Unit 01: Linear, Quadratic and Rational Functions

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 1**
Length: **4-5 weeks**
Status: **Published**

Brief Summary of Unit

This unit reviews concepts previously studied in Geometry and Algebra II/Algebra II & Trig Honors. Coordinate Geometry is reviewed to stress the distance formula, slope formula, finding the equations of lines, and graphing lines. The class is then directed to solve quadratic equations by factoring, completing the square, and the quadratic formula. In addition, there is a review of complex numbers and rational expressions. There is also an introduction of how to utilize the graphing calculator as an algebraic tool to solve equations, graph functions and find relative extrema and intervals of increasing and decreasing. Lastly, students will be introduced to the three representations of a function and will be taught to recognize linear, quadratic and rational relationships by a graph, table of values or its equation.

Standards

Diversity and Inclusion: Students will focus on equity, inclusion, and tolerance when analyzing the comparison of various quantities regarding characteristics of people. Equality will also be highlighted which can be associated with both numerical representations and the connection between people. This can be associated with treating people fairly and equally.

LA.K-12.NJSLSA.L4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.
LA.K-12.NJSLSA.L5	Demonstrate understanding of word relationships and nuances in word meanings.
MA.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.
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.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-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.A-REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

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.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).
MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
MA.A-SSE.A.2	Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.
MA.A-SSE.A.1a	Interpret parts of an expression, such as terms, factors, and coefficients.
MA.A-SSE.A.1b	Interpret complicated expressions by viewing one or more of their parts as a single entity.
TEC.K-12.8.1	All students will use computer applications to gather and organize information and to solve problems.
TEC.K-12.8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world as they relate to the individual society, and the environment.
WORK.K-12.9.1	All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace.
WORK.K-12.9.2	All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace.
	Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Transfer

- Finding relations between similar representations of the same data is important for versatility.
- Imaginary numbers construct the idea that numbers mathematically exist, but not realistically.
- Noticing specific connections between Geometry and Algebra using coordinates.
- Solving quadratic equations using any listed method will be useful in extension to polynomial equation solving.
- Using technology to establish a higher level thinking process of how to read a graph and understand its mathematical applications.

Essential Questions

- How can these functions and their graphs be used as mathematical models to solve real-world problems?

- What are the characteristics of linear, quadratic, and rational functions?
- What are the comparisons between an equation, graph, and table of information?
- Why does understanding imaginary numbers help in real world application problems?

Essential Understandings

- Both the graph and the equation of a line can be determined by its y-intercept and slope.
- If a > 0, then the vertex of the parabola is a minimum. If a < 0, then the vertex of the parabola is a maximum. The x value of the vertex can be found by the formula -b/2a
- Three methods are available to solve a quadratic equation: factoring, quadratic formula, and completing the square. Students should know which method is appropriate for each type of problem.
- A system of linear equations can be solved by elimination, substitution or graphing.
- Answers involving complex numbers should be simplified into a + bi form and if the answer involves a fraction, the denominator should be rationalized.
- Graphing quadratic functions consists of finding the roots, y-intercept and vertex.
- Parallel lines have the same slope, while perpendicular lines will have slopes that are opposite reciprocals.
- Pythagorean Theorem can be applied in lieu of using the distance formula.
- The midpoint between two points is directly related to the mean of each the x and y coordinates.
- There are simple ways to recognize if a function is linear, quadratic or rational by looking at its graph, a table of values or its equation.
- There may be extraneous roots when solving rational or radical equations.

Students Will Know

- How to solve a quadratic equation with real or imaginary solutions.
- How to utilize a graphing calculator to graph a function and solve an equation.
- The different formulas needed to find equation of a line including point-slope and slope-intercept.
- The formula (and their derivations) to find slope, distance and midpoint.
- The meaning of i in terms of complex numbers and how to simplify expressions involving i.
- The methods for simplifying rational expressions and solving rational equations.
- The properties of parallel and perpendicular lines.
- When to apply the formula for the vertex of a parabola.

Students Will Be Skilled At

- Applying the real world meaning of a parabola's vertex point.
- Expressing imaginary numbers as solutions to quadratic equations.
- Factoring rational expressions to be simplified and creating like denominators to solve rational equations.
- Implementing formulas within the coordinate plane.

- Using graphing calculators to graph and solve function equations.

Evidence/Performance Tasks

Assessments

- Formative: Daily assessments using examples from class notes, NJSLA test bank problems, and/or Albert/AP Classroom assessments
- Summative: Teacher-created assessments, NJSLA test bank problems, Big Ideas Math online platform problems, Albert/AP Classroom and/or Big Ideas Math unit assessments
- Benchmark: IXL or teacher created diagnostic assessments in addition to unit assessments from Big Ideas Math
- Alternative Assessments: Student-centered activities such as scavenger hunts, various projects involving real world applications, and differentiated learning tasks in Khan Academy, DeltaMath, and IXL

- Answer essential questions
- Class discussion of daily topic
- Classwork and homework that assess the essential questions
- Evaluate complex (imaginary) expressions.
- Explore and recognize linear and quadratic functions, including their shifts, stretches and shape using graphing calculator exercises.
- Find the midpoint and length of a given segment.
- Graph and analyze linear functions.
- Graph and analyze quadratic and rational functions.
- Identify asymptotic behavior.
- Provide alternative means of assessments for certain students
- Solve a variety of equations, including linear, quadratic, imaginary, rational and radical.
- Take tests and quizzes that will assess the essential questions, including pre-assessments.
- Teacher Observation
- Tests and quizzes that assess the essential questions
- Use a graphing utility to solve equations.
- Written assignments that assess the essential questions that involves providing explanations

Learning Plan

- Discuss the difference between linear and quadratic models.
- Graph parabolas through the use of intercepts and the vertex.
- Knowledge of the graphing calculator is imperative in Pre-Calculus. The teacher can instruct the

students about the graphing calculator by using the graphing calculator software for the Interactive Whiteboard while the students use their own TI-83/TI-84 calculators or ones supplied during the class period. After the graphing of lines and parabolas via pencil and paper, the students will learn how to graph lines and parabolas with the calculator. Then, the students will also be instructed how to find the maximum/minimum point on a parabola using the graphing calculator and how to use it to solve complex equations.

- Perform the basic four operations with complex numbers.
- Perform the basic four operations with rational expressions and solve rational equations.
- Preview the essential questions and connect to learning throughout the unit.
- Review Coordinate Geometry, including: distance formula, midpoint formula, slope formula, graphing lines, finding the equations of lines.
- Solve quadratic equations via factoring, quadratic formula, completing the square.
- Utilize the graphing calculators to further explore linear, quadratic and rational functions.

Materials

Core instructional materials: Core Book List including PreCalculus Enhanced with Graphing Utilities, Sullivan, Savvas

Supplemental materials: Khan Academy, Edia, and DeltaMath

- District approved textbook
- Khan Academy
- Teacher created activiites
- Teacher created notes
- Whitebaord tables

Suggested Strategies for Modifications

Possible accommodations/modification for CP PreCalc & Trig