Algebra 2 Honors: Unit 1

Marking Period	Unit Title	Recommended Instructional Days
1	Quadratic Functions and Equations	15 - 18 days

Domain: Number and Quantity, Algebra, Functions

NJSLS Strand:

Key:

Major Cluster
Supporting Cluster
Additional Cluster

N.CN.A.1 Know there is a complex number *i* such that $i^2 = -1$, and every complex number has the form a + b*i* with a and b real.

N.CN.A.2. Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

N.CN.C.7. *Solve quadratic equations with real coefficients that have complex solutions.*

Progress Indicator:
Tests • Quizzes • Practice problems for homework • Online textbook • Worksheets • Leveled assessments

Recommended Activities, Investigations, Interdisciplinary Connections, and/or Student Experiences to Explore NJSLS-CLKS within Unit

Essential Question/s:
What are the advantages of a quadratic function in vertex form?
How do you use quadratic functions to model situations and solve problems?
How do we use the imaginary unit to express complex numbers in terms of i?

Activity Description:
Vertex Form of a Quadratic Function
Standard Form of a Quadratic Function
Solving Quadratics by graphing and the Zero Product Property
Complex Numbers and Operations
Solving Quadratics using Square Roots
Completing the Square
The Quadratic Formula
Quadratic Regression

Interdisciplinary Connections: Music
A manager estimates a band's profit p for a concert by using the function $p(t) = -200t^2 + 2500t - c$, where t is the price per ticket and c is the band's operating cost. The table shows the band's operating cost at three different concert locations. What range of ticket prices should the band charge at each location in order to make a profit of at least $1000 at each concert?

A-SSE.A.2. Use the structure of an expression to identify ways to rewrite it.
A-SSE.B.3a. Factor a quadratic expression to reveal the zeros of the function it defines.
A-SSE.B.3b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
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.*
A-CED.A.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
A-CED.A.3. Represent constraints by equations or inequalities, and by systems of equations and/or

Band's Costs	
Location	**Operating Cost**
Freemont Park	**$900**
Saltillo Plaza	**$1500**
Riverside Walk	**$2500**

Answer:
Freemont Park: between $0.82 and $11.68
Saltillo Plaza: between $1.10 and $11.40
Riverside Walk: between $1.61 and $10.89

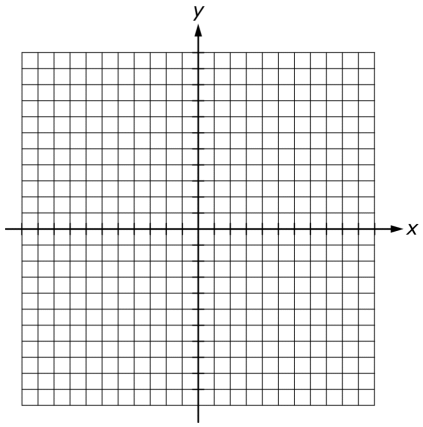
Content: Artistic Process: Performing/Presenting/Producing
NJSLS#: HS.VPA2-1 - 2-5

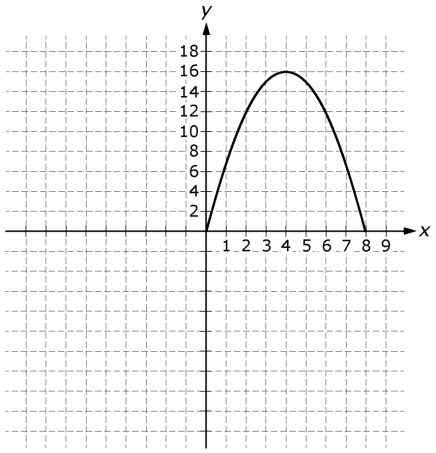
Example Tasks:

Task 1:

The area of a rectangular garden is expressed by the function $A(x) = x(8 - x)$, where the length of the garden is x feet and the width of the garden is $(8 - x)$ feet.

Part A: What values of x make sense in the context of the problem?

inequalities, and interpret solutions as viable or nonviable options in modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* **A-REI.A.1.** Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. **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		Part B: Graph the function $A(x)$ in the coordinate plane below for the *x*-values you identified in Part A.  Part C: What are the dimensions of the garden that will result in the maximum possible area? **Answer:** A: $0 < x < 8$ B:

complex solutions and write them as a + bi for real numbers a and b. **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 solutions approximately; e.g., using technology to graph functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.* **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 in a verbal description of the relationship. *Key features include: intercepts;*		 C: 4 ft by 4 ft **Task 2:** The height above ground, *h*, of an arrow *t* seconds after being shot straight up into the air can be modeled by the formula $h(t) = 1.5 + 40t - 4.9t^2$, where *t* is in seconds and *h* is in meters. What is the average rate of change of the height, in meters per second, of the arrow over the first three seconds after being shot? Show your work. **Answer:** At time $t = 0$, the height is $h = 1.5$ meters. At time $t = 3$, the height is $h = 1.5 + 40(3) - 4.9(3)^2 = 77.4$ meters, so the height changed by 75.9 meters in 3 seconds, and the average

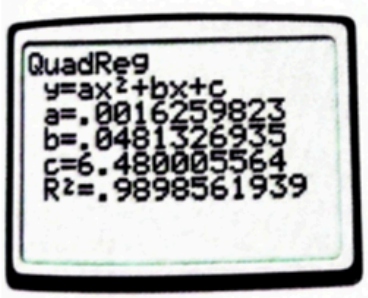
*intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.** **F-IF.B.5.** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n)gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function. ★ **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. Graph linear and quadratic functions and show intercepts, maxima, and minima. **F-IF.C.8.** Write a function defined by an expression in different but equivalent forms to reveal and explain		rate of change of the height is thus $\frac{75.9}{3} = 25.3$ meters per second. **Task 3:** Solve : $x^2 - x + 1 = 0$ **Answer:** $x = \frac{1 + i\sqrt{3}}{2}$ and $x = \frac{1 - i\sqrt{3}}{2}$ **Task 4:** **Find a quadratic model for the wattage of fluorescent bulbs F given the comparable incandescent bulb wattage I. Use the model to estimate the wattage of a fluorescent bulb that produces the same amount of light as a 120–watt incandescent bulb.** **Wattage Comparison** **Incandescent (watts)** 40 60 75 90 100 **Fluorescent (watts)** 11 15 20 23 28 **Answer:**

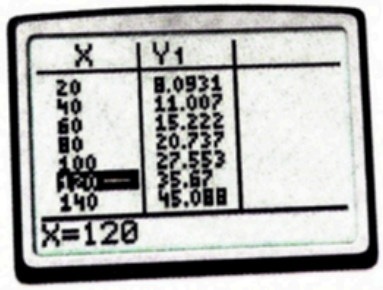
different properties of the function.
a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

F-BF.A.*1*. *Write a function that describes a relationship between two quantities.*

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. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*

Enter the data into two lists in a graphing calculator. Use the quadratic regression feature.

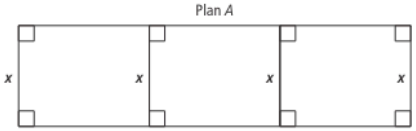


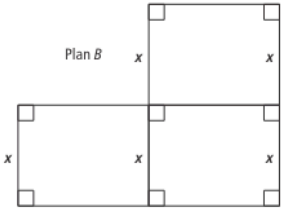


The model is $F(I) \approx 0.0016I^2 + 0.0481I + 6.48$. A 36-watt fluorescent bulb produces about the same amount of light as a 120-watt incandescent bulb.

Task 5:

A group of students want to build three identical rectangular gardens, each of which has a width of x ft. The gardens will be arranged in one of two ways, as shown by the plans below. The students have 480 ft of fencing and plan to build a fence around each of the three gardens. They will also install lighting for the gardens.





1. Suppose that the students use all of the fencing. Given that the width of a small rectangular garden is x ft, write an expression in terms of x for the length of one of the small rectangular gardens in Plan A. Then write an expression in terms of x for the length of one of the small rectangular gardens in Plan B. Explain.

2. Write an expression for the combined area of the three gardens in Plan A and of the three gardens in Plan B. Show two different ways to write each expression. Explain.
   Area for Plan A:
   Area for Plan B:

3. The students want to choose the plan that will give the maximum combined area for the 3 gardens. Use a graphing calculator to identify the plan they should choose. Explain your reasoning.

4. What are the zeros of the function f(x) = 240x − 2x 2 ? Explain your reasoning.

5. The students hire an electrician to set up the lighting for their garden. For one of the circuits installed by the electrician, there are three source voltages:
   Source 1: (9 + 4i) V
   Source 2: (5 − 3i) V
   Source 3: (2 + 6i) V
Find the total voltage for the circuit. Explain.

Answer:
Part 1

		Plan A: $\frac{480 - 4x}{6}$; Plan B: $\frac{480 - 5x}{5}$; Sample answer: For Plan A, subtract $4x$ from 480 because there are 4 sides with length x ft. Then divide by 6 because there are 6 remaining lengths. For Plan B, subtract $5x$ from 480 because there are 5 sides with length x ft. Then divide by 5 because there are 5 remaining lengths. Part 2 Area for Plan A: $3 \cdot \frac{x(480 - 4x)}{6}$ or $240x - 2x^2$ Area for Plan B: $3 \cdot \frac{x(480 - 5x)}{5}$ or $288x - 3x^2$ Sample answer: For each plan, multiply the width x of each garden by its length using the expression from Item 1. Then multiply the area of each rectangular garden by 3 to find the combined area. Each expression can be rewritten as shown. Part 3 Plan A; Sample answer: Let function $f(x) = 240x - 2x^2$ represent the total area of Plan A, and let function $g(x) = 288x - 3x^2$ represent the total area of Plan B. Graph the functions to find and compare their maximum values. For Plan A, the maximum area is 7,200 ft^2 when $x = 60$ ft. For Plan B, the maximum area is 6,912 ft^2 when $x = 48$ ft. They should choose Plan A. Part 4 The zeros are 0 and 120. Sample answer: The area is 0 if the length $x = 0$, or if the width $\frac{480 - 4x}{6} = 0$. Part 5 $(16 + 7i)$; $(9 + 4i) + (5 - 3i) + (2 + 6i) = 9 + 5 + 2 + 4i - 3i + 6i = 16 + 7i$; Sample answer: Add the voltages and combine like terms. **At the end of each topic please review the Assessment Practice and Performance Tasks questions.**

Performance Task The Bluebird Bakery sells more cookies when it lowers its prices, but this also changes profits.

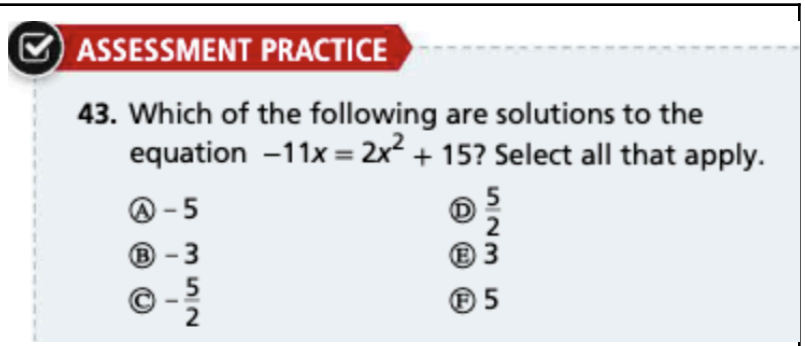
The profit function for the cookies is $f(x) = -500(x - 0.45)^2 + 400$. This function represents the profit earned when the price of a cookie is x dollars. The bakery wants to maximize their profits.

Part A What is the domain of the function?

Part B Find the daily profits for selling cookies for $0.40 each and for $0.75 each.

Part C What price should the bakery charge to maximize their profits from selling cookies?

Part D What is the maximum profit?



Spot Light on:
LGBT and Disabilities Law: N.J.S.A 18A:34-4.35

- Sally Ride: First American woman in space.

Climate Change

- Students may relate the domain of a function c(m) representing the amount of carbon dioxide produced by burning m molecules of ethane (gasoline), to its graph in order to determine the appropriate domain for c(m).

Mathematics Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reason 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.

Social and Emotional Learning: ***Competencies***	**Social and Emotional Learning:** ***Sub-Competencies***	
Self- awareness Social Awareness Self- Management Relationship Skills Responsible Decision-Making	Recognizing the importance of self-confidence in handling daily tasks and challenges. Demonstrate an awareness of the expectations for social interactions in a variety of ways. Demonstrate an understanding of the need for mutual respect when viewpoints differ. Recognize the skills needed to establish and achieve personal and educational goals. Utilize positive communication and social skills to interact effectively with others. Develop, implement, and model effective problem solving and critical thinking skills.	

Assessments (Formative) ***To show evidence of meeting the standard/s, students will successfully engage within:***	**Assessments (Summative)** ***To show evidence of meeting the standard/s, students will successfully complete:***
<u>Formative Assessments:</u> ● Entry and Exit Slips ● Quizzes ● Self Assessments	**<u>Benchmarks:</u>** ● Chapter Tests ● Projects ● LinkIT **<u>Summative Assessments:</u>** ● District Assessment ● Standardized Tests
Differentiated Student Access to Content:	

Teaching and Learning *Resources/Materials*			
Core Resources	**Alternate Core Resources *IEP/504/At-Risk/ESL***	**ELL Core Resources**	**Gifted & Talented Core Resources**
• Savvas Envision • Achieve the core • Khan Academy • Desmos	• Skill building worksheets • Math Manipulatives	• Dictionary for native languages • Videos in their native language.	• Leveled Assessments • Enrichment worksheets
Supplemental Resources			
Technology: • **Chromebooks, Graphing Calculators, Smartboards** **Other:** • **Zoom and Google Meets, Schoology,, Interactive Textbooks**			
Differentiated Student Access to Content: Recommended *Strategies & Techniques*			
Core Resources	**Alternate Core Resources *IEP/504/At-Risk/ESL***	**ELL Core Resources**	**Gifted & Talented Core**
• **Deliver instruction utilizing varied learning styles including audio, visual, and tactile/kinesthetic, provide individual instruction as needed, modify assessments and/or rubrics, repeat**	• **Utilize a multi-sensory (VAKT) approach during instruction, provide alternate presentations of skills by varying the method (repetition, simple explanations, additional examples, modeling, etc.), modify test content and/or format, allow students to retake test for additional credit, provide additional times and preferential seating as needed, review,**	• **Extend time requirements, preferred seating, positive reinforcement, check often for understanding/review, oral/visual directions/prompts when necessary, supplemental materials including use of an online bilingual dictionary, and modified assessment and/or rubric.**	• **Create an enhanced set of introductory activities, integrate active teaching/learning opportunities, incorporate authentic components, propose interest-based extension activities, and connect student to related**

	restate and repeat directions, provide study guides, and/or break assignments into segments of shorter tasks.		

NJSLS CAREER READINESS, LIFE LITERACIES & KEY SKILLS	**Disciplinary Concept: Creativity and Innovation**	
	Core Ideas:	**With a growth mindset, failure is an important part of success**
	Performance Expectation/s:	**9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).**
	Career Readiness, Life Literacies, & Key Skills Practices	
	Act as a responsible and contributing community member and employee. **Attend to financial well-being.** **Consider the environmental, social and economic impacts of decisions.** **Demonstrate creativity and innovation.** **Utilize critical thinking to make sense of problems and persevere in solving them.** **Model integrity, ethical leadership and effective management.** **Plan education and career paths aligned to personal goals.** **Use technology to enhance productivity, increase collaboration and communicate effectively.** **Work productively in teams while using cultural/global competence.**	

New Jersey Legislative Statutes and Administrative Code (place an "X" before each law/statute if/when present within the curriculum map)									
	Amistad Law: *N.J.S.A. 18A 52:16A-88*		Holocaust Law: *N.J.S.A. 18A:35-28*	X	LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*		Diversity & Inclusion: *N.J.S.A. 18A:35-4.36a*	X	Standards in Action: *Climate Change*