NEW MILFORD PUBLIC SCHOOLS

New Milford, Connecticut

College Prep Algebra 2

November 2018

BOE Approved April 2019

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New Milford's Mission Statement

The mission of the New Milford Public Schools, a collaborative partnership of students, educators, family and community, is to prepare each and every student to compete and excel in an ever-changing world, embrace challenges with vigor, respect and appreciate the worth of every human being, and contribute to society by providing effective instruction and dynamic curriculum, offering a wide range of valuable experiences, and inspiring students to pursue their dreams and aspirations.

Algebra II College Prep

Grade 10-12

Algebra 2 is an extension of Algebra 1 and includes the study of complex numbers, some elementary functions, polynomials, inequalities, logarithms, graphing techniques, parabolas, an introduction to trigonometry, and appropriate word problems. A graphing calculator (TI-83+, TI-84+) is required for this course.

Subject/Course: CP Algebra 2 **Unit 1: Basics of Algebra**
Time frame: 2-3 weeks

Stage 1 Desired Results

ESTABLISHED GOALS

CCSS.Math.Content.HSA.SSE.A.1
Interpret expressions that represent a quantity in terms of its context.

CCSS.Math.Content.HSA.SSE.A.1.a
Interpret parts of an expression, such as terms, factors, and coefficients

CCSS.Math.Content.HSA.SSE.B.3
Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

CCSS.Math.Content.HSA.CED.A.1
Create equations and inequalities in one variable and use them to solve problems.

CCSS.Math.Content.HSA.REI.A.1
Explain each step in solving a

Transfer

Students will be able to independently use their learning to…
apply properties of real numbers to simplify algebraic expressions and use variables to represent unknown quantities in real-world situations.

CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.

CCSS.Math.Practice.MP2 Reason abstractly and quantitatively.

CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.

CCSS.Math.Practice.MP4 Model with mathematics.

CCSS.Math.Practice.MP5 Use appropriate tools strategically.

CCSS.Math.Practice.MP6 Attend to precision.

CCSS.Math.Practice.MP7 Look for and make use of structure.

Meaning

UNDERSTANDINGS	ESSENTIAL QUESTIONS
All numbers belong to specific sets and subsets according to their classification.	Why is it important to recognize specific elements as members of different number sets?
There is a specific order of operations that must be followed when simplifying terms and expressions.	What is the importance of following a specified order of operations?
Linear equations can be solved following	How can you use the properties of real numbers to simplify and solve equations and inequalities?

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. CCSS.Math.Content.HSA.REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	a specific process to give a solution. Literal equations are formulas with many variables and can be solved according to the same process as equations with one variable. Some literal equations have variables in the denominator of a fraction and will have some variables with restrictions on possible variables. Several real-world situations can be modeled using algebraic linear equations. Solving inequalities is much like solving equations, but the direction of the inequality symbol is changed when multiplying and dividing by a negative number. Absolute value represents a positive distance from zero on a number line and may result in two solutions. Some equations and inequalities present situations that are not possible and will result in having no solution.	How do literal equations help you model real-world situations? Why do some equations have restrictions on the possible values of the variables? What applications can be represented by linear equations? How are inequalities like equations and how are they different? How are absolute value equations and inequalities similar to linear equations and inequalities, and what makes them different? What makes an equation have no possible solution?

	Acquisition	
	Students will know ...	*Students will be skilled at…*
	The absolute value of a number. The process for evaluating and simplifying algebraic expressions and the specific order of operations. How to solve a linear and literal equation. The processes for solving application problems involving motion, perimeter,consecutive integers, ratios, and complementary and supplementary angles. Steps to solving inequalities and absolute value equations and inequalities and how to graph solutions on a number line. Key terms: natural, whole, integer, rational, irrational, real, number line, absolute value, greater than (>),less than (<), variable, algebraic expression, term,evaluate, like terms, coefficient, order of operations (PEMDAS), linear equation,perimeter, consecutive, ratio, complementary, supplementary, inequality,compound inequality.	Finding the absolute value of a number. Simplifying and evaluate algebraic expressions. Solving linear, literal, and absolute value equations and identifying those that have no solution. Applying linear equations to models involving motion, perimeter, consecutive integers, ratio, complementary angles, and supplementary angles. Solving inequalities, compound inequalities, and absolute value inequalities according to specified processes. Graphing the solution(s) to inequalities and absolute value inequalities on a number line. Using technology tools (i.e., calculators, graphing calculators,educational software) for problem solving, self-directed learning, and extended learning activities.

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
TMA	Checklist/Rubric: evaluating clear focus of purpose, thorough understanding of content, clear interpretation and application of concepts, and citation of evidence to support claim.	PERFORMANCE TASK(S): Goal: Determine a person's Daily Caloric Needs based on their Basal Metabolic Rate (BMR). Role: Healthcare Professional Audience: Patient Situation: As a healthcare professional you are to determine your patient's BMR based on their weight height age,and gender. Product: Calculation and analysis of BMR results. To differentiate: Allow students to choose from problems at a variety of difficulty levels.
M, A	Thorough understanding of vocabulary, order of operations, correct processes to solving.	OTHER EVIDENCE: Monitoring class work through board work, group work, questioning, and walk-arounds
T, M, A	Thorough understanding of vocabulary, order of operations, correct processes to solving. Accurate application of content/process to	Check for understanding via going over homework, board and white board activities, and medium such as warm ups and exit tickets

T, M, A T, M, A	arrive at correct mathematical solution. Selection of evidence that is relevant to content and standardized test processes.	Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives Alternative assessment projects such as ”find the mistakes”, explain the process, posters, and real world applications Review of standardized test questions to prep students for the challenge of the SAT and ACT exams Quizzes Unit Test - to include variety of DOK level of problems and may include SAT style problems.

Stage 3 – Learning Plan		
Code M	***Pre-Assessment*** ● Teacher checks for prerequisite and prior knowledge via warm-up and questioning activities, such as order of operations; adding,subtracting,multiplying and dividing rational numbers. ● As the lessons progress, students can also be given questions such as “Find the mistakes in simplifying an algebraic expression.” ● Additionally, warm-ups should contain review on previous material covered during the unit to ensure retention and mastery.	
	Summary of Key Learning Events and Instruction	Progress Monitoring
M, A	● Teacher checks for prerequisite and prior knowledge via warm-up and questioning activities, such as basic review problems on graphing on a number line, evaluating absolute values, and simplifying and evaluating algebraic expressions. As the lessons progress, students can also be given questions such as “Find the mistakes in simplifying an algebraic expression.” Additionally, warm-ups should contain review on previous material covered during the unit to ensure retention and mastery.	● Quick check on homework to assess common errors to inform future instruction. ● Monitoring class work through board work, group work, questioning, and walk-arounds ● Check for understanding via going over board and smart board activities, and medium such as reflections and exit tickets ● Quizzes ● Test (may include 10-15 multiple choice, 15-20 regular answer, 3-5 word problems)
M, A	● Students will work independently evaluating and simplifying algebraic expressions.	
T,M, A	● Teacher uses the TI Emulator software to demonstrate the process of using the graphing calculator to evaluate expressions and to check solutions to equations.	
T, M A	● Students will practice using the graphing calculator to solve equations and to evaluate expressions.	
M, A	● Teacher models steps to solving algebraic, literal, and fractional equations by hand.	
M, A	● Students will work in small groups to solve equations that include basic, fractional, and literal types.	
T, M, A	● Teacher also relates literal equations to formulas and	

	other real-world uses.	
M, A	● Students will work collaboratively in pairs or small groups to practice solving word problems of various types. Solution strategies, algebraic equations, and actual solutions will be compared and discussed among the groups.	
M, A	● Teacher demonstrates the various algebraic methods to solving word problems involving motion, perimeter, consecutive integers, ratios, and complementary/supplementary angles.	
M, A	● Students will work independently to solve inequalities and will then “think, pair, share” with a partner to compare their solutions. eads discussion on inequalities and how they compare to equations and to the values on a number line. Solutions are modeled for linear and compound inequalities.	
M, A	● Teacher reviews the concept of absolute value as it relates to the number line. Distance interpretation is used as an option to solving absolute value equations and inequalities.	
T, M, A	● Students will participate in “Teacher-Student” activity (in pairs) whereby each student writes two absolute value equations and two absolute value inequalities. Each student then solves their partner’s problems and has their solutions checked by the other.	

Suggested Resources:

- Textbook: Charles, Randall et al. *Algebra 2 Common Core*, Boston, MA: Pearson, 2012.
- Supplemental worksheets from the textbook resources on solving equations and application problems, absolute value equations, and inequalities.
- Six stations review activities
- On-line resources such as You Tube, Khan Academy, Desmos, etc.
- Teacher-made supplemental worksheets on solving linear and literal equations, word problems, and chapter review.
- Graphing calculator TI Emulator software.

Subject/Course: CP Algebra 2 **Unit: 2- Introduction to Functions**
Time frame: 5-6 weeks

Stage 1 Desired Results

ESTABLISHED GOALS

CCSS.Math.Content.HSA.CED.A.2
Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CCSS.Math.Content.HSA.CED.A.3
Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context

CCSS.Math.Content.HSA.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).

CCSS.Math.Content.HSA.REI.D.12
Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear

Transfer

Students will be able to independently use their learning to…
identify different forms of linear functions given specific information.

CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.

CCSS.Math.Practice.MP2 Reason abstractly and quantitatively.

CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.

CCSS.Math.Practice.MP4 Model with mathematics.

CCSS.Math.Practice.MP5 Use appropriate tools strategically.

CCSS.Math.Practice.MP6 Attend to precision.

CCSS.Math.Practice.MP7 Look for and make use of structure.

Meaning

UNDERSTANDINGS Students will understand that…	*ESSENTIAL QUESTIONS* *Students will keep considering…*
Many relations have specific characteristics that result in them being considered functions. Functions can be represented in several forms including as relations, as a mapping, and by using function notation. Every line contains its own unique slope and y-intercept. The slope of a line represents	Why is it important to represent the same relation or function using multiple formats? How can some data be represented using linear modeling? How is slope relevant to analyzing trends in data?

inequalities in two variables as the intersection of the corresponding half-planes. CCSS.Math.Content.HSF.IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y=f(x). CCSS.Math.Content.HSF.IF.A.2 Use function notation, evaluate functions for inputs in their domains,and interpret statements that use function notation in terms of a context. CCSS.Math.Content.HSF.IF.B.5 Relate the domain of a function to its graph and, where applicable,to the quantitative relationship it describes CCSS.Math.Content.HSF.IF.B.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 CCSS.Math.Content.HSF.IF.C.7.a Graph linear and quadratic functions and show intercepts,	the rate of change of that line. Appropriate information about a line can be used to write an equation for that line. A vertical line has no slope and cannot be modeled as a function. Composition of functions combines two different functions into one new function. An inverse of a function “undoes” what the original function did to a value. Real-world data that has a linear trend can be represented with a line of best fit. Absolute value functions have specific characteristics when graphed. Two variable inequalities have solution regions when graphed. There are sets of functions called families in which each function is a transformation of a special function called the parent.	How are the characteristics of a linear equation different from a nonlinear equation? What special relationships between two lines are important to recognize? How is a vertical line different from other lines? What are some real-world uses of inverse and composite functions? What are the similarities and differences between the graphs of linear functions and absolute value functions? What real-world situations can be modeled by linear or absolute value inequalities? What are possible solutions when dealing with two variable inequalities? How can the solutions be represented? How can you use transformations of parent functions to help graph various functions?
	Acquisition	
	Students will know…	*Students will be skilled at…*
	The distinction between relations and functions.	Determining the domain and range from a relation and represent the relation using a

maxima, and minima. CSS.Math.Content.HSF.BF.A.1 Write a function that describes a relationship between two quantities. CCSS.Math.Content.HSF.BF.A.1.c Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time. CCSS.Math.Content.HSF.BF.B.4 Find inverse functions. CCSS.MATH.CONTENT.HSF.BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, 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.	The domain and range of a function. The processes to identify and evaluate functions. How to model data using linear functions. What the slope of a line represents and how to find it. What composition of functions is and how to apply it. The different equations of lines and how to graph using the various equations by hand as well as using the graphing calculator. The steps to graphing absolute value functions. The process to graphing two variable inequalities and absolute value inequalities. What an inverse of a function is and how to find it. The process to solve problems involving direct, indirect, and joint variation. Key terms: relation, function, domain, range, mapping, vertical line test, function notation, line of best fit, slope, slope-intercept form, point-slope form, vertical line, horizontal line, parallel, perpendicular, intercepts, composition of functions, inverse, absolute value, direct variation, inverse variation	mapping diagram Deciding if a relation is a function when given a set of ordered pairs, a mapping, and a graph. Evaluating a specific value given the equation or graph of a function (i.e., find f(3) given the graph of f(x)). Composing two functions. Given a function, finding the inverse of that function and graph it. Writing and graphing equations in point-slope and slope-intercept form. Recognizing slope as a rate of change Identify slopes of horizontal, vertical, parallel, and perpendicular lines. Using graphing calculators to find the line of best fit and make predictions. Graphing an absolute value function by locating its vertex. Recognizing the solution set to the graph of an inequality and identify the boundary line as being include (solid line) or excluded (dashed line). Solving problems involving direct, inverse, and joint variation by using equations involving the constant of variation or by using proportions. Showing graphic representation of data.

	How to analyze and graph transformation of functions.	Using technology tools (i.e., calculators, videos,educational software) for problem solving, self-directed learning, and extended learning activities. Graphing the transformation of a parent function, given factors that result in vertical shift, horizontal shift, stretch, compression, and reflection.

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T, M, A	Scoring Rubric used to evaluate successful understanding of the process and criteria for a desired outcome.	PERFORMANCE TASK(S): Goal: To find the line of best fit given real-world data Role: Financial consultant Audience: Business managers for various companies Situation: Given three different companies (photography, home improvement, and theater), the consultant is asked to provide a cost analysis from given data. Product: Calculated predictions with appropriate explanations Standard for Success: rubric based on understanding, accuracy, communication of results, presentation of evidence to support claim. To Differentiate: Allow students to choose from problems at a variety of difficulty levels.

M, A	Thorough understanding of vocabulary, evaluation of functions, and modeling of relations.	OTHER EVIDENCE: Monitoring class work through board work, group work, questioning techniques,and walk-arounds.
M, A	Thorough understanding of vocabulary, application of functions, and correct graphing of functions.	Check for understanding via going over homework, board and smart board activities, and medium such as warm ups and exit tickets.
T, M, A	Accurate application of content/process to arrive at correct mathematical solution.	Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives
T, M, A	Selection of evidence that is relevant to content and standardized test processes.	Alternative assessment projects such as ”find the mistakes”, explain the process, posters, and real world applications Review of standardized test questions to prep students for the challenge of the SAT and ACT exams Quizzes Unit Test - to include variety of DOK level of problems and may include SAT style problems.

Stage 3 – Learning Plan		
Code	***Pre-Assessment***	
M	• Teacher checks for prerequisite and prior knowledge of evaluating algebraic expressions and graphing coordinates in a coordinate plane. • Questioning activities, such as definition of slope, different formulas for the equation of a linear function and their graphs. • As the lessons progress, students can also be given questions such as "Find the mistakes...." • Warm-ups and skill checks contain review of previous material such as solving equations and absolute value inequalities during the unit to ensure retention and mastery, and check on vertical alignment with prior curriculum.	
	Summary of Key Learning Events and Instruction	Progress Monitoring
M, A	• Teacher activates prior learning of graphing by giving warm-up exercises on graphing points in the coordinate plane and evaluating expressions.	• Quick check on homework to assess common errors to inform future instruction.
M, A	• Teacher defines relation, domain, range, and function and models examples on how to identify these from given information (data sets, mapping, graph).	• Monitor class work through board work, group work, questioning, and walk-arounds
M, A	• Students will work independently to identify domain and range and determine if a relation is a function. Students will also evaluate functions information (data sets, mapping, graph).	• Student collaboration in problem solving followed by explanation to class through a gallery walk.
T, M, A	• Teacher discusses the real-world application of composition of functions and models the process of composing two functions into one new function.	• Check for understanding via going over, board and whiteboard activities, and medium such as reflections and exit tickets
M, A	• Students will complete a practice worksheet on composition of functions and will then compare and discuss their results with a partner.	• Quizzes • Test (may include 10-15 multiple choice, 10-20 regular answer, 8-10 graphs)
M, A	• Teacher initiates and leads class discussion on slope, its representation as the rate of change, and how to calculate the slope.	
T, M,A	• Students will work in teacher-made groups to calculate the slope of a line and to write equations of lines given different conditions (i.e., given two points, a point and	

	an intercept, or a point and a parallel/perpendicular line).	
M, A	● Using a chart, teacher presents the different forms of equations of lines and discusses when to use each equation.	
T	● After a review of writing equations of lines, teacher demonstrates how to use the graphing calculator with the aid of the TI Emulator to find the line of best fit.	
T, M, A	● Students will use the graphing calculator with a partner to find the line of best fit given real-world applications and make predictions	
M	● Teacher provides an activity for students to discover what an inverse of a function is.	
T,M	● Students will work collaboratively to discover the relationship between a function and its inverse and will complete a practice worksheet on finding inverses of functions.	
M, A	● Teacher then model steps to finding inverses of given functions.	
T,M,A	● Teacher uses the graphing calculator to lead class in discovery of what an absolute value graph looks like.	
T,M,A	● Students will practice graphing absolute values in pairs – one graphing by hand and the other checking the graph with a graphing calculator.	
M, A	● Teacher models how to graph inequalities.	
M, A	● Students will use the smartboard or whiteboards to graph inequalities.	
T, M	● Teacher discusses direct, inverse, and joint variation using real-world situations.	
T,M	● Students will brainstorm as a class to come up with situations that model direct, inverse, and joint variation. Students will work in small groups to solve problems involving different forms of variation.	

Suggested Resources:

- Textbook: Charles, Randall et al. *Algebra 2 Common Core*, Boston, MA: Pearson, 2012.
- Teacher-made supplemental worksheets on SAT function review, practice with relations and functions, function notation, graphing linear equations, writing equations of lines, direct, inverse and joint variation, composite functions, and chapter review
- Six Stations review for Functions
- Resource materials provided by Pearson such as implementing the common core, differentiation and standardized test practice
- On-line resources such as YouTube, Khan Academy, Desmos, etc.
- Graphing calculator
- TI Emulator software

Subject/Course: CP Algebra 2 **Unit 3: Quadratic Functions and Modeling**
Time frame: 6-7 weeks

Stage 1 Desired Results

ESTABLISHED GOALS

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

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

CCSS.Math.Content.HSN.CN.A.3
(+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

CCSS.Math.Content.HSN.CN.C.7
Solve quadratic equations with real coefficients that have complex solutions.

CCSS.Math.Content.HSA.SSE.A.1
Interpret expressions that represent a quantity in terms of its context.*

Transfer

Students will be able to independently use their learning to…
identify the vertex, line of symmetry, maximums, minimums, domain, range, and transformations of quadratic functions.

CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.

CCSS.Math.Practice.MP2 Reason abstractly and quantitatively.

CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.

CCSS.Math.Practice.MP4 Model with mathematics.

CCSS.Math.Practice.MP5 Use appropriate tools strategically.

CCSS.Math.Practice.MP6 Attend to precision.

CCSS.Math.Practice.MP7 Look for and make use of structure.

Meaning

UNDERSTANDINGS
Students will understand that…

The value √-1 can be represented as an imaginary number (i).

Complex numbers combine real and imaginary numbers and can have operations of addition,subtraction, multiplication, and division performed on them.

ESSENTIAL QUESTIONS
Students will keep considering…

Why are some values not considered real numbers?

Where did complex numbers originate, and how do they fit into the algebraic framework?

How can quadratic equations be solved?

CCSS.Math.Content.HSA.SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.* CCSS.Math.Content.HSA.SSE.B.3.a Factor a quadratic expression to reveal the zeros of the function it defines. CCSS.Math.Content.HSA.SSE.B.3.b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. CCSS.Math.Content.HSA.REI.B.4 Solve quadratic equations in one variable. CCSS.Math.Content.HSA.REI.B.4.a 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.	Quadratic equations can be solved using a variety of methods, specifically factoring, the quadratic formula, completing the square, and the square root method. Quadratic functions are shaped like parabolas and have special properties. The graph of the parabola will not cross the x-axis when an imaginary number is the solution to the Quadratic equation. It is easier to recognize a parabola's vertex when the Quadratic function is in vertex form. It is easier to recognize a parabola's y-intercept when the Quadratic function is in standard form. Parabolic graphs model trajectory type real world situations found in physics and other disciplines. The axis of symmetry, minimum or maximum, vertex, y-intercept, domain, and range can be found using the trace key or the table of a graphing calculator.	What is the importance of finding values such as intercepts and maximum/minimum from a graph? What conclusion can be drawn when an imaginary number results from solving a quadratic equation? What are the advantages of a quadratic function in vertex form?standard form? How do quadratic functions relate to real-world situations? How can technology be used to represent functions and to verify solutions found manually?
	Acquisition	
	Students will know… Definition of imaginary and complex numbers. Quadratic functions – definition, equation, graphing form, and how to graph.	*Students will be skilled at…* Identifying and graph complex numbers. Adding, subtracting, and multiplying complex numbers.

CCSS.Math.Content.HSA.REI.B.4.b 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. CCSS.Math.Content.HSA.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). CCSS.Math.Content.HSF.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.** CCSS.Math.Content.HSF.IF.C.7 Graph functions expressed	The methods and processes to solving a quadratic equation. The steps to finding the x- and y-intercepts of a quadratic function. Definition of a maximum/minimum point. Definition of a discriminant. Key terms: imaginary numbers, complex numbers, quadratic functions, parabola, quadratic equation, complete the square, quadratic formula, vertex, axis of symmetry, maxima, minima	Graphing quadratic functions and identifying the vertex, axis of symmetry, direction of opening, maximum or minimum value, x- and y- intercepts, domain, and range. Completing the square to get a quadratic function in graphing form. Solving quadratic equations using factoring, quadratic formula, and by completing the square. Finding the x- and y- intercepts of a quadratic function. Determining types of solutions of a quadratic function by using the discriminant. Using technology tools (i.e., calculators, videos,educational software) for problem solving, self-directed learning, and extended learning activities. Showing graphic representation of data.

symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* CCSS.Math.Content.HSF.IF.C.7.a Graph linear and quadratic functions and show intercepts, maxima, and minima. CCSS.Math.Content.HSF.IF.C.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.		

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T,M,A	Scoring Rubric used to evaluate successful understanding of the process and criteria for a desired outcome.	Goal: To interpret the graphs of real-world quadratic functions and use the graphs to determine critical data point information. Role: Mathematician Audience: Golfers Situation: Students are given a quadratic function that models the height in feet that a golf ball will travel in seconds when hit from the ground. Students are to identify and interpret the maximum value of the parabola and x - and y - intercepts. Product : Students will determine the maximum height a golf ball will travel and the time it will take to reach that height. They will also find the total time the ball is in the air. To differentiate: Allow students to choose from problems at a variety of difficulty levels.

M, A	Thorough understanding of the vocabulary, and correct graphing of quadratic functions.	Monitoring class work through board work, group work, questioning techniques,and walk-arounds
T, M, A	Thorough understanding of solving quadratic equations using the 4 different methods and their solutions.	Check for understanding via going over homework, board and smart board activities, and medium such as warm ups and exit tickets
T, M, A	Accurate application of content/process to arrive at correct mathematical solution.	Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives
T, M, A	Selection of evidence that is relevant to content and standardized test processes.	Alternative assessment projects such as ”find the mistakes”, explain the process, posters, and real world applications Review of standardized test questions to prep students for the challenge of the SAT and ACT exams Quizzes Unit Test - to include variety of DOK level of problems and may include SAT style problems.

Stage 3 – Learning Plan	
Code	***Pre-Assessment***
M	● Teacher checks for prerequisite and prior knowledge via warm-ups and entrance tickets on solving linear equations and absolute value inequalities, writing and graphing equations of lines in slope-intercept form. ● Questioning activities, such as basic problems with simplifying algebraic expressions. ● As the lessons progress, students can also be given questions such as “Find the mistakes....” ● Warm-ups and skill checks contain review of previous material during the unit to ensure retention and mastery, and check on vertical alignment with prior curriculum.

	Summary of Key Learning Events and Instruction	Progress Monitoring
M	● Teacher checks for prerequisite and prior knowledge via questioning activities, such as basic review problems on simplifying expressions, factoring, graphing, and solving linear functions	● Quick check on homework to assess common errors to inform future instruction.
T	● Students will work independently on a review assessment for simplifying expressions, factoring, graphing, and solving linear functions.	● Student collaboration in problem solving followed by explanation to class through a gallery walk.
M	● Teacher gives warm-up questions to lead into the concept of imaginary numbers. Complex numbers are also discussed, and teacher models examples of simplifying and performing operations of addition, subtraction, multiplication, and division with complex numbers.	● Check for understanding via going over, board and smartboard activities, and medium such as reflections and exit tickets ● Quizzes ● Test (may include 10-20 multiple choice, 15-30 regular answer, 1-2 graphs)
T	● Students will give ideas and examples of imaginary and complex numbers.	
T,A	● Students will work as a class and then independently to simplify and perform mathematical operations with complex numbers. Individual students will put up answers to practice problems on the board	
M	● Teacher uses TI Emulator graphing calculator or Smart Board technology to facilitate class discovery of the effect the values a, h, and k have on the graphing form of a quadratic function ($y = a(x-h)^2 + k$).	
T,A	● Students will discover the properties of the graphing form of a quadratic function by observing the changes of the graph of a parabola when different values are inserted. Students will work as a class and in pairs to find the key values of a parabola and to graph it. Students' work will be put on the board as a way to review and monitor progress.	
M	● Teacher uses that discovery to introduce the key features of the graph of a parabola: vertex, axis of symmetry, direction of opening, max/min value, x- and y- intercepts, domain, and range.	
M	● Teacher models, with the help from students, how to	

	graph a parabola from that information.	
M	● Teacher models how to get any quadratic function into graphing form by the method of completing the square.	
T,A	● Students will practice completing the square to get a quadratic function in graphing form by working in teacher created groups.	
M	● Teacher reviews steps to factoring a quadratic equation and discusses the need for alternate methods for solving quadratic equations. Modeling of examples that do not factor should be used to show the methods of completing the square and the quadratic formula. Ample time and practice of each method are given.	
T,A	● Students will solve quadratic equations using the methods of factoring, quadratic formula, and completing the square. Students will verbally state the quadratic formula from memory and use song as a way of stating it.	
M	● Teacher uses song as a means to memorize the quadratic formula. Teacher models the value of the discriminant to explain the type and number of solutions for a quadratic function	
T,A	● Students will determine the type and number of solutions in a quadratic equation given its discriminant.	

Suggested Resources:

- Textbook: Charles, Randall et al. *Algebra 2 Common Core*, Boston, MA: Pearson, 2012.
- Supplemental worksheets from the textbook resources on operations with complex and imaginary numbers, solving quadratics by completing the square, solving quadratics by the quadratic formula, and solving quadratic equations
- Teacher made supplemental worksheets on operations with complex and imaginary numbers, solving quadratic equations by various methods, quadratic functions (finding critical values and graphing), and chapter review
- Resource materials provided by Pearson such as implementing the common core, differentiation and standardized test practice
- On-line resources such as You Tube, Khan Academy, Desmos, etc.
- Graphing calculator
- TI Emulator software

Subject/Course: CP Algebra 2 **Unit: 4 Polynomial Operations**

Time Frame: 5-6 weeks

Stage 1 Desired Results

ESTABLISHED GOALS

CCSS.Math.Content.HSA.SSE.A.1.a Interpret parts of an expression, such as terms, factors, and coefficients

CSS.Math.Content.HSA.SSE.A.1.b Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.*

CCSS.Math.Content.HSA.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 $(x^2 - y^2)(x^2 + y^2)$.*

CCSS.Math.Content.HSA.SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

CCSS.Math.Content.HSA.SSE.B.3.a Factor a quadratic expression to reveal the zeros of the function it defines.

CCSS.Math.Content.HSA.APR.A.1 Understand that polynomials form a system analogous to the integers,

Transfer

Students will be able to independently use their learning to…
identify the degree, the zeros, roots ,and x-intercepts of a polynomial function

CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.

CCSS.Math.Practice.MP2 Reason abstractly and quantitatively.

CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.

CCSS.Math.Practice.MP4 Model with mathematics.

CCSS.Math.Practice.MP5 Use appropriate tools strategically.

CCSS.Math.Practice.MP6 Attend to precision.

CCSS.Math.Practice.MP7 Look for and make use of structure.

Meaning

UNDERSTANDINGS

Values, expressions, and polynomials can be simplified using a specific process.

Exponents are related to the operations of addition and multiplication.

Polynomials can be added, subtracted, and multiplied to make a more simplified expression.

ESSENTIAL QUESTIONS
Students will keep considering…

How are the properties of exponents related to the basic arithmetic operations?

How are polynomial expressions combined using operations of addition, subtraction, and multiplication?

How does a negative exponent change a value?

namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials. CCSS.MATH.CONTENT.HSF.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. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity*.*	Negative exponents represent reciprocals of values. Polynomials can be broken up into products of more simplified terms by factoring. Polynomial functions can represent many real world situations such the path of projectiles. Quadratic and other polynomial equations can be solved using factoring. The degree of a polynomial is the greatest degree among its monomial terms. The degree provides information about the end behavior, turning points, and number of solutions for a polynomial function. Graphs of Polynomial functions can be used to find domain, range, and intercepts and to tell the nature of the function(increasing, decreasing, constant , maxima, minima) A polynomial function has distinguishing behaviors. You can look at its algebraic form and know something about its graph. You can look at its graph and know something about its algebraic form.	Why does factoring “work” as a method of solving quadratic and polynomial equations? What are some real-world applications that involve polynomial modeling? How do you find the degree of a polynomial function? What does the degree of a polynomial tell you about its related polynomial function? For a polynomial function, how are factors, zeros, and x-intercepts related? For a polynomial equation, how are factors and roots related?

	Acquisition	
	Students will know…	*Students will be skilled at…*
	Properties of exponents	Simplifying expressions using the rules of exponents
	Degree of a monomial and polynomial	Identifying the degree of a monomial and polynomial
	Definition of an algebraic term	Classifying a polynomial by the number of terms
	Addition, subtraction, and multiplication processes of polynomials	Performing the operations of Addition, subtraction, and multiplication of polynomials
	Steps and processes to factoring polynomials	Factoring polynomial expressions
	Methods and processes to solving a polynomial equation	Solving polynomial equations by factoring or graphing methods
	A polynomial function is classified by degree.	Graphing polynomials and Identifying intercepts, points of relative maxima and minima, intervals where the function is increasing, decreasing, or constant, as well as find specific values from the graph of a function
	The degree of a polynomial determines the possible number of turning points in its graph and the end behavior of the graph.	Recognize from a graph the key features of a polynomial such as the factors, zeros, relative minimums, relative maximums.
	A turning point is a relative maximum or relative minimum of a polynomial function.	Using technology tools (i.e., calculators, videos,educational software) for problem solving, self-directed learning, and extended learning activities.
	What constitutes even vs. odd multiplicity when the function is in its algebraic form.	
	Key terms: exponent, polynomial, monomial, binomial, trinomial, degree, coefficient, factor, greatest common factor	

	, difference of squares, sum/difference of cubes, grouping	

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T,M,A	Scoring Rubric used to evaluate successful understanding of the process and criteria for a desired outcome.	PERFORMANCE TASK(S): Goal: To apply the skills of polynomial functions in the design of roller coaster rides. Role: Roller Coaster Engineer Audience: Amusement Park Manager Situation: Given three different polynomial functions that model roller coasters, the student is asked to graph each function, find the heights at different independent variables (time), and evaluate the function at a given independent variable. Product: Demonstration of a clear and in depth understanding of polynomial functions, such as sketching and analyzing graphs of polynomial functions, determining zeros of a polynomial function, and determining polynomial function behavior. Standard for Success: rubric based on understanding, accuracy, communication of results, presentation of evidence to support claim. To differentiate:Provide different levels of difficulty from which the students can choose

M, A	Thorough understanding of polynomial behavior, evaluation of functions, and modeling of polynomials.	OTHER EVIDENCE: Monitoring class work through board work, group work, questioning techniques,and walk-arounds
T, M, A	Thorough understanding of vocabulary, application of functions, and correct graphing of functions.	Check for understanding via going over homework, board and smart board activities, and medium such as warm ups and exit tickets
T, M, A	Accurate application of content/process to arrive at correct mathematical solution.	Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives
T, M, A	Selection of evidence that is relevant to content and standardized test processes.	Alternative assessment projects such as ”find the mistakes”, explain the process, posters, and real world applications Review of standardized test questions to prep students for the challenge of the SAT and ACT exams Quizzes

		Unit Test - to include variety of DOK level of problems and may include SAT style problems.

Stage 3 – Learning Plan	
Code	***Pre-Assessment***
M	● Teacher checks for prerequisite and prior knowledge via warm-ups and entrance tickets on graphing quadratic functions, solving quadratics equations by graphing and factoring. ● Questioning activities, such as basic problems with exponents and radicals. ● As the lessons progress, students can also be given questions such as “Find the mistakes....” ● Warm-ups and skill checks contain review of previous material during the unit to ensure retention and mastery, and check on vertical alignment with prior curriculum.

		Progress Monitoring ● Quick check on homework to assess common errors to inform future instruction.
M	● Teacher checks for prerequisite and prior knowledge via warm-ups on solving and graphing linear functions	
T	● Students will work independently and as a class solving equations and graphing linear equations both manually and on graphing calculators.	● Monitor class work through board work, group work, questioning, and walk-arounds
M	● Teacher introduces the properties of exponents by using visual representations to what exponents mean (e.g., $x^2 \cdot x^3 = x5$ since $x^2 = x \cdot x$ and $x^3 = x \cdot x \cdot x$ giving us a result of 5 x's).	● Student collaboration in problem solving followed by explanation to class through a gallery walk.
T, M	● Students will work independently simplifying exponential expressions and then share results in a teacher created pairing.	● Check for understanding via going over, board and smart board activities, and medium such as reflections and exit tickets
M	● Teacher models the addition, subtraction, and multiplication of polynomials.	● Quizzes
M, T	● Students will verbally explain the process of adding, subtracting, and multiplying polynomials. Students will explain what FOIL means in the multiplication of polynomials.	● Test (may include 10-20 multiple choice, 15-30 regular answer)
M	● Teacher explains factoring of a polynomial expression beginning with GCF and grouping on day one, then the difference of squares and the sum and difference of cubes, and lastly trinomials.	
T	● Teacher allows students several opportunities for independent practice and teacher-created groups throughout this topic. Supplemental worksheets and board problems should be used to assess mastery of this concept.	
T,A	● Students will use smartboard to practice factoring polynomial expressions. Students will work in pairs on a mixed review assessment on factoring to explain which method of factoring should be used.	
M	● Teacher uses flow chart to help students determine which method of factoring should be used to factor a polynomial.	
T,M	● Students will describe the factoring methods for solving	

	polynomial equations and practice this method in teacher assigned groups.	
M	● Teacher highlights for students that no matter what a polynomial looks like, the process of factoring always starts with factoring out a GCF if possible. Teacher illustrates method for solving polynomial equation via factoring by hand and by graphing calculator.	
M,A	● Students will solve polynomial equations having a degree greater than two by entering the linear portion in Y1 in their graphing calculators and the rest of the equation in Y2 of their graphing calculators. Students will then use the intersect feature to find the x-values at that point of intersection.	

Suggested Resources:

- Textbook: Charles, Randall et al. *Algebra 2 Common Core*, Boston, MA: Pearson, 2012.
- Supplemental worksheets from the textbook resources on exponents, factoring, and solving equations by factoring
- Teacher made supplemental worksheets on exponents, polynomial operations, factoring, solving equations by factoring, and chapter review
- Resource materials provided by Pearson such as implementing the common core, differentiation and standardized test practice
- On-line resources such as You Tube, Khan Academy, Desmos, etc.
- Graphing calculator
- TI Emulator software

Subject/Course: CP Algebra 2 **Unit 5: Radical Functions and Rational Exponents**
Time frame: 3-4 weeks

Stage 1 Desired Results

ESTABLISHED GOALS

CCSS.Math.Content.HSN.RN.A.1
Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*

CCSS.Math.Content.HSN.RN.A.2
Rewrite expressions involving radicals and rational exponents using the properties of exponents.

CCSS.Math.Content.HSA.REI.A.2
Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Transfer

Students will be able to independently use their learning to…
simplify, add, subtract, multiply, and divide radical expressions as well as identifying solutions to radical equations.

CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.

CCSS.Math.Practice.MP2 Reason abstractly and quantitatively.

CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.

CCSS.Math.Practice.MP4 Model with mathematics.

CCSS.Math.Practice.MP5 Use appropriate tools strategically.

CCSS.Math.Practice.MP6 Attend to precision.

CCSS.Math.Practice.MP7 Look for and make use of structure.

Meaning

UNDERSTANDINGS	ESSENTIAL QUESTIONS
Exponents and radicals are related to the operation of multiplication; a radical is the inverse of an exponent. Simplifying radicals results in a smaller value under the radical while maintaining an exact value.	How are the properties of exponents related to the basic arithmetic operations? How do radicals relate to exponents? Why is it important to simplify

	Rationalizing the denominator eliminates radical expressions from the denominator. Radical expressions can be combined under the basic operations of addition, subtraction, multiplication, and division following a specific process. Rational exponents are another way to express radicals. Equations with radicals can be solved using exponents and may result in extraneous solutions. The distance formula derives from the Pythagorean Theorem and is a radical expression.	radicals? Why is it necessary to rationalize the denominator ? How do radical expressions relate to rational exponents? How can radical equations be solved? When you square each side of an equation is the resulting equation equivalent to the original? How does the distance formula relate to radicals?
	Acquisition	
	Students will know… Definition of nth root, radicand, index, and a principal root of a radical. Steps and processes to simplify a radical expression. Properties for multiplying and dividing radical expressions.	*Students will be skilled at…* Simplifying nth roots. Determining all real roots of a real number and the degree of a radical expression. Simplifying radical expressions.

	Steps and processes to “Rationalize the Denominator”. Properties for adding and subtracting radical expressions. Steps and processes to multiply and divide binomial radical expressions. Alternate form of writing a radical expression. Methods and processes to simplify expressions with rational exponents. Steps to solving square root and other radical equations. Distance and midpoint formulas. Key terms: nth root, real roots, radicand, index, principal root, rational exponent radical equation, square root equation, like radicals, exponential expression, conjugate, midpoint	Multiplying and dividing radical expressions. Rationalizing the denominator of a radical expression. Adding and subtracting radical expressions. Multiplying and dividing binomial radical expressions. Re-writing a radical expression using a rational exponent. Simplifying expressions with rational exponents. Solving square root and other radical equations. Finding the distance and midpoint of a segment given the endpoints. Using technology tools (i.e., calculators, videos,educational software) for problem solving, self-directed learning, and extended learning activities.

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T,M,A	Scoring Rubric used to evaluate successful understanding of the process and criteria for a desired outcome.	PERFORMANCE TASK(S): GOAL : To solve a puzzle that matches expressions with rational exponents with the corresponding radical expression Role: Students Audience: Classmates Situation: Students will work in pairs.They will be given a puzzle with various expressions in both radical and exponential form and will match equivalent expressions appropriately to solve the puzzle Product: Puzzle successfully solved.. Standard for Success: rubric based on understanding, accuracy, communication of results, presentation of evidence to support claim. To differentiate: Allow students the option to make their own puzzles for their classmates to solve.

M, A	Thorough understanding of simplifying radicals, combination of basic operations of adding, subtraction, multiplication, and division.	OTHER EVIDENCE Monitoring class work through board work, group work, questioning techniques,and walk-arounds
T, M, A	Thorough understanding of solving equations with radicals, rational exponents, and rationalizing the denominator.	Check for understanding via going over homework, board and smart board activities, and medium such as warm ups and exit tickets
T, M, A	Accurate application of content/process to arrive at correct mathematical solution.	Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives
T, M, A	Selection of evidence that is relevant to content and standardized test processes. .	Alternative assessment projects such as ”find the mistakes”, explain the process, posters, and real world applications Review of standardized test questions to prep students for the challenge of the SAT and ACT exams Quizzes Unit Test - to include variety of DOK level of problems and may include SAT style problems.

Stage 3 – Learning Plan	
Code	***Pre-Assessment***
M	● Teacher checks for prerequisite and prior knowledge via warm-ups and entrance tickets on multiplying binomials and solving by factoring. ● Questioning activities, such as basic problems with solving polynomial equations. ● As the lessons progress, students can also be given questions such as “Find the mistakes....” ● Warm-ups and skill checks contain review of previous material during the unit to ensure retention and mastery, and check on vertical alignment with prior curriculum.

	Summary of Key Learning Events and Instruction	Progress Monitoring
M, A	• Teacher checks for prior knowledge using common formative assessment (pre-test) on properties of exponents and solving polynomial equations.	• Quick check on homework to assess common errors to inform future instruction.
M, A	• Students will work independently on a pre-test for the properties of exponential expressions	• Monitor class work through board work, group work, questioning, and walk-arounds • Student collaboration in problem solving followed by explanation to class through a gallery walk.
M,A	• Teacher continues to check prerequisite knowledge throughout the unit using warm-up problems and scaffolding activities.	
M, A	• Students will work independently solving polynomial equations and then write their results on the blackboard.	• Check for understanding via going over, board and smart board activities, and medium such as reflections and exit tickets
M, A	• Teacher models real roots by writing $y^2 = 64$ on the board to show the number of real nth roots.	• Quizzes
M, A	• Students will explain what is meant by the nth root of a number, where n is a positive integer greater than or equal to two. Students will work in teacher created pairs simplifying radical expressions.	• Unit Test
M, A	• Teacher reviews the perfect square factors, perfect cube factors, perfect fourth root factors, etc. to explain the steps for simplifying radical expressions.	
M, A	• Teacher reiterates the importance of factoring out the greatest of these types of factors first.	
M, A	• Teacher models the properties for multiplying and dividing radical expressions.	
M,A	• Students will work independently and in small groups practicing multiplying and dividing radical expression	
M, A	• Teacher introduces the concept of “Rationalizing the Denominator” as an alternate method to dividing radical expressions when the denominator contains a radical.	
T,M,A	• Students will work in teacher created pairs whereby each student is to make up problems that require the division of the radical expression to be completed by rationalizing the denominator and ones that do not require rationalizing the denominator. The students will work their partner’s problems out and check each	

	other's work	
M	● Teacher defines "like radicals" to model adding and subtracting radical expressions. Emphasis is placed on the need for students to first simplify the radical expression they want to add or subtract.	
M,A	● Students will use white boards to practice adding and subtracting radical expressions	
M,A	● Teacher models the steps to multiplying and dividing radical expressions.	
M, A	● Students will practice multiplying and dividing binomial radical expressions as a class and independently	
M,A	● Teacher makes a connection using the FOIL method for multiplying binomials to multiplying binomial radical expressions.Teacher allows students many opportunities for independent practice on these topics	
M,A	● Teacher defines meaning of a conjugate and models the steps to dividing a radical expression where the denominator is a binomial radical expression.	
M	● Students will work individually on simplifying radical expressions that require them to rationalize the denominator by multiplying the numerator and denominator by the conjugate.	
M,A	● Teacher defines an exponential expression (radical exponent expression) using the analogy that tree roots are below ground and power lines are above ground to help students visualize that a numerator of a rational exponent represents the power of the real number and the denominator represents the root of the radical.	
M, A	● Students will verbally explain which value in an expression with rational exponents is the root of that expression and what is the power	
M, A	● Teacher models the methods to simplifying an exponential expression given a radical expression and simplifying a radical expression given an exponential expression.	
M, A	● Students will work individually and as a class to rewrite an exponential expression to its radical form and rewrite	

	a radical expression to its exponential form	
M	● Teacher reviews solving polynomial equations and models similarities to solving square root and other radical equations.	
T,A	● Students will describe the procedure for solving a radical equation and then be given the opportunity to practice solving radical equations by working in teacher-created groups	
T, M	● Teacher reviews the Pythagorean Theorem as a way to lead into the derivation of the distance formula. Teacher also reviews the midpoint formula. Both formulas are written on the board, and problems are modeled by the teacher.	
M,A	● Students will work in teacher created groups to find the distance between two points and the midpoint of a segment.	

Suggested Resources:

- Textbook: Charles, Randall et al. *Algebra 2 Common Core*, Boston, MA: Pearson, 2012.
- Supplemental worksheets from the textbook resources on simplifying radical expressions, simplifying rational exponents, solving equations with radicals, and chapter review
- Teacher made supplemental worksheets on simplifying radical expressions, distance and midpoint, solving equations with radicals, and chapter review
- Resource materials provided by Pearson such as implementing the common core, differentiation and standardized test practice
- On-line resources such as YouTube, Khan Academy, Desmos, etc.
- Graphing calculator
- TI Emulator software

Subject/Course: CP Algebra 2 **Unit: 6 Exponential and Logarithmic Functions**
Time frame: 3-4 weeks

Stage 1 Desired Results

ESTABLISHED GOALS

CCSS.Math.Content.HSA.SSE.B.3.c
Use the properties of exponents to transform expressions for exponential functions.

CCSS.Math.Content.HSF.IF.C.7.e
Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

CCSS.Math.Content.HSF.IF.C.8.b
Use the properties of exponents to interpret expressions for exponential functions.

CCSS.Math.Content.HSF.BF.B.5
(+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

Transfer

Students will be able to independently use their learning to…
model situations with exponential functions.

CCSS.Math.Practice.MP1 Make sense of problems and persevere in solving them.

CCSS.Math.Practice.MP2 Reason abstractly and quantitatively.

CCSS.Math.Practice.MP3 Construct viable arguments and critique the reasoning of others.

CCSS.Math.Practice.MP4 Model with mathematics.

CCSS.Math.Practice.MP5 Use appropriate tools strategically.

CCSS.Math.Practice.MP6 Attend to precision.

CCSS.Math.Practice.MP7 Look for and make use of structure.

Meaning

UNDERSTANDINGS *Students will understand that…*	ESSENTIAL QUESTIONS *Students will keep considering…*
Exponential equations can be solved by getting a common base or by using logarithms. Logarithms are used to represent exponents, which could not be solved. The properties of logarithms relate to the properties of exponents.	What is the value of an exponential equation in the real-world? How are exponents and logarithms related? How does the relationship between exponential and logarithmic functions help us? What are some real-world applications of

	Interest on banking accounts is modeled with exponential functions as well as archaeology, oceanography, and manufacturing applications to name a few.	logarithmic and exponential functions?
	Acquisition	
	Students will know… The process to solving exponential equations by getting a common base and by using logarithms. A logarithm is a way to represent exponents. The properties of logarithms. Key terms: exponential equation, base, logarithm	*Students will be skilled at…* Changing expressions to have the same base in order to solve exponential equations. Changing expressions from exponential form to logarithmic form and vice-versa. Evaluating logarithmic expressions. Apply the properties of logarithms to solve exponential equations.

Stage 2 – Evidence		
Code	**Evaluative Criteria**	**Assessment Evidence**
T,M,A	Scoring Rubric used to evaluate successful understanding of the process and criteria for a desired outcome.	PERFORMANCE TASK(S): GOAL: Students will apply concepts of exponential equations in order to calculate continuous versus yearly compounded interest. Role: Students will take on the role of a financial analyst Audience: Business Manager Situation: Students are given different scenarios that they will compare the two different types of interest rates. Product: Analysis of the different scenarios. Standard for Success: rubric based on understanding, accuracy, communication of results, presentation of evidence to support claim. To Differentiate: Provide various levels of difficulty from which students can choose

M, A	Thorough understanding of the vocabulary, and correct graphing of exponential and logarithmic functions.	Monitoring class work through board work, group work, questioning techniques,and walk-arounds
T, M, A	Thorough understanding of solving exponential and logarithmic equations.	Check for understanding via going over homework, board and smart board activities, and medium such as warm ups and exit tickets
T, M, A	Accurate application of content/process to arrive at correct mathematical solution.	Differentiate through purposeful or flexible grouping, use of diagrams and explanations to demonstrate understanding and active lessons involving discovery, scaffolding, jigsaw activities and use of hands-on manipulatives
T, M, A	Selection of evidence that is relevant to content and standardized test processes.	Have students research their own scenarios where a logarithmic application occurs for growth or decay. Alternative assessment projects such as ”find the mistakes”, explain the process, posters, and real world applications Review of standardized test questions to prep students for the challenge of the SAT and ACT exams Quizzes Unit Test - to include variety of DOK level of problems and may include SAT style problems.

Stage 3 – Learning Plan		
Code	***Pre-Assessment***	
M	• Teacher checks for prerequisite and prior knowledge via warm-ups and entrance tickets on simplifying rational exponents,evaluating expressions and using linear models. • Questioning activities, such as basic problems with simplifying expressions with exponents. • As the lessons progress, students can also be given questions such as “Find the mistakes....” • Warm-ups and skill checks contain review of previous material during the unit to ensure retention and mastery, and check on vertical alignment with prior curriculum.	
	Summary of Key Learning Events and Instruction	Progress Monitoring
		• Quick check on homework to assess common errors to inform future instruction.
M	• Teacher uses independent/guided practice via supplemental worksheets to review simplifying expressions with exponents.	• Monitor class work through board work, group work, questioning, and walk-arounds
T,A	• Students work independently and in teacher created groups to complete practice problems that review exponents. Students will use think-pair-share to compare and discuss their answers	• Student collaboration in problem solving followed by explanation to class through a gallery walk.
M	• Teacher walks around and monitors student progress, assists individual students, and models examples when needed for the class.	• Check for understanding via going over, board and white board activities, and medium such as reflections and exit tickets
T,A	• Students will individually complete problems on solving exponential equations. Students will volunteer their solutions and will explain the process they used.	• Quizzes • Test (may include 10-20 multiple choice, 15-30 regular answer)
M	• Teacher gives warm-up questions on exponents as a way to introduce exponential equations.	
M	• Teacher models different examples of exponential equations that have the same base and the steps to solving them.	
M,T	• Teacher has the class graph the equation y = 2x and its inverse as a way of introducing the graph of an exponential equation and a logarithm.	

M T,A	● Teacher models how to solve and evaluate logarithmic equations and expressions by changing to exponential form and by applying the properties of logarithms. ● Students will practice evaluating and solving logarithmic expressions and equations by various activities such as independent activities such as independent practice, board work, think-pair-share, and/or use of white boards.	

Suggested Resources:

- Textbook: Charles, Randall et al. *Algebra 2 Common Core*, Boston, MA: Pearson, 2012.
- Supplemental worksheets from the textbook resources on logarithmic functions and solving equations with logarithms
- Teacher made supplemental worksheets on exponential equations, logarithmic functions and equations, and chapter review
- Resource materials provided by Pearson such as implementing the common core, differentiation and standardized test practice
- On-line resources such as YouTube, Khan Academy, Desmos, etc.
- Graphing calculator
- TI Emulator software