Algebra 2 Unit Plan

Tier 2 Unit 2: Quadratic Functions

2015-2016

ORANGE PUBLIC SCHOOLS

OFFICE OF CURRICULUM AND INSTRUCTION

OFFICE OF MATHEMATICS

Contents

Unit Overview

Unit 2: Quadratics

Essential Questions

- How are quadratic functions represented in real life situations and what are the different forms of a quadratic function?
- How do you solve a quadratic function?
- How are the real solutions of a quadratic equation related to the graph of the related quadratic function?
- What are complex numbers and what do they represent in a quadratic function?

Enduring Understandings

- Working with quadratic functions in both standard and vertex form.
- Using quadratic functions to model real life situations
- Finding all types of zeros of a quadratic function from a graph and by solving the equation using factoring, completing the square, and the quadratic formula.
- Understanding what an imaginary number is and how to perform arithmetic operations on complex numbers

Common Core State Standards

Central CCSS

1) F-IF-7.a: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph linear and quadratic functions and show intercepts, maxima, and minima.
2) A-REI-11: Explain why the x-coordinates of the points where the graphs of the equations $y= f(x)$ and $y = g(x)$; find the solutions approximately , e.g., using technology to graph the 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.
3) A-REI-4.b: Solve quadratic equations by inspection, 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 $a \pm b$ for real numbers a and b.
4) F-IF-8.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.
5) N-CN-7: Solve quadratic equations with real coefficients that have complex solutions
6) N-CN-1: Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ and a and b real
7) N-CN-2: Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers
8) A.REI.5: Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
9) A.REI.7: Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically

Spiraled CCSS

10) A-CED-2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
11) F-IF-5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
12) F-IF-6: Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
13) A.APR-3: Identify zeros of polynomials when suitable factorizations are available, and use the zeros

to construct a rough graph of the function defined by the polynomial.

Ongoing CCSS

14) F-IF-4: For a function that models a relationship between two quantities, and sketch graphs showing key features given a verbal description of the relationship.
15) F-IF-9: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
16) A-SSE-2: Use the structure of an expression to identify ways to rewrite it.
17) A-SSE-1.a: Interpret parts of an expression, such as terms, factors, and coefficients
18) **S.ID.6:** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
    a. fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or chooses a function suggested by the context.
    b. Informally assess the fit of a function by plotting and analyzing residuals.
    c. Fit a liner function for a scatter plot that suggests a linear association.
19) **F.BF.3:** Identify the effect of 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 graph.

Calendar (Honors)

October 2015						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
18	19	20	21	22	23	24
25	26	27	28	39	30	31

Nobember 2015						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

December 2015						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7

Scope and Sequence

Overview		
Lesson	Topic	Suggesting Pacing and Dates
1	Quadratic Functions (4-1)	2 days
2	Standard form of a Quadratic Function (4-2)	2 days
3	Modeling with Quadratic Functions (4-3)	3 days
4	Solving Quadratic Equations (4-5 and 10-2)	2 days
5	Factoring (4-4)	2 days
6	Completing the Square (4-6)	2 days
7	The Quadratic Formula (4-7)	1 day
8	Complex Numbers (4-8)	2 days
9	Solving System with a Linear & Quadratic Function	2 days
10	Compare Properties of two Function Each Represent in a Different Way (Use the question bank Task 1 ,Task 2, & PARCC sample item see page 31)	1 day

Assessment Framework

Assessment	CCSS	Estimated Time	Format	Graded
Diagnostic/Readiness Assessment (Beginning of Unit)	F-IF.4, 5,7,8, 9 A-CED-2, , AREI-4, 11 A-SSE-2, 3, N-CN-1, 2, 7	½ Block	Individual	Yes
Assessment Check Up 1	F-IF.4, 5,7,8, 9 A-REI-4, A-SSE-2, 3	½ Block	Individual	Yes
Performance Task (Quadratic Modeling)	S-ID-6, A-CED-2	½ Block	Individual	Yes
Unit 2 Assessment	F-IF.4, 5,7,8, 9 A-CED-2, , AREI-4, 11 A-SSE-2, 3, N-CN-1, 2, 7	1 Block	Individual	Yes
Performance Tasks Task 1.Whose ball is higher? Task 2: Choosing a Model Task 3: Linear & Quadratic System	F-IF.4, 5,7,8, 9 A-CED-2, , AREI-4, 11, S.ID.6 A-SSE-2, 3, N-CN-1, 2, 7	1 Block	Individual	Yes

Lesson Analysis

Lesson 1: Quadratic Functions in Vertex Form

Objectives

- Using the quadratic parent function, students will work individually/in pairs/small group to identify intercepts, maximum/minimum, concavity, vertex, and axis of symmetry to sketch a graph of a quadratic function correctly for ___ out of ___ problems on the daily exit slip.
- Given a quadratic parent function, student will identify the effect on the graph of replacing f(x) by Identify how the graph change by replacing f(x) by f(x)+k, f(x+k), kf(x), and f(kx) correctly for ___ out of ___ problems on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 7: Look for and make use of structure

Vocabulary:

Parabola, Quadratic function, Parent quadratic function, axis of symmetry, zeros, vertex, minimum/maximum , vertex form

Common Misconceptions/Difficulties:

- Connection between concave up or down and if that gives you a maximum or minimum
- Identifying key features when given a table that represents a quadratic function

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F-IF-4: For a function that models a relationship between two quantities, and sketch graphs showing key features given a verbal description of the relationship. F-IF-7.a: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph linear and quadratic functions and show intercepts, maxima, and minima.	***Review*** • The shape of a quadratic function is a parabola ***New*** • The vertex is the intersection of the axis of symmetry and the quadratic function • The graph of any quadratic function is a transformation of the graph of the parent quadratic function, $y = x^2$. • The vertex of a function can either be a minimum, giving you a concave up graph, or a maximum, giving you a concave down graph. • A table of values for a function can be used to identify the key features of a quadratic function.	***Review*** • Describe a real life situation that could represent a parabolic function • Graph quadratic functions given in vertex forms, and show key features (vertex, axis of symmetry..) • Identify and write the equation of the axis of symmetry when given the coordinate point of the vertex • Graph a concave up function arching up and a concave down function as arching down. • Identify whether the graph has a minimum or maximum from a given table and identify intercepts from the given table. •	Textbook 4-1 (TI-84 graphing calculator)	2 day	Page 198 Lesson Check #1, #3, #6
F.BF.3: Identify the	***Review:***	***Review:***			

effect of 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 graph.	• Identify the effect on the graph of replacing f(x) by f(x)+k, f(x+k), kf(x), and f(k) in linear function. ***New:*** • Identify how the graph change by replacing f(x) by f(x)+k, f(x+k), kf(x), and f(k) In **quadratic functions**	• Graph translation of f(x)=x (linear), or graph translation for a given graph ***New:*** • Graph translation for $f(x)=x^2$, and show the key feature of the function on the graph.			

Lesson 2: Standard form of a Quadratic Function

Objectives

- By investigating different representation of quadratic function, students will work individually/in pair/in small group to identify key features and graph a sketch of the function for different representations of quadratic functions correctly for ___ out of ___ problems on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 5: Use appropriate tools strategically
- MP 7: Look for and make use of structure

Vocabulary:
Standard form, y-intercept, vertex formula

Common Misconceptions/difficulty:

- Correctly using the vertex formula, specifically the negative sign.
- Using table to find the key features of a quadratic graph is a challenge to most students.
- Using appropriate "Window" setting to graph a function on graphing calculators

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F-IF-4: For a function that models a relationship between two quantities, and sketch graphs showing key features given a verbal description of the relationship	***Review*** • Graphing calculators can be used to explore functions in standard form ***New***	***Review*** • Use a graphing calculator to make a graph for a quadratic function ***New*** • Find the key features for a quadratic from the graph or a table on graphing calculator	Textbook 4-2	2 day	Lesson check pg. 206 #'s: 1, 2, 3, & 6
F-IF-7: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. F.IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function	***Review*** • A function can be represented multiple ways; such as a graph, a table, and an equation • A table of values can be used to graph a function that is given in standard form. ***New*** • Standard form of a quadratic is $ax^2 + bx + c$ where a describes the concavity of the function and c is the y-intercept • All equations of a function can be manipulated into different forms; for a quadratic function the different forms of an	***Review*** • Match and compare key features of the same function that are given in different representations • Create a table of values using a given equation in standard form and graph the function ***New*** • Identify the y-intercept and the concavity of a function and whether or not it while have a maximum or minimum by looking at the written function • Graph functions given in standard form using the key features; y-intercept and concavity			

	equation are standard form, factored form, and vertex form.	• Find the coordinate of vertex from for a quadratic function written in standard form • Convert standard form to vertex form by using vertex formula			

Lesson 3: Modeling with Quadratic Functions

Objectives

- By applying the concept of quadratic function, students will work individually/in pair/in small group to create functions for the problem given and interpret the key features of the function in the context of the problem correctly for ___ out of ___ problems on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 4: Model with mathematics
- MP 7: Look for and make use of structure

Vocabulary:
Parabola

Common Misconceptions/difficulties:

- Incorrectly setting up scales of the x and y axis in a coordinate plane

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F-IF-5: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	***Review*** • Every function has a set domain (set of x-values) and range (set of y-values) ***New*** • Domain of a function is determined by the context of the function given and what values make sense to be included in the particular problem • Set notation is used to represent domain and range	***Review*** • Identify the domain and range of given function in table form ***New*** • Identify domain/range values of quadratic function given the context of the real life problem • Correctly use set notation to describe the domain/range of a function • Creating an equation of a parabola	Textbook 4-3	3 day	Page 212 Lesson check #1, 2, 6
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. A-CED-2: Create equations in two or more variables to represent relationships	***Review*** • When modeling a quadratic function height or a measure of distance is most often represented by the y-values and time is most commonly represented by the x-values ***New*** • A real life context that compares two quantities that increase to a peak and then decrease or decrease to a low and then increase are represented by	***Review*** • Set up coordinate plane for a specific problem using correct measures and scale on both axis' ***New*** • Identify types of real life problems that could be presented by a quadratic function *Use key features from a real life problem to graph its parabola and interpret the key features in the context. * Compare key features of two quadratic function	Task: Springboard Dive		

between quantities; graph equations on coordinate axes with labels and scales. F-IF-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.9: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). **S.ID.6:** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or chooses a function suggested by the context. b. Informally assess the fit of a function by plotting and analyzing residuals.	quadratic functions * All key features of a quadratic function graph represented specific information from the context of the problem	which represented in different ways *Create quadratic equations by using the data from graphs. (**Standard form**) ***Review:*** • Use **Stat** and **LinReg** on a graphing calculator to find the line of best fit. ***New:*** • Use **Stat** and **QuadReg** to create a quadratic model to solve real life problems • **Choose a function (including linear or quadratic) to best fit the data on two quantitative variables on a scatter plot.**			

Lesson 4: Solving Quadratic Functions (Table and Graph)

Objectives

- Using a graphing calculator to make graph/table for the quadratic functions given, students will work individually/in pair/in small group to solve quadratic functions correctly for __ out of ___ problems on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 5: Use appropriate tools strategically
- MP 7: Look for and make use of structure

Vocabulary:
Zero of a function, zero-product property, equation editor

Common Misconceptions/difficulties:

- Using an equation that is not in standard form in a graphing calculator
- Forgetting to set the equation equal to zero before entering the equation into a graphing calculator
- Mistaking the y-intercept in a given table for the x-intercepts
- Missing a x-intercept that is not a whole number when looking at a given table

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A-REI-11: Explain why the x-coordinates of the points where the graphs of the equations *y= f(x)* and *y = g(x);* find the solutions approximately , e.g., using technology to graph the 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.	***Review*** • The standard form of a quadratic equation is $ax^2 + bx + c = 0$ • The zeros of a quadratic function are where the function intersects the x-axis • The vertex of a quadratic function is the highest or lowest y-value the function reaches ***New*** • The standard form of a quadratic equation is calculator ready • The vertex of a quadratic function is the highest or lowest y-value the function reaches • A graphing calculator can be used to calculate all points of a quadratic function by using the table or looking at the graph	***Review*** • Manipulate equations to make sure they are in standard form and equal to zero • Identify the zeros of a function given graph of quadratic functions ***New*** • Use a graphing calculator to find zeros of a given quadratic function • Determine the zeros of a function by looking at a table of a given quadratic function • Correctly identify the type of zeros by looking at the graph or when given values of the zeros Correctly identify the zero of a graph and identify the axis of symmetry from a graph or given values for the zeros.	Textbook 4-5 (Focus on Problem #2,3,&4. Problem #1 can be used for next lesson "factoring")	2 days	Practice problems pg. 229, #'s: 20, 28, 29, 36

	• A sketch of the graph or graphing calculator can be used to solve a quadratic equation • The axis of symmetry the line of symmetry half way in between both zeros. • All quadratic function have two zeros; they can be standard zeros, repeated zeros, or imaginary zeros.				

Lesson 5: Factoring

Objectives

- Using the zero-product property and factoring skills, students will work individually/in pair/in small group to solve quadratic functions correctly for ___ out of ___ problems on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 6: Attend to precision
- MP 7: Look for and make use of structure

Vocabulary:
Factoring, trinomial, binomial, greatest common factor, prefect square trinomial, difference of two squares, zero-product property

Common Misconceptions:

- Incorrectly using positive and negative signs when factoring into a binomial
- Incorrectly factoring when a is not equal to 1
- Forgetting to use distributive property to check their work

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A-SSE-2: Use the structure of an expression to identify ways to rewrite it.	***Review*** • The distributive property is used to multiply two or more binomials ***New*** • The reverse of distributive property is factoring • Quadratic functions that are perfect squares can be factored in one of two ways; factoring a perfect square trinomial or factoring the difference of two squares.	***Review*** • Use the distributive property to change a binomial into the standard form of a quadratic ***New*** • Identify which method is best to use to factor a given quadratic functions	Textbook 4-4, 4-5 problem #1, practice p229 #9-17	2 days **Note: Just use two days to review different skills and then use the daily fluency practice time to practice for the mastery.**	Lesson check pg. 221, #'s: 2, 4, 10, 11
A-REI-4.b: Solve quadratic equations by inspection, 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 $a \pm b$ for real	***Review*** • Factors of a number are two numbers that multiply to that number • Solving a quadratic equation means to find the x-values or zeros of the function ***New*** • The concept of factoring applies the same way to factoring a trinomial expression; it is two factors called binomials	***Review*** • Identify all factors of a given number • Identify the factors of both the a and c terms of a quadratic function in preparation for using the x-method ***New*** • Factor and solve for a given quadratic function by using GCF method and x-method • Factor and solve for a	Task: Graphs of Quadratic Functions Task: Which Function?		

numbers *a* and *b*. A-SSE.3a: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. Factor a quadratic expression to reveal the zeros of the function it defines. A.APR-3: Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.	that multiply to get the starting trinomial • X-method can be used to factor most trinomials. If the trinomial is a perfect square the additional methods for factoring can be also be applied	given perfect square quadratic by the perfect square trinomial method or difference of two squares method			

Lesson 6: Completing the Square

Objectives

- Using the completing the square method, students will work individually/in pair/in small group to rewrite a quadratic function into vertex form and solve the function correctly for __ out of the 4___ problems on the exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 6: Attend to precision
- MP 7: Look for and make use of structure

Vocabulary:
Completing the square, perfect square,

Common Misconceptions:

- Misunderstanding the difference when directions state to solve for the function or change to vertex form
- Incorrectly working with negative signs while manipulating the function
- Forgetting to use the positive and negative values of a number when taking the square root

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F-IF-8.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.	***Review*** • A standard form of a quadratic tells you the y-intercept and concavity of the function • A vertex form of a quadratic tells you the coordinate points of the vertex ***New*** • Completing the square can be used to change a quadratic function from standard form into vertex form in order to find different key features of the function • The square root of any number will always be a positive and negative value; both of these values will determine the roots of a given function	***Review*** • Identify the y-intercept and concavity from a given function in standard form • Identify the coordinates of the vertex from a function given in vertex form ***New*** • Use the steps for completing the square to change a function from standard form to vertex form • Use the vertex form and standard form of the function to determine key features of the quadratic	Textbook 4-6 https://www.youtube.com/watch?v=izkd7Tlh0ol (video for using algebra tiles to explain completing square method)	2 days **Note: Just use two days to review different the skill and then use the daily fluency practice time to practice for the mastery.**	Lesson check pg. 237, #: 9, Practice problems, #'s: 12, 34, & 38
A-REI-4.b: Solve quadratic equations by inspection, taking square roots, completing the square,	***Review*** • Some quadratic functions cannot be factored using x-method because they do not	***Review*** • Solve given quadratic functions using factoring or GCF methods and identify functions that	Task: Throwing Baseballs		

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 $a \pm b$ for real numbers a and b.	have whole number factors ***New*** • One way to factor quadratic functions that do not have whole number factors is by completing the square • Completing the square is a process that allows you to factor a completed trinomial square by factoring it as a square of a binomial and then finding the square root.	these methods cannot be used to solve for. ***New*** • Use the steps for completing the square to solve the quadratic function • Always solve for two roots when solving any quadratic function			

Lesson 7: The Quadratic Formula

Objectives

- Using the quadratic formula, students will work individually/in pair/in small group to identify types of solution/zeros and solve a quadratic function correctly for ___ out of 4___ problems on the exit slip

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 6: Attend to precision
- MP 7: Look for and make use of structure

Vocabulary:

Quadratic formula, discriminant, coefficients , roots of quadratic functions

Common Misconceptions:

- Forgetting the negative in front of the first *b* term in the formula
- Not solving for two roots using the negative and positive values of the square root

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
N-CN-7: Solve quadratic equations with real coefficients that have complex solutions	***Review*** • The square root of any number will always be a positive and negative value; both of these values will determine the roots of a given function ***New*** • A quadratic function can have real or imaginary solutions • The discriminant of a quadratic function can be used to determine what type of solutions the function has	***Review*** • Find the square root of both positive and negative numbers ***New*** • Find the discriminant of a quadratic function and identify whether the function has two real zeros, two repeated real zeros, or two imaginary zeros.	Textbook 4-7	1 day	Lesson check pg. 244, #'s: 2, 4, 6, & 9
A-REI-4.b: Solve quadratic equations by inspection, 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 $a \pm b$ for real numbers a and b.	***Review*** • Some quadratic functions cannot be factored using x-method because they do not have whole number factors ***New*** • One way to factor quadratic functions that do not have whole number factors is by using the quadratic formula • The quadratic formula can be used to solve any quadratic function	***Review*** • Solve given quadratic functions using factoring or GCF methods and identify functions that these methods cannot be used to solve for. ***New*** • Substitute the coefficients of the standard form of a quadratic equation into the quadratic formula • Solve a quadratic function using the quadratic formula			

Lesson 8: Complex Numbers

Objectives

- Using the quadratic formula and properties of complex numbers, students will work individually/in pair/in small group to solve a quadratic function with complex roots and perform operations with complex numbers for 3__ out of __ problems on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 7: Look for and make use of structure
- MP 8: Look for and express regularity in repeated reasoning

Vocabulary:
Imaginary unit, Imaginary numbers, complex numbers, imaginary solutions,

Common Misconceptions/difficulties:

- Some students are confused about $\sqrt{1}$ and $\sqrt{-1}$

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
N-CN-7: Solve quadratic equations with real coefficients that have complex solutions	***Review*** • The square root of any number will always be a positive and negative value; both of these values will determine the roots of a given function ***New*** • A quadratic function can have real or imaginary solutions	***Review*** • Find the square root of both positive and negative numbers ***New*** • Use the quadratic formula to solve a quadratic function with imaginary roots	Textbook 4-8 (skip problem #2 complex number plane) Note: Complex number plane is not identified by PARCC in algebra 2 test	2 day	Lesson check pg. 253, # 7, Practice problems, #'s 10, 18, 39
N-CN-1: Know there is a complex number *i* such that $i^2 = -1$, and every complex number has the form $a + bi$ and a and b real N-CN-2: Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers	***Review*** • In order to multiply complex numbers you must use the distributive property • When adding or subtracting terms with variables you can only combine like terms ***New*** • When multiplying complex numbers with imaginary parts you must also use the distributive property • When adding or	***Review*** • Use the distributive property to multiply binomials ***New*** • Use the distributive property to multiply complex numbers with imaginary parts • Add and subtract complex numbers with real and imaginary parts • Simplify all complex numbers with i^2 using the relation $i^2 = -1$	Task: Complex number patterns Task: Completing Square (with complex number solution)		

	subtracting complex numbers (similarly to variables) you can only combine real parts with real parts and imaginary parts with imaginary parts • You can simplify complex numbers by using the relation $i^2 = -1$				

Algebra 2 Tier 2 Unit 2: Quadratics

Objectives

- Using graphing and substitution methods, students will work (individually/in pair/in group) to solve a linear-quadratic system, as seeing by correctly answering at least 3 out of 4 Lesson Check questions (Pg. 261: #1 by graphing, #2 by substitution, #7ab).

Focused Mathematical Practices

- MP 3:Construct viable arguments and critique the reasoning of others.

Vocabulary: no new vocabulary. See earlier systems lessons.

Common Misconceptions:

- Students may have trouble understanding the differences between systems that have one solution, no solutions, and infinitely many solutions in the context of the problem. Students may also have trouble understanding what the intersection truly means in the context of the problem.
- Students may have trouble grasping conceptual understanding of what a solution to a system of equations represents in all representations (graphic, numeric and algebraic).

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.REI.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 the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, or polynomial	***Review*** • Solution to a system of equations is the point where the two graphs intersect ***New*** • The solution of a system of linear-quadratic equations can be no solution, one solution, or two solutions.	***Review*** • Use Ti-84 to solve system graphically • Graph linear equation & quadratic equation • Identify solution(s) to system of equations ***New*** • Identify number of solution of system of linear-quadratic equation. • Use appropriate Window on the graphing calculator to find the solution(s)	• textbook Page 258, 259 & page 262 (select linear-quadratic system) • ELL support – Quadratic systems worksheet • Reteaching worksheet :quadratic systems	2 days ***this lesson only focus on linear –quadratic system**	Mid-Chapter Quiz (pg, 156: 1 – 9, 15, 17, 18) Lesson Check (Pg. 261: #1 by graphing, #2 by substitution, #7ab) Lesson quiz (Pg. 264)
A.REI.7: Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.	***Review*** • Equation that can be solved using the Properties of Equality is obtained by substitution method **New** • None	**Review** • Solve literal equations • Solve **simply** quadratic equation by factoring **New** • Substitute one equation (linear) into another (quadratic) to determine the solution(s) to a system of equations	Task: A linear and quadratic system		

Ideal Math Block

The following outline is the department approved ideal math block for grades 9-12.

1) Fluency Practicee (5-7 mins)
2) Do Now (7-10 min)
    a. Serves as review from last class' or of prerequisite material
    b. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

3) Starter/Launch (5 min)
    a. Designed to introduce the lessona
    b. Uses concrete or pictorial examples
    c. Attempts to bridge the gap between grade level deficits and rigorous, on grade level content
    d. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

4) Mini-Lesson (15-20 min)
    a. Design varies based on content
    b. May include an investigative approach, direct instruction approach, whole class discussion led approach, etc.
    c. Includes CFU's
    d. Anticipates misconceptions and addresses common mistakes

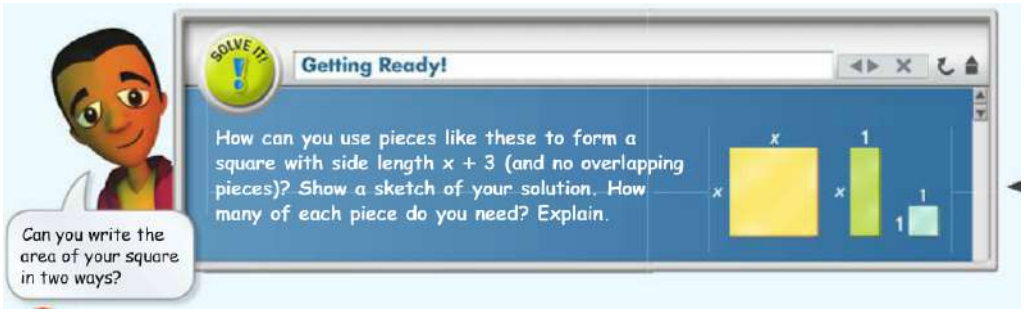
5) Class Activity (25-30 min)
    a. Design varies based on content
    b. May include partner work, group work/project, experiments, investigations, game based activities, etc.

6) Independent Practice (7-10 min)
    a. Provides students an opportunity to work/think independently

7) Closure (5-10 min)
    a. Connects lesson/activities to big ideas
    b. Allows students to reflect and summarize what they have learned
    c. May occur after the activity or independent practice depending on the content and objective

8) DOL (5 min)
    a. Exit slip

Sample Lesson Plan

Lesson	6: Completing the Square	Days	1/2
Objective	Using the completing the square method SWBAT rewrite a quadratic function into vertex form and solve the function correctly for 3 out of the 4 problems on the daily exit slip.	CCSS	F-IF-8.a and A-REI-4.b
Learning activities/strategies	**Do Now:** solving for a square root review. Start off with 3 problems to practice solving for x using square roots. 1) $x^2 = 25$ 2) $3x^2 - 27 = 0$ 3) $(x-3)^2 = 9$ -Review do now for 5 minutes after time is up. **Starter/Launch: Getting ready pg. 233**  -Have students work on this problem with a partner independently at first with **algebra tiles to explore what the problem is asking.** Guiding questions as they are working: • "How would you represent a side length of x + 3?" • "What does it mean to be a square?" • "How many pieces of each kind do you think you may need to create the square?" After the class has had time to explore come together as a whole class to review and discuss their explorations. **Mini lesson:** Completing the square to help solve a quadratic function using algebra tiles (example from page 235). • Introduce the idea of $(b/2)^2$ being used to complete the square and create a perfect square trinomial that can be solved. • Have students work independently or in partners with algebra tiles as you work along with them on the smart board to complete the square and explore the connection between factored form and standard form of a quadratic equation. • "Is it easier to solve for an equation in factored form or standard form?" "why?" • "Why would it be helpful to change a non-perfect square trinomial into a perfect square to help us solve the equation?" **Class activities:** • Scavenger Hunt activity to have students walk through each step of completing the square. • Student will work in groups of 2 or 3. Each group will be given an equation to solve using the completing the square method. • Each step is placed on an index card with numbers and hidden around the room. The groups have to search for the steps in consecutive order and complete the steps on the cards in the correct order in order to solve the problem.		

	• The first group that solves their problem wins. Once all groups have finished or had the chance to attempt their problem come together as a whole class to review and take notes on the steps to completing the square on the smart board. The example problem that was used in the scavenger hunt will be completed as a whole class to clear up any misunderstandings or mistakes from the earlier activity. **Independent Practice:** Practice problems as a group; pg. 237, #'s 14, 35, 37, 39, 41, and 45 **Closure:** Review practice problems and clear up any misunderstandings Notebook check to make sure notes were taken for the day **DOL (exit ticket):** Lesson check pg. 237, #: 9, Practice problems, #'s: 12, 34, & 38
Differentiation	3: Modeled examples of each step provided on index card during activity 2: Calculators will be provided 1: Modeled problems to be provided during lesson activity and practice problems to help guide students
Assessment	Formative: results of daily activity, circulating the room during independent practice Summative: Daily exit slip Authentic:
Common Misconceptions	• Misunderstanding the difference when directions state to solve for the function or change to vertex form • Incorrectly working with negative signs while manipulating the function • Forgetting to use the positive and negative values of a number when taking the square root

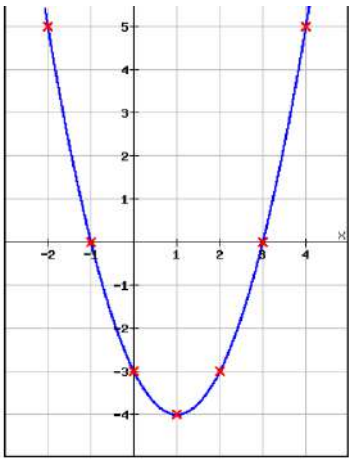
Supplemental Material

CCSS	Dropbox location and filename	Link (original task and answer key)
F-IF-4	Orange 9-12 Math > Curriculum Algebra 2 > Tier 2> Unit 2 > Supplemental Material > **Throwing Baseballs**	https://www.illustrativemathematics.org/illustrations/1279
F-IF.8 A-REI	Orange 9-12 Math > Curriculum Algebra 2 > Tier 2> Unit 2 > Supplemental Material > **Springboard Dive**	https://www.illustrativemathematics.org/illustrations/375
F-IF-7 A-SSE	Orange 9-12 Math > Curriculum Algebra 2 > Tier 2> Unit 2 > Supplemental Material **> Graphs of Quadratic Function**	https://www.illustrativemathematics.org/illustrations/388
F-IF-8	Orange 9-12 Math > Curriculum Algebra 2 > Tier 2> Unit 2 > Supplemental Material > **Which Functions**	https://www.illustrativemathematics.org/illustrations/640
N-CN-1	Orange 9-12 Math > Curriculum Algebra 2 > Tier 2> Unit 2 > Supplemental Material > **Complex Number Patterns**	https://www.illustrativemathematics.org/illustrations/722
A-REI-4b N-CN-2	Orange 9-12 Math > Curriculum Algebra 2 > Tier 2> Unit 2 > Supplemental Material >**Completing Square**	https://www.illustrativemathematics.org/illustrations/1690
A-REI-4b	Orange 9-12 Math > Curriculum Algebra 2 > Tier 2> Unit 2 > Supplemental Material **> Complete square work sheet**	http://www.cabrillo.edu/~mbuchannan/Math%20154B%20Webfolder/Math%20154B%20Complete%20Square%20Wkst.pdf
A-REI-4b	Orange 9-12 Math >Curriculum Algebra 2 > Tier 2> Unit 2 > Supplemental Material >**Solve Quadratic Equation by Completing Square**	http://www.cpm.org/pdfs/skillBuilders/AC/AC Extra Practice Section24.pdf
Question Bank	***Orange 9-12 Math >Curriculum Algebra 2 > Tier 2> Unit 2> Question Bank***	

Multiple Representations

Multiple Representation (Quadratic Function)

Make connection between equations and graphs



Vertex: (1, -4) ---- minimum/maximum
Axis of symmetry --- x = 1
Vertex form: y = a(x-h)2 + k
y = a(x -1)^2 + (-4)

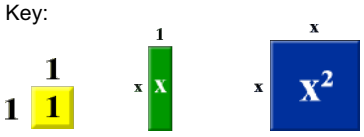
Zeros: x = 3, x=-1 ---- solutions/roots (*x-intercept*)
Factor form: y = a (x –x_1)(x-x_2)
y = a (x -3)(x- -1)

y-intercept: (0, -3)
Standard form: y = ax^2 + bx + c
y = ax2 + bx + (-3)
a is a positive number (because the graph is upward)

Factoring with algebra tiles

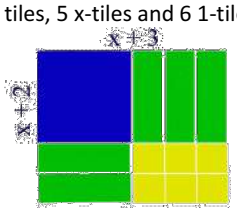
Concrete Model

Key:



Factor: **x^2 + 5x + 6**

Using algebra tiles, build a rectangle containing the tiles specified in the problem (1 x^2-tiles, 5 x-tiles and 6 1-tile



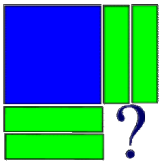
Abstract/Symbols

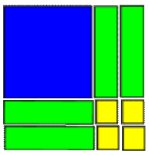
We can rewrite the x2 + 5x + 6 to factor form (x+2)(x+3)

Use algebra tiles to complete the square

- Concrete

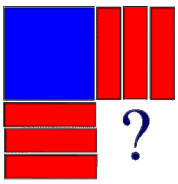
What is needed to create a perfect square trinomials for :

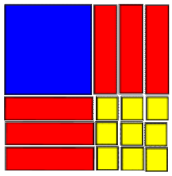




$x^2 + 4x + ?$ → $x^2 + 4x + 4$

Use the algebra tiles to create a **square**.
What tiles will be needed to complete the square?





$X^2 - 6x + ?$ → $X^2 - 6x + 9$

- Pictorial/Verbal Description

Use the algebra tiles to create a **square**.
Red tiles represent negative values.
What tiles will be needed to complete the square

* After viewing several examples, help students to see the pattern for finding the needed constant term. ***"Take half of the coefficient of the x-term and square it.***

- Abstract/Symbols

Transfer concrete model to symbolic expression
Example:
"Take half of the coefficient of the x-term and square it.
$X^2 + 10x + ?$ → $x^2 + 10x + 25$
Half of 10 = 5 then 5 square = 25

Unit Authentic Assessment

CCSS	Dropbox location and filename	Link (original task and answer key)
F-IF.4, 5,7,8, 9 A-CED-2, , AREI-4, 11 A-SSE-2, 3, N-CN-1, 2, 7	Orange 9-12 Math > Curriculum Algebra 2 > Tier 2> Unit 2 > Performance Task> Task 1> **Whose ball is higher**	Adapting from https://www.illustrativemathematics.org/illustrations/1279
A.CED.2, F.IF.5, S.ID.6	Orange 9-12 Math > Curriculum Algebra 2 > Tier 2> Unit 2 > Performance Task> Task 2 > **Choosing a Model**	Adapting from: http://cs.franklin.edu/~sieberth/MATH160/bookFiles/Chapter3/333371_0307_317-323.pdf
A.ARE.1,5, 7, 11	Orange 9-12 Math> Curriculum Algebra 2 > Tier 2 > Unit 2 > Performance Task> Task 3> **Linear and Quadratic System**	

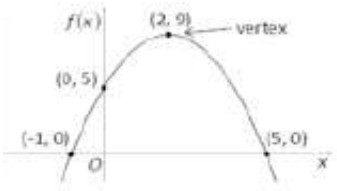
PARCC Sample Assessment Items

SAMPLE ITEM

High School	Functions
Type	Type I, Claim A
Most relevant	F-IF.9. Compare properties of two functions each represented in a

High School – Functions

A portion of the graph of a quardratic function $f(x)$ is shown in the xy - plane. Selected values of a linear function $g(x)$ are shown in the table.



x	g(x)
-4	7
-1	1
2	-5
5	-11

For each comparison below, use the drop-down menu to select a symbol that correctly indicates the realtionship betweeen the first and the second quantity.

First Quantity	Comparison	Second Quantity
The y-coordinate of the y-intercept $f(x)$		The y-coordinate of the y-intercept $g(x)$
$f(3)$		$g(3)$
Maximum value of $f(x)$ on the interval $-5 \le x \le 5$		Maximum value of $g(x)$ on the interval $-5 \le x \le 5$
$\frac{f(5) - f(2)}{5 - 2}$		$\frac{g(5) - g(2)}{5 - 2}$

Standard(s) for Mathematical Content	different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum. Also relies on knowledge and skills from the first cluster in F-IF ("Understand the concept of a function and use function notation").
Most relevant Standard(s) for Mathematical Practice	MP.6 (Attend to precision) - The task requires the student to parse a dense set of statements involving formal language (e.g., "the y-coordinate of the y-intercept of g(x)").
Item description and assessment qualities	This task requires an understanding of the function concept across representations, as well as a number of basic skills in functions. The multi-part nature of the task allows for greater depth of comparison between the two functions than a one-point item would. Unlike traditional multiple choice, it is difficult to guess the correct answer or use a choice elimination strategy.
Scoring	Full credit requires selecting the correct values from all of the drop-down menus. Partial credit can be given for each answer that is correct.

Additional Resources

From pearsonsuccessnet.org; Chapter 4
Find the errors
Enrichment
Re-teaching
Activities, games, and puzzles
Performance tasks
Chapter project
Pearson Algebra 2 Common Core Teacher's Edition

http:PowerAlgebra.com

https://www.illustrativemathematics.org

http://map.mathshell.org.uk/materials/tasks.php?taskid=264&subpage=apprentice

http://www.ccsstoolbox.com/parcc/PARCCPrototype_main.html

http://www.parcconline.org/samples/item-task-prototypes

Student Resources

From pearsonsuccessnet.org; Chapter 4

- Standardized test prep
- Homework tutors
- Think about a plan
- Student companions