA.N-CN.C.7	Solve quadratic equations with real coefficients that have complex solutions.
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).

Indicators

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in

an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

MA.A-SSE.B	Write expressions in equivalent forms to solve problems

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

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

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5 + 7 × 3, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 - 3(x - y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

MA.F-IF.C.7a	Graph linear and quadratic functions and show intercepts, maxima, and minima.
MA.F-IF.C.7b	Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
MA.F-IF.C.7c	Graph polynomial functions, identifying zeros when suitable factorizations are available,

and showing end behavior.

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.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.

Lesson Titles

- Calculating Roots with Graphing Calculator
- Completing the Square
- Graph Quadratic Inequalities
- Quadratic Formula
- Quadratic Functions & Their Graphs
- Solve Systems of Quadratic Equations
- Solve Systems of Quadratic Inequalities
- Taking Square Roots
- The Discriminant

Career Readiness, Life Literacies & Key Skills

TECH.9.4.2.CI.1	Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2).
TECH.9.4.2.CT.2	Identify possible approaches and resources to execute a plan (e.g., 1.2.2.CR1b, 8.2.2.ED.3).
TECH.9.4.2.CT.3	Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
TECH.9.4.2.DC.2	Explain the importance of respecting digital content of others.
TECH.9.4.2.DC.3	Explain how to be safe online and follow safe practices when using the internet (e.g., 8.1.2.NI.3, 8.1.2.NI.4).
TECH.9.4.2.TL.2	Create a document using a word processing application.
TECH.9.4.2.TL.3	Enter information into a spreadsheet and sort the information.

Inter-Disciplinary Connections

| LA.RI.11-12.1 | Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain. |
| LA.RST.9-10.3 | Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions |

	defined in the text.
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.RST.9-10.8	Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
LA.WHST.9-10.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.
LA.W.11-12.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
LA.W.11-12.1.A	Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence.
LA.W.11-12.1.B	Develop claim(s) and counterclaims avoiding common logical fallacies and using sound reasoning and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.9-10.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
LA.W.11-12.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)
LA.W.11-12.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
LA.SL.11-12.1.C	Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
LA.L.11-12.6	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
12.9.3.ST-SM.2	Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
STEM.9-12.9.4.12.O.2	Demonstrate mathematics knowledge and skills required to pursue the full range of postsecondary education and career opportunities.
STEM.9-12.9.4.12.O.17	Employ critical thinking skills (e.g., analyze, synthesize, and evaluate) independently and in teams to solve problems and make decisions.
STEM.9-12.9.4.12.O.48	Employ teamwork skills to achieve collective goals and use team members' talents effectively.

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK

- Bloom's Analysis: Break the concept into parts to understand how each is related to one another
- Bloom's Application: Use knowledge gained in new ways
- Bloom's Comprehension: Make sense of what has been learned

- Bloom's Evaluation: Put new information together in an innovative way

- Bloom's Knowledge: Recall relevant knowledge from prior lessons and long-term memory

- Bloom's Synthesis: Make judgements based on a set of guidelines to create new meaning

- Intro lesson on finding roots with graphing calculator

- Intro lesson on how to factor by completing the square

- Intro lesson on quadratic formula

- Intro lesson on taking (finding) square roots

- Intro lesson on the graphing parabolas

- Intro lesson on understanding the discriminant and its nature to the roots

- Notes will be taken using Smart Notebook

- Review homework

- Review warm up

- Students will present solutions on the board

- Students will work independently on examples

- Students will work together on a worksheet

- Tutoring during Delsea One

Modifications

ELL Modifications

- Focus on domain specific vocabulary and keywords

- Offer alternate/or modify assessments

- Provide formal and informal verbal interaction to provide practice, increase motivation, and self-monitoring

- Tap prior knowledge

- Tutoring during Delsea One

- Use real objects when possible

IEP & 504 Modifications

- Allow student to correct mistakes or answer wrong questions correctly for additional credit if failed the first test (another way to re-teach material)

- Allow student to take notes in class for reinforcement but also provide a copy of completed/correct notes to study from

- Provide formulas on the test and/or sample problems

- Provide students with content vocabulary prior to teaching a lesson that contains that vocabulary (pre-teaching)

- Tutoring during Delsea One

G & T Modifications

• Ask students' higher level questions that require students to look into causes, experiences, and facts to draw a conclusion or make connections to other areas of learning

• Determine where students' interests lie and capitalize on their inquisitiveness. (Is there a specific career they are interested in? How would this apply to their interest?)

• Encourage students to explore concepts in depth and encourage independent studies or investigations

• Provide additional rigorous challenge problems for advanced students

At Risk Modifications

- guided notes
- retesting
- speaking to students privately when redirecting behaviors
- study
- tutoring during Delsea One

Formative Assessment

- Exit Ticket
- Group Work
- Guided Practice
- Individual Practice
- Journal Entry
- Kahoot!
- Observation
- Oral Responses
- Poll class to self-analyze their comfort level of the lesson
- Socrative
- Teacher Observation
- Vocabulary Review

Alternate Assessments

Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Benchmark Assessment

Skills-based assessment- math practice

Summative Assessment

- Alternative Assessment
- Marking Period Assessment
- Project Outlining All Methods of Solving Quadratic Equations
- Quiz on Completing the Square
- Quiz on Graphing Parabolas
- Quiz on Graphing Systems of Quadratic Inequalities
- Quiz on Quadratic Formula and Discriminant
- Quiz on Solving Quadratic Systems
- Unit Test on Quadratic Functions and their Graphs

Resources & Materials

- Chromebook
- Graphing Calculator
- Promethean Board
- Smart Notebook
- Teacher generated worksheets
- Textbooks: Algebra and Trigonometry Structure and Method Book 2 (McDougal Littell), Algebra II Common Core (Pearson)

Technology

- google classroom
- http://kutasoftware.com/
- http://mathxlforschool.com/home_school.htm
- https://create.kahoot.it

- https://njctl.org/
- https://quizizz.com/
- https://socrative.com/
- https://www.desmos.com/
- https://www.resourceaholic.com/
- https://www.youtube.com/watch?v=3ayhvAI3IeY&feature=youtu.be
- https://www.youtube.com/watch?v=bclm1tJB-3g&feature=youtu.be
- https://www.youtube.com/watch?v=mZs5pQ6gAUQ&feature=youtu.be
- https://www.youtube.com/watch?v=rKZhTJia_00&feature=youtu.be
- https://youtu.be/CiH2_YJJCRs
- https://youtu.be/cX6nveevklA
- https://youtu.be/hDc-guDp1fc
- https://youtu.be/mDwN1SqnMRU
- https://youtu.be/QHHbvaQL8_c
- https://youtu.be/rnkk0rC9Gyo
- https://youtu.be/tGH0xcT8q90
- Student 1-1 Device (chromebook)
- TI Graphing Calculator

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.C.CS4	Contribute to project teams to produce original works or solve problems.
TECH.8.1.12.E.CS1	Plan strategies to guide inquiry.
TECH.8.1.12.E.CS3	Evaluate and select information sources and digital tools based on the appropriateness for specific tasks.
TECH.8.1.12.E.CS4	Process data and report results.
TECH.8.1.12.F.CS2	Plan and manage activities to develop a solution or complete a project.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.
TECH.8.1.12.F.CS4	Use multiple processes and diverse perspectives to explore alternative solutions.