Algebra II Mathematics Curriculum Guide

Grade Level/Course Title: Algebra II	**Quarter 1**	**Academic Year: 2018-2019**

Mathematics Focus for the Course:
For the high school Model Algebra II course, instructional time should focus on four critical areas: (1) relate arithmetic of rational expressions to arithmetic of rational numbers; (2) expand understandings of functions and graphing to include trigonometric functions; (3) synthesize and generalize functions and extend understanding of exponential functions to logarithmic functions; and (4) relate data display and summary statistics to probability and explore a variety of data collection methods.

Essential Questions for this Unit:
1. How can students develop fluency writing, interpreting, and translating among various forms of linear equations and inequalities, and use them to solve problems?
2. How can students interpret functions given graphically, numerically, symbolically, and verbally; translate between representations?
3. How can students express systems of equations and find and interpret their solutions?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 1 **August-Sept** **Linear Functions and Systems** **13 total days** **(+):add 3 days**	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.	• Proper Syntax Syntax (GMR) • Academic Vocabulary • Key Features of Functions average rate of change maximum, minimum zero of the function • Transformation of Function compression, stretch, transformation, translation	1.1 Identify key features of a graph of a function, including the intercepts, positive and negative intervals and areas where the function is increasing or decreasing. Calculate and interpret the average rate of change of a function over a specified interval. **(2 days)** ❖ **MP. 3 Construct Viable Arguments** ❖ **MP.6 Attend to Precision** 1.2 Graph a transformed function by identifying the effect on the graph of replacing *f(x)* by *f(x)+kf(x), f(kx),* and *f(x+f)* for specific values of *k***.** Write the equation of a transformed function.**(2 days)** ❖ **MP. 5 Use Appropriate Tools Strategically** ❖ **MP. 7 Look For and Make Use of Structure** ❖ 1.3 Create and graph piecewise-defined functions including absolute value functions and steps functions. **(2 days)** ❖ **MP.6 Attend to Precision** ❖ **MP. 7 Look For and Make Use of Structure**
	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.		
	F.BF.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology.		

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Essential Questions for this Unit:
1. How can students develop fluency writing, interpreting, and translating among various forms of linear equations and inequalities, and use them to solve problems?
2. How can students interpret functions given graphically, numerically, symbolically, and verbally; translate between representations?
3. How can students express systems of equations and find and interpret their solutions?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 1 **Linear Functions and Systems**	F.IF.7b	Graph square root, cube root, and piecewise-define functions, including step functions and absolute value functions.	• Piecewise –Defined Functions Step function • Arithmetic Sequences and Series Common difference, explicit and recursive Definitions, sequence, series, sigma notation • Solving Equations and Inequalities • Linear Systems Augmented matrix, coefficient matrix, dimensions, inconsistent system, matrix, solution of linear equations, system of linear equations, system of linear inequalities	1.4 Identify the common difference in an arithmetic sequence. Write arithmetic sequences both recursively and with explicit formula. Construct arithmetic sequences, given a graph, a description of a relationship or two input-out pairs. **(2 days)** ❖ **MP.3 Construct Viable Arguments** ❖ **MP. 7 Look For and Make Use of Structure** 1.5 Use graphs, tables, and graphing technology to find and approximate solutions to equations and inequalities. Find approximate solutions to equations and inequalities by setting each expression equal to *y* and graphing.(**2 days)** ❖ **MP.1 Make sense of Problems and Persevere in Solving Them** 1.6 Solve linear systems graphically and algebraically. Identify regions that satisfy system of inequalities. **(2 days)** ❖ **MP.1 Make sense of problems and Persevere** ❖ **MP. 2 Reason Abstractly and Quantitatively**
	F.BF.2	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. ★		
	A.CED.1	Create equations and inequalities in one variable and use them to solve problems		
	A.REI.6	Solve systems of linear equations exactly and approximately (e.g. , with graphs), focusing on pairs of linear equations in two variables.		
	A.CED.3	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.		

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Essential Questions for this Unit:
1. How can students understand that all quadratic functions are transformations of the parent function $f(x) = x^2$?
2. How can understand that the x-values of the points of intersection of the graphs of linear and quadratic functions represent the solutions of the system of equations.
3. How will students recognize complex solutions when solving a quadratic equation using the Quadratic Formula?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 2 **September** **Quadratic Functions and Equations** **17 total days** **(+): add 1 day**	A.CED.3	Represent constraints by equations or inequalities, and by systems of equations and /or inequalities, and interpret solutions as viable or nonviable options in a modeling context.	• Mathematical Modeling in 3 Acts: Current Events • Vertex Form of a Parabola, Quadratic Function • Standard Form of a Quadratic Equation • Factored Form of a Quadratic Equation	Use mathematical modeling to represent a problem situation and to propose a solution. Test the appropriateness of their math models. Explain why the results from their mathematical models might not align exactly with the problem situation. **(1 day**) ❖ **MP. 4 Model with Mathematics** 2.1 Create quadratic functions in vertex form to represent relationship between variables as shown in their graphs. Graph functions on coordinate axes using their key features. Interpret key features of the graph of a quadratic function. (**2 days)** ❖ **MP.1 Make sense of Problems and Persevere in Solving Them** ❖ **MP. 7 Look For and Make Use of Structure** 2.2 Create quadratic functions written in standard form. Identify the features of quadratic function and graph a quadratic function written in standard form. **(2 days)** ❖ **MP. 4 Model with Mathematics** ❖ **MP. 7 Look For and Make Use of Structure** 2.3 Write a quadratic equation in factored form and use it to identify the zeros of the function it defines. Determine the intervals over which a quadratic function is positive or negative. **(2 days)** ❖ **MP.1 Make sense of Problems and Persevere in Solving Them** ❖ **MP. 7 Look For and Make Use of Structure**
	A.CED.2	Create equations in two or more variables to represent relationship between quantities; graph equations on coordinate axes with labels and scales.		
	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.SSE.3a	Identify zeros of polynomials when suitable factorization are available, and use the zeros to construct a rough graph of the function defined by the polynomial. Factor a quadratic expression to reveal the zeros of the function it defines.		

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Essential Questions for this Unit:
1. How can students understand that all quadratic functions are transformations of the parent function $f(x) = x^2$?
2. How can understand that the x-values of the points of intersection of the graphs of linear and quadratic functions represent the solutions of the system of equations.
3. How will students recognize complex solutions when solving a quadratic equation using the Quadratic Formula?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 2 continued **Quadratic Functions and Equations**	N.CN.1	Know there is a complex number *i* such that $i^2 = -1$, and every complex number has the form a + b*i* with a and b real.	• Complex Numbers and Operations complex conjugates, complex numbers, imaginary number, imaginary unit • Mathematical Modeling in 3 Acts • Completing the Square Perfect square trinomial • The Quadratic Formula	2.4 Add, subtract, and multiply complex numbers using the properties of operations and the relation $i^2 = 1$. Use complex numbers to represent numbers that are not on the number line. **(2 days)** ❖ **MP. 4 Model with Mathematics** ❖ **MP. 7 Look For and Make Use of Structure** ❖ **MP. 8 Look For and Express Regularity in Repeated Reasoning.** Use mathematical modeling to represent a problem situation and to propose a solution. Test the appropriateness of their math models. Explain why the results from their mathematical models might not align exactly with the problem situation**. (1 day)** ❖ **MP. 4 Model with Mathematics** 2.5 Transform a quadratic equation into the form $(x - p)^2 = q$ by completing the square. Complete the square to reveal the minimum or maximum value of a quadratic expression. **(2 days)** ❖ **MP. 3 Construct a Viable Arguments** ❖ **MP.6 Attend to Precision** ❖ **MP. 7 Look For and Make Use of Structure** 2.6 Use the quadratic Formula to solve quadratics that have complex solutions. **(2 days)** ❖ **MP. 3 Construct a Viable Arguments** ❖ **MP. 5 Use Appropriate Tools Strategically**
	N.CN.2	Use the relation $i^2 = -1$ and the commutative, associative and distributive properties to add, subtract, and multiply complex numbers.		
	F.BF.1a	Determine an explicit expressions, a recursive process or steps for calculation from a context.		
	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. REI.4a	Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that as he same solutions.		
	A.REI.4b	Solve quadratic equations by inspections, taking square roots, completing the square, the Quadratic Formula and factoring, as appropriate to the initial form of the equation.		

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Essential Questions for this Unit:
1. How can students understand that the leading coefficient and the degree of a polynomial can be used to predict the end behavior of the graph of a function?
2. How can students understand the notion that polynomials can be used to approximate other functions?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 2 (continued)	A.REI.7	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically	• Linear- Quadratic System systems of equations solution of a system linear system linear-quadratic system	2.7 Use algebra to solve linear – quadratic equation. Solve a linear-quadratic system using graphing and explain why the points of intersection are the solutions. **(2 days)** ❖ **MP. 3 Construct a Viable Arguments** ❖ **MP. 5 Use Appropriate Tools Strategically**
Chapter 3 October **Polynomial Functions** **16 total days** **(+): add 1 day**	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 equations 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, polynomial, rational, absolute value, exponential, and logarithmic functions.	• Graphing Polynomial Functions degree of a polynomial leading coefficient polynomial function relative maximum relative minimum turning point standard form of a polynomial • Adding, Subtracting, and Multiplying Polynomials	3.1 Graph polynomial functions and show the key features of the graph. Predict the end behavior of polynomial functions by interpreting the leading coefficients and degrees. Sketch the graphs showing the key features, given a verbal description. **(2 days)** ❖ **MP. 2 Reason Abstractly and Quantitatively** ❖ **MP. 5 Use Appropriate Tools Strategically** ❖ **MP. 7 Look For and Make Use of Structure** 3.2 Add, subtract, and multiply polynomials and understand that polynomials are closed under these operations. Compare a polynomial function represented algebraically with one represented graphically**. (2 days)** ❖ **MP. 2 Reason Abstractly and Quantitatively** ❖ **MP. 3 Construct a Viable Arguments**
	F.IF.4	For a function that models a relationship between two quantities, interpret key features of graphs showing key features given a verbal description of the relationship.		
	F.IF.7c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.		
	A.APR.1	Understand that polynomials form a system analogous to the integers; namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.		

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Essential Questions for this Unit:

3. How will students understand the relationship between the factorization of polynomials and the roots of a polynomial?
4. How can students regard the Remainder Theorem as a theorem, not a technique?
5. How can students understand that polynomial identities are useful tools for describing numerical relationships and for multiplying and factoring polynomials more efficiently?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 3 (continued) **Polynomial Functions**	F.IF.9	Compare properties of two functions ,each represented in a different way (algebraically, graphically , numerically in tables, or by verbal description	• Polynomial Identities Binomial Theorem Identity Pascal's Theorem • Dividing Polynomials Factor Theorem Remainder Theorem synthetic division • Zeros of Polynomial Functions extraneous solutions zero of a function zero product property	3.3 Prove polynomial identities and use them to multiply and factor polynomials. Expand polynomials using the Binomial Theorem and coefficients determined by Pascal's triangle. **(2 days)** ❖ **MP. 2 Reason Abstractly and Quantitatively** ❖ **MP. 7 Look For and Make Use of Structure** 3.4 Divide polynomial expressions using long division. Use synthetic division to rewrite rational expressions. **(2 days)** ❖ **MP. 2 Reason Abstractly and Quantitatively** ❖ **MP. 6. Attend to Precision** 3.5 Identify the zeros of a function by factoring or using synthetic division. Use the zeros of the function to sketch the graph. **(2 days)** ❖ **MP. 7 Look For and Make Use of Structure** ❖ **MP. 8 Look For and Express Regularity in Repeated Reasoning.**
	A.APR.4	Prove polynomial identities and use them to describe the numerical relationships		
	A.APR.5	Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for positive integer n, where x and y are any numbers, with coefficients determined, for example, by Pascal's Triangle.		
	A.APR.2	Know and apply the Remainder Theorem: For polynomial $p(x)$ and a number a, the remainder of division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if if ($x - a$) is a factor of $p(x)$		
	A.APR.6	Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.		

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Essential Questions for this Unit:
6. How can students extend their understanding of the polynomial identities to include complex numbers?
7. How can students understand that a function is even if it is symmetric across the *y*-axis, and that it is odd if it is symmetric about the origin?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 3 (continued) **Polynomial Functions**	A.APR.3	Identify the zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomials.	Mathematical Modeling In 3 Acts: • Theorems About Roots of Polynomials complex conjugates irrational conjugates rational root theorem • Transformation of Polynomial Functions axis of symmetry parent function	Use mathematical modeling to represent a problem situation and to propose a solution. Test the appropriateness of their math models. Explain why the results from their mathematical models might not align exactly with the problem situation. **(2 days)** ❖ **MP. 4 Model with Mathematics** 3.6 Extend polynomial theorems and identities to find the real and complex solutions of a polynomial equation. Write polynomial functions using the conjugates. **(2 days)** ❖ **MP. 5 Use Appropriate Tools Strategically** ❖ **MP. 7 Look For and Make Use of Structure** 3.7 Graph polynomial functions and show the key features of the graph. Predict the end behavior of polynomial functions by interpreting the leading coefficients and degrees. Sketch the graphs showing the key features, given a verbal description. **(2 days**) ❖ **MP. 3 Construct a Viable Arguments** ❖ **MP. 7 Look For and Make Use of Structure** **Quarterly Assessment #1**
	F.IF.7c	Graph polynomial functions, identifying the zeros when suitable factorization is available, and showing end behavior.		
	A.SSE.2	Use the structure of an expression to identify ways to rewrite it.		
	A.APR.1	Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition , subtraction, and multiplication; add, subtract and multiply polynomials.		
	N.CN.9(+)	Know the fundamental Theorem of Algebra that is true for quadratic polynomials.		
	F.BF.3	Identify the effect on the graph of replacing f(x) by f(x) + k, k(f(x), 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.		

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Essential Questions for this Unit:
1. How can students understand that inverse variation represents a proportional relationship between two variables such that as one variable increases, the other variable decreases?
2. How can students see rational functions as useful for describing many real world situations?
3. How can students have opportunities to evaluate various rational expressions for many values of *x*, both by hand and using software?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 4 (Nov) **Rational Functions** **10 total days (+): add 1 day**	F.BF.3	Identify the effect on the graph of replacing f(x) by $f(x) + k$, $k(f(x))$, 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.	• Inverse Variation and the Reciprocal Function multiplication inverse Reciprocal, asymptote constant of variation, reciprocal function • Graphing Rational functions rational number rational expression rational function	4.1 Use inverse variation to write and graph the Reciprocal function. Identify the effect of transformation on the graph of the reciprocal function and define the effects of h and k on the function f(x) = 1/(x – h) + k. (**2 days)** ❖ **MP. 1 Make sense of Problems and Persevere in Solving Them**. 4.2 Graph rational functions by identifying asymptotes and end behavior. Rewrite simple rational expressions in different forms using long division. (**2 days)** ❖ **MP. 2 Reason Abstractly and Quantitatively** ❖ **MP. 7 Look For and Make Use of Structure**
	A.APR.7d	Graph rational functions, identifying zeros and asymptotes when suitable factorization is available, and showing end behavior.		
	A.APR.6	Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.		

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Essential Questions for this Unit:
4. How can students see that any two polynomials can be divided in much the same way as with numbers (provided the divisor is not zero)?
5. How can students use their previous knowledge of simplifying fractions to simplify rational expressions when multiplying and dividing?
6. How can students understand that while solving rational equations, they may find solutions that are not in the domain of the equation?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 4 **Rational Functions**	A.APR.6	Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.	• Multiplication and Dividing Rational Expressions greatest common factor rational number, rational expressions, simplified form of rational expressions. • Adding and Subtracting Rational Expression algebraic fraction numeric fraction compound fraction • Solving Rational Equations domain, rational expression, undefined	4.3. Use the structure of rational expressions to rewrite simple expressions in different forms. Understand that rational expressions form a System analogous to the system of rational number s and use that understanding to multiply and divide rational expressions. **(2 days)** ❖ **MP. 6. Attend to Precision** ❖ **MP. 7 Look For and Make Use of Structure** 4.4 Understand that rational expressions form a system analogous to the system of rational numbers and use that understanding to add and subtract rational expressions. **(2 days)** ❖ **MP. 5 Use Appropriate Tools Strategically** ❖ **MP. 7 Look For and Make Use of Structure** 4.5 Solve rational equations in one variable. Identify extraneous solutions to rational equations and give example of how they arise. **(2 days)** ❖ **MP. 1 Make sense of Problems and Persevere IN Solving Them**. ❖ **MP. 7 Look For and Make Use of Structure**
	A.SSE.2	Use the structure of an expression to identify ways to rewrite it.		
	A.APR.7	Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.		
	A.REI.2	Solve simple ~~rational and~~ radical equations in one variable, and give examples showing how extraneous solutions may arise.		
	A.CED.1	Create solutions and inequalities in one variable and use them to solve problems.		

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Essential Questions for this Unit:
1. How can students understand that the properties of integer exponents can be extended to rational exponents?
2. How can students use properties of exponents to rewrite expressions with rational exponents as radical expressions and radical expressions as expressions with rational exponents?
3. How can students understand how the values of radical functions transform the graph of the parent function?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 5 (Dec) **Rational Exponents And Radical Functions** **14 total days** **(+): add 1 day**	N.RN.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.	• Mathematical Modeling in 3 Acts • Nth Roots , Radicals and Rational Exponents complex conjugate exponent index, nth root radical symbol radicand • Properties of Exponents and and radicals radical expression rational exponent like radicals reduced radical form	Use mathematical modeling to represent a problem or situation and to propose a solution. Test and verify the appropriateness of their math models. **(1 day)** ❖ **MP. 4 Model with Mathematics** 5.1 Use properties of exponents to rewrite expressions involving radicals in terms of rational exponents. Find all real nth roots of a number. Evaluate expressions with rational exponents. Use nth roots to solve equations by rewriting expressions using the properties of exponents. **(2 days)** ❖ **MP. 1 Make sense of Problems and Persevere in Solving Them** ❖ **MP. 5 Use Appropriate Tools Strategically** 5.2 Use the properties of exponents and radicals to identify ways to rewrite radical expressions. Interpret radical expressions that represent a quantity in terms of its context. (**2 days)** ❖ **MP. 2 Reason Abstractly and Quantitatively** ❖ **MP. 7 Look For and Make Use of Structure** 5.3 Graph radical functions, including square root and cube root functions. Identify the effect of transformation on the key features of the graphs of radical functions. **(2 days)** ❖ **MP. 2 Reason Abstractly and Quantitatively** ❖ **MP. 7 Look For and Make Use of Structure**
	N.RN.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents		
	A.SSE.1	Interpret expressions that represent a quantity in terms of its context		
	A.SSE.2	Use the structure of an expression to identify ways to rewrite it.		
	F.IF.7b	Graph square root , cube root, and piece – defined functions, including step functions and absolute values functions.		
	F.BF.3	Identify the effect on the graph of replacing f(x) by $f(x) + k$, $kf(x)$, 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		

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Essential Questions for this Unit:
4. How can students apply the skills of rewriting radical expressions and expressions with rational exponents to solve radical equations?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 5 (continued) **Rational Exponents And Radical Functions**	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.	• Graphing Radical Equations function, radical radical function • Solving Radical Equations extraneous solutions radical equation rational exponents reciprocal power • Mathematical Modeling in 3 Acts : The Snack Shack	5.4 Solve radical equation in one variable. Explain how extraneous solutions may arise when solving radical equations. Solve radical inequalities and apply the solution within real world a context. **(2 days)** ❖ **MP. 3 Construct a Viable Arguments** ❖ **MP. 7 Look For and Make Use of Structure** Use mathematical modeling to represent a problem situation and propose a solution. Test and verify the appropriateness of their math models. Explain why the results from their mathematical models might not align exactly with the problem situation. (**1 day)** ❖ **MP. 4 Model with Mathematics**
	F.IF.7b	Graph square root and cube root, and piecewise – defined functions, including step functions and absolute value functions.		
	F.BF.3	Identify the effect on the graph of replacing *f(x)* by *f(x) + k, kf(x), f(kx),* and *f(x + k)* for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.		
	A. REI.2	Solve simple rational and radical equations In one variable, and give examples showing how extraneous solutions may arise.		
	A.CED.1	Create equations and inequalities in one variable and use them to solve problems.		

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Mathematics Focus for the Course:
For the high school Model Algebra II course, instructional time should focus on four critical areas: (1) relate arithmetic of rational expressions to arithmetic of rational numbers; (2) expand understandings of functions and graphing to include trigonometric functions; (3) synthesize and generalize functions and extend understanding of exponential functions to logarithmic functions; and (4) relate data display and summary statistics to probability and explore a variety of data collection methods.

Essential Questions for this Unit:
5. How can students understand that an inverse relation is a relation in which the independent variable and the dependent variable are reversed?
6. How can students know that the graph of an inverse function is a reflection of the graph of the function across the line $y = x$?
7. How can students understand that knowing the inverse function is useful when determining the input value that maps to the known output?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 5 (continued)	A.CED.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving problems	• Functions Operations domain, substitution, composite function composition of functions • Inverse relations and Functions dependent variable independent variable inverse operations inverse variation • Key Features of Exponential Functions decay factor, exponential decay function, exponential function, exponential growth function, growth factor	5.5 Combine functions by addition, subtraction, multiplication, or by division and identify the domain of the result. Compose functions, specifying the order in which the functions are applied and describing the domain of the composite function. **(2 days)** ❖ **MP. 6. Attend to Precision** ❖ **MP. 7 Look For and Make Use of Structure** 5.6 Use tables, graphs, and equations to represent the inverse of a relation. Write an equation for the inverse of a function by restricting the domain. Verify that one function is the inverse of another, composition. (**2 days)** ❖ **MP. 2 Reason Abstractly and Quantitatively** ❖ **MP. 7 Look For and Make Use of Structure**
	F.BF.1b	Combine standard function types using arithmetic operations		
	F.BF.1c	Composite functions		
	F.BF.4a	Solve an equation of the form f(x) = c for a simple function f that has an inverse and write the expression for the inverse.		
	F.BF.4b (+)	Verify by composition that one function is the inverse of another.		
	F.IF.8b	Use the properties of exponents to interpret expressions for exponential functions.		
	S.ID.6a	Fit a function to the data; use functions fitted to data to solve problems in the content of the data.		

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Grade Level/Course Title: Algebra II	**Quarter 2**	**Academic Year: 2018-2019**

Mathematics Focus for the Course:
For the high school Model Algebra II course, instructional time should focus on four critical areas: (1) relate arithmetic of rational expressions to arithmetic of rational numbers; (2) expand understandings of functions and graphing to include trigonometric functions; (3) synthesize and generalize functions and extend understanding of exponential functions to logarithmic functions; and (4) relate data display and summary statistics to probability and explore a variety of data collection methods.

Essential Questions for this Unit:
1. How can students understand that for exponential functions of the form $f(x) = a \cdot bx$, the domain is the set of all real numbers?
2. How can students explore the properties of logarithms and connect them to those of exponents?
3. How can students solve problems involving exponential functions and logarithms and express their answers using logarithm notation?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 6 **Exponential and Logarithmic Functions** **15 total days** **(+): add 1 day**	F.IF.7	Graph exponential and logarithmic functions, showing intercepts and behavior, and trigonometric functions, showing period, midline and amplitude.	• Exponential models compound interest exponential function compound interest formula Mathematical Modeling in 3 Acts : The Crazy Conditioning • Logarithm exponential function inverse function common logarithm logarithm logarithmic function natural logarithmic function	6.1 Interpret key features of exponential functions represented by graphs, tables and equations. Graph transformations of exponential functions showing intercepts and behavior. Model quantities that increase or decrease by a fixed percent each time period using exponential functions. **(2 days)** ❖ **MP. 4 Model with Mathematics** ❖ **MP. 7 Look For and Make Use of Structure** 6.2 Rewrite exponential functions to identify rates. Interpret the parameters of an exponential function within the context of compound interest problems. Construct exponential models given two points or by using regression. (**2 days)** ❖ **MP. 1 Make sense of Problems and Persevere in Solving Them** ❖ **MP. 4 Model with Mathematics** Use mathematical modeling to represent a problem situation and to propose a solution. Test and verify the appropriateness of their math models. Explain why the results from their mathematical models might not align exactly with the problem situation. **(1 day)** ❖ **MP. 4 Model with Mathematics**
	F.LE.5	Interpret the parameters in a linear or exponential function in terms of a context.		
	S.ID.6a	Fit a function to the data; use functions fitted to data to solve problems in the context of the data.		
	F.IF.8b	Use the properties of exponents to interpret expressions for exponential functions.		
	F.BF.4a	Solve an equation these of the form $f(x) = c$ for a simple function, that has an inverse and write an expression for the inverse.		
	F.BF.5	Understand the inverse relationship between exponents and logarithm and use this relationship to solve problems involving logarithms and exponents.		

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Grade Level/Course Title: Algebra II	**Quarter 2**	**Academic Year: 2018-2019**

Mathematics Focus for the Course:
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Essential Questions for this Unit:

4. How can students understand that logarithms are the inverse of exponentiation and that by applying this relationship, they can graph logarithmic functions and solve exponential and logarithmic equations?
5. How can students understand that geometric sequences are exponential functions with a domain limited to the set of natural numbers?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 6 (Jan – beg. Feb) **Exponential and Logarithmic Functions**	F.LE.4	For exponential models, express as a logarithm the solution to ab= d where a, C, and d are numbers and the base b is 2, 10 or e; evaluate logarithm using technology.	• Logarithmic Functions asymptote, end behavior reflection • Properties of Logarithm Logarithm, power, product quotient • Exponential and Logarithmic Equations exponential Equations logarithmic equations • Geometric Sequences and Series arithmetic sequence arithmetic series common ratio geometric sequence geometric series	6.3 Understand the inverse relationship between exponents and logarithms. Use logarithm to solve exponential models. Evaluate logarithms using technology. **(2 days**) ❖ **MP. 2 Reason Abstractly and Quantitatively** ❖ **MP. 7 Look For and Make Use of Structure** 6.4 Graph logarithmic functions and interpret their key features. Write and interpret the inverses of exponential and logarithmic functions. ❖ **MP. 4 Model with Mathematics (2 days)** ❖ **MP. 7 Look For and Make Use of Structure** 6.5 Use the properties of logarithm to rewrite logarithm expression. Use the Change of Base Formula to evaluate logarithmic expressions and solve equations. **(2 days)** ❖ **MP. 2 Reason Abstractly and Quantitatively** ❖ **MP. 7 Look For and Make Use of Structure** 6.6 Use logarithms to express the solutions to exponential models. Solve exponential and logarithmic equations. (**2 days)** ❖ **MP. 2 Reason Abstractly and Quantitatively** ❖ **MP. 7 Look For and Make Use of Structure** 6.7 Construct a geometric sequence given a graph, table, or description of a relationship. Translate between geometric sequences written in recursive and explicit forms. Use the formula for the sum of a finite geometric series to solve problems. **(2 days)** ❖ **MP. 2 Reason Abstractly and Quantitatively** **Quarterly Assessment #2**
	F.BF.3	Identify the effect on the graph of replacing f(x) by $f(x) + k$, $k(f(x))$, 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.		
	A.SSE.2	Use the structure of an expression to identify ways to rewrite it.		
	F.LE.2	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table.		

Grade Level/Course Title: Algebra II/Trig	**Quarter 3**	**Academic Year: 2018-2019**

Mathematics Focus for the Course:
For the high school Model Algebra II course, instructional time should focus on four critical areas: (1) relate arithmetic of rational expressions to arithmetic of rational numbers; (2) expand understandings of functions and graphing to include trigonometric functions; (3) synthesize and generalize functions and extend understanding of exponential functions to logarithmic functions; and (4) relate data display and summary statistics to probability and explore a variety of data collection methods.

Essential Questions for this Unit:
1. How can students understand tha the ratios of the sides of a right triangle for a given angle are defined by the six trigonometric functions?
2. How can students understand that trigonometric functions are periodic functions with outputs that repeat after a constant interval of inputs?
3. How can students understand that a unit circle can be used to extend the trigonometric functions to all real numbers?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 7: (January) **Trigonometric Functions** **13total days** **(+): add 1 day**	G.SRT.6	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles★	• Trigonometric Functions and Acute Angles • Proper Syntax Syntax (GMR) • Academic Vocabulary • Angles and the Unit Crcle • Coterminal angles, Initial side, Radian, Radian measure, Reference angles/triangles, standard position, terminal side, Unit circle.	7.1 Use special triangles to determine ratios geometrically. Use trigonometric functions and Pythagorean Theorem to find missing side lengths. Identify and explain trigonometric identities. **(2 days)** ❖ **MP 7: Look for and make use of structure** Students apply their previous understanding of the relationship among angle measures in a right triangle to determine that any right triangles with an angle measure of Θ having one trigonometric ratio in common have six trigonometric ratios in common. ❖ **MP 8: Look for and Express Regularity in Repeated Reasoning** Students look for patterns when they make the generalization that for an isosceles right triangle, the reciprocal trigonometric functions are always equal to their respective functions. 7.2 Find the measures of an angle in standard position and its reference angle.
	G.SRT.7	Explain and use the relationship between the sine and cosine of complementary angles.★		
	G.SRT.8	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.★		
	F.TF.1	Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.		

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Grade Level/Course Title: Algebra II/Trig	**Quarter 3**	**Academic Year: 2018-2019**

Mathematics Focus for the Course:
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Essential Questions for this Unit:
1. How can students understand tha the ratios of the sides of a right triangle for a given angle are defined by the six trigonometric functions?
2. How can students understand that trigonometric functions are periodic functions with outputs that repeat after a constant interval of inputs?
3. How can students understand that a unit circle can be used to extend the trigonometric functions to all real numbers?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 7 (Jan – beg. Feb) **Trigonometric Functions**	F.TF.2	Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.	• Trigonometric Functions and Real Numbers • Academic Vocabulary • Graphing Sine and Cosine Functions • Key features of the graphs of Sine and Cosine functions • Mathematical Modeling in 3 Acts: What Note was This?	Use radian measure on the unit circle to find arc length. Convert between degrees and radians.**(2 days)** ❖ **MP 2:** Reason Abstractly and Quantitatively ❖ **MP 5:** Use appropriate tools strategically 7.3 Use reference angles and triangles to evaluate trigonometric functions and their reciprocal functions. Use the Pythagorean Identity to find the sine, cosine, and quadrant of an angle. **(2 days)** ❖ **MP 2: Reason Abstractly and Quantitatively** Student can complete the Explore and reasoning activity on page 117 of their textbook. ❖ **MP 4: Model with Mathematics** 7.4 Graph and identify the key features of sine and cosine functions. Find and interpret the average rate of change of a periodic function over a specified interval. Compare key features of different periodic functions.**(3 days)** ❖ **MP 4: Model with Mathematics** ❖ **MP 7: Look for and Make use of Structure** • Use mathematical modeling to represent a problem situation and to propose a solution. • Test and verify the appropriateness of their math models. • Explain why the result from the mathematical models might not align exactly with the problem situation.
	F.TF.3	(+) Use special triangle to determine geometrically the values of sine, cosine, tangent for $\frac{\pi}{3}, \frac{\pi}{4}$ and $\frac{\pi}{5}$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi \pm x$ and $2\pi - x$ In terms of their values for x, where x is any real number.		
	F.TF.8	Prove the Pythagorean identity sin2 (Θ) + cos2 (Θ) = 1 and use it to find sin (Θ), cos (Θ), or tan (Θ) given sin (Θ), cos(Θ), or tan (Θ) and the quadrant of the angle.		
	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. ★		
	F.IF.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).		

Grade Level/Course Title: Algebra II	**Quarter 3**	**Academic Year: 2018-2019**

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Essential Questions for this Unit:

1. How can students understand tha the ratios of the sides of a right triangle for a given angle are defined by the six trigonometric functions?
2. How can students understand that trigonometric functions are periodic functions with outputs that repeat after a constant interval of inputs?
3. How can students understand that a unit circle can be used to extend the trigonometric functions to all real numbers?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 7 (Jan – beg. Feb) **Trigonometric Functions**	F.BF.3	Identify the effect on the graph of replacing f (x) by f (x) + k, kf (x), f (kx), and f (x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.	• Graphing Other Trigonometric Functions • Academic Vocabulary + Review reciprocal functions and asymptotes. • Phase Shift	7.5 Describe and compare key features of the graphs of trigonometric functions. Graph functions of the form *f(x)= a tan bx* and relate the graph of a function to the graph of the parent function. **(2 days)** ❖ **MP 6: Attend to Precision** ❖ **MP 7: Look for and Make use of Structure.** 7.6 Identify how charging the parameters of the sine or cosine function affects the graph of the function. Use trigonometric functions to model situations with specific amplitude, frequency and midline. **(2 days)** ❖ **MP 7: Look for and make use of structure** ❖ **MP 8: Look for and express regularity in repeated reasoning.**
	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. Key features include: intercepts.★		
	F.TF.5	Choose trigonometric functions to model periodic phenomena with special amplitude, frequency, and midline. ★		
	F.TF.4	(+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.		

Grade Level/Course Title: Algebra II	**Quarter 3**	**Academic Year: 2018-2019**

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Essential Questions for this Unit:
1. How can students understand that inverse trigonometric functions can be used to find all of the solutions of a trigonometric equation?
2. How can students understand that trigonometric identities can be used to simplify trigonometric expressions because they are true for all values of the variable for which both sides of the equation are defined?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 8 (February) **Trigonometric Equations and Identities** **11 total days** **(+): add 1 day**	F.TF.6	(+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.	• Solving Trigonometric Equations Using Inverses • Key features of functions and inverse functions • Mathematical Modeling in 3 Acts: Ramp Up Your Design • Law of Sines and Law of Cosines • Review Pythagorean Theorem using right triangles. • Trigonometric Identities • Review unit circle, terminal side, centered on the origin of the coordinate plane	8.1 Define and evaluate inverse trigonometric functions. Solve trigonometric equations using inverse functions, and interpret the solutions within a modeling context. **(2 days)** ❖ **MP 5: Use appropriate tools strategically.** ❖ **MP 7: Look for and make use of structure.** • Use mathematical modeling to represent a problem situation and propose a solution. • Test and verify the appropriateness of their math models. • Explain why the results from their mathematical models might not align exactly with the problem situation. **(1 day)** ❖ **MP 4: Model with Mathematics** 8.2 Derive the Law of Sines and the Law of Cosines. Use the Law of Cosines and the Law of Sines to find unknown angles and sides of non-right triangles. **(2 days)** ❖ **MP 2: Reason Abstractly and Quantitatively.** ❖ **MP 7: Look for and make use of structure** 8.3 Verify trigonometric identities using the unit circle. Use trigonometric identities to rewrite expressions. Prove sum and difference formulas for sine, cosine and tangent, and use them to solve real-world problems.**(2 days)** ❖ **MP 2: Reason Abstractly and Quantitatively.** ❖ **MP 3: Construct Viable Arguments** Students construct an algebraic argument to prove the quotient identity $\cot\theta = \frac{\cos\theta}{sin\theta}$.
	F.TF.7	(+)Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.		
	G.SRT.10	(+)Prove the Laws of Sines and Cosines and use them to solve problems.		
	G.SRT.11	(+)Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).		
	F.TF.4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.		
	F.TF.9	Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.		

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Essential Questions for this Unit:

3. How can students develop an understanding that the complex plane has two axes, as does the coordinate plane?
4. How can students understand that the horizontal axis represents the real part of the complex number and the vertical axis represents the imaginary part of the complex number?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 8 (February) **Trigonometric Equations and Identities**	N.CN.5	(+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation.	• The Complex Plane • Applications of complex plane, imaginary axis and modulus of a complex number, real number • Polar Form of Complex Numbers • Argument, polar form of a complex numbers	8.4 Represent complex numbers and their relationships on the complex plane. Find the midpoint of a segment on the complex plane. Calculate the distance between numbers in the complex plane using the modulus of the difference. Use the complex plane to represent addition and subtraction of complex numbers geometrically. **(2 days)** ❖ MP 4: Model with Mathematics ❖ MP 7: Look for and make use of structure 8.5 Represent a complex number in polar form and convert between rectangular and polar forms. Verify and use the sum and difference formulas. Use polar form to calculate products and powers. **(2 days)** ❖ MP 5: Use appropriate tools strategically. ❖ MP 7: Look for and make use of structure.
	N.CN.6	(+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.		
	N.CN.4	(+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.		

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Essential Questions for this Unit:

1. How can students understand that each conic section has a geometric definition that describes a property of every point on the curve, and that these definitions are used to derive the equation of a parabola, a circle, an ellipse, or hyperbola?
2. How can students discover that the coefficients A and C in the standard form of a second-degree equation $Ax^2 + Cy^2 + Dx + Ey + F = 0$ determine the type of conic section that the equation represents?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 9 (February) **Conic Section** **9 total days** **(+): add 1 day**	G.GPE.2	Derive the equation of a parabola given a focus and directrix.	• Parabolas • Key Features of the graph of a parabola. • Circles Key features of a circle	9.1 Derive the equation of a parabola. Relate the parabola's focal length to its equation. Rewrite an expression by completing the square and then use it to find the focus and directrix of a parabola. **(2 days)** ❖ **MP 7: Look for and make use of structure** ❖ **MP 8: Look for and express regularity in repeated reasoning.** Students notice the relationships between the way a plane intersects a double right cone and the type, size, and shape of the conic section that is created. 9.2 Use the center, the radius and the Pythagorean Theorem to derive the equation of a circle. Write and graph the equation of a circle and use it to model a real-world situation. Find the center and the radius of a circle by completing the square. Solve a linear-quadratic system algebraically and verify by graphing. **(2 days)** ❖ **MP 4: Model with Mathematics** ❖ **MP 7: Look for and make use of structure**
	A.SSE.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. ★		
	A.SSE.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 $(x^2 - y^2)(x^2 + y^2)$.*		

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Essential Questions for this Unit:

1. How can students understand that each conic section has a geometric definition that describes a property of every point on the curve, and that these definitions are used to derive the equation of a parabola, a circle, an ellipse, or hyperbola?
2. How can students discover that the coefficients A and C in the standard form of a second-degree equation $Ax^2 + Cy^2 + Dx + Ey + F = 0$ determine the type of conic section that the equation represents?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 9 **(Feb - March)** **Conic Section**	G.GPE.1	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.	• Mathematical Modeling in 3 Acts: Watering the Lawn • Develop a representative model • Graph, apply the equations of other conic sections in the shapes of ellipses and hyperbolas • Ellipses Key features of an Ellipse	• Use mathematical modeling to represent a problem situation and to propose a solution. • Test and verify the appropriateness of their math models. • Explain why the results from their mathematical models might not align exactly with the problem situation. **(1 day)** 9.3 Derive the equation of an ellipse. Write and graph the equation of an ellipse and use an ellipse to model a real-world situation. Graph a transformed ellipse by completing the square to rewrite the equation in an equivalent form. **(2 days)** ❖ **MP 4: Model with mathematics.** ❖ **MP 8: Look for and express regularity in repeated reasoning**. 9.4 Use the foci and the Distance Formula to derive an equation of a hyperbola. Write and graph the equation of a hyperbola and use it to model a real-world situation. Determine which conic section is represented by a second-degree equation. **(2 days)** ❖ **MP 1: Make sense of problems and persevere in solving them** **Quarterly Assessment #3**
	A.REI.7	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.		
	G.GPE.3	(+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.		
	G.GPE.2	Derive the equation of a parabola given a focus and directrix.		
	A.SSE.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. ★		

Grade Level/Course Title: Algebra II/Trig	**Quarter 4**	**Academic Year: 2018-2019**

Mathematics Focus for the Course:
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Essential Questions for this Unit:
1. How can students use the languages of set theory to expand their ability to compute and interpret theoretical and experimental probabilities for compound events, attending to mutually exclusive events, independent events, and conditional probability?
2. How can students use probability to make informed decisions?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 12: (March) **Probability** **12 total days** **(+): add 1 day**	S.CP.2	Understand that two events, *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent.★	• Probability Events • Academic Vocabulary • Conditional Probability • Dependent events	12.1 Explain independence of events in every language and everyday situations. Determine the probability of the union of two events (A or B) and the intersection of two independent events (A and B). ❖ **MP 2: Reasoning abstractly and quantitatively. (2 days)** ❖ **MP 3: Construct viable arguments and critique reasoning.** 12.2 Understand the conditional probability of A given B as the fraction of outcomes in B that also belong to A. Interpret independence of events in terms of conditional probability. Use any two-way frequency table to decide if events are independent and to approximate conditional probabilities. **(2 days)** ❖ **MP 1: Make sense of problems and persevere in solving problems.** ❖ **MP 7: Look for and make use of structure** 12.3 Calculate the number of permutations and combinations in mathematical and real-world contexts. Use permutations and combinations to compute probabilities of compound events and solve problems. **(2 days)** ❖ **MP 3: Construct viable arguments and critique reasoning** ❖ **MP 7: Look for and make use of structure.**
	S.CP.3	Understand the conditional probability of *A* given *B* as *P*(*A* and *B*)/*P*(*B*), and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A*, and the conditional probability of *B* given *A* is the same as the probability of *B*.		
	S.CP.9	(+) Use permutations and combinations to compute probabilities of compound events and solve problems.		

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Grade Level/Course Title: Algebra II/Trig	**Quarter 4**	**Academic Year: 2018-2019**

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Essential Questions for this Unit:
1. How can students use the languages of set theory to expand their ability to compute and interpret theoretical and experimental probabilities for compound events, attending to mutually exclusive events, independent events, and conditional probability?
2. How can students use probability to make informed decisions?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 12 (April) **Probability**	S.MD.1	(+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.	• Permutations and Combinations • Key features of permutations and combinations • Probability Distributions • Relative frequency • Graphing and calculating • Expected Value • Binomial Probability, Mean, Binomial distributions • Probability and Decision Making	12.4 Develop a probability distribution based on theoretical probabilities or empirical data. Graph probability distributions. Calculate probability in binomial experiments. **(2 days)** ❖ **MP 2: Reason abstractly and quantitatively** ❖ **MP 4: Model with Mathematics** ❖ **MP 6: Attend to precision.** 12.5 Calculate the expected value in situations involving chance Weigh the possible outcomes of a decision by comparing expected values and finding expected payoffs. **(2 days)** ❖ **MP 2: Reason abstractly and quantitatively.** ❖ **MP 3: Construct viable arguments and critique reasoning** ❖ **MP 4: Model with mathematics.** 12.6 Analyze decisions and evaluate fairness using probability concepts. **(2 days)** ❖ **MP 1: Make sense of problems and persevere in solving them.** ❖ **MP 2: Reason abstractly and quantitatively.**
	S.MD.3	(+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value.		
	S.MD.5	(+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. a. Find the expected payoff for a game of chance. b. Evaluate and compare strategies on the basis of expected values.		
	S.CP.9	(+) Use permutations and combinations to compute probabilities of compound events and solve problems.		
	S.MD.6	(+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).		
	S.MD.7	(+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).		

Algebra II Mathematics Curriculum Guide

Grade Level/Course Title: Algebra II/Trig	**Quarter 4**	**Academic Year: 2018-2019**

Mathematics Focus for the Course:
For the high school Model Algebra II course, instructional time should focus on four critical areas: (1) relate arithmetic of rational expressions to arithmetic of rational numbers; (2) expand understandings of functions and graphing to include trigonometric functions; (3) synthesize and generalize functions and extend understanding of exponential functions to logarithmic functions; and (4) relate data display and summary statistics to probability and explore a variety of data collection methods.

Essential Questions for this Unit:
1. How can students understand that a statistical question can be answered by collecting many pieces of information or data?
2. How can students recognize and understand that random sampling methods result in data that better represents the population?
3. How can students understand that the distribution of a data set affects which statistical measures are used to describe it?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 11 (April) **Data Analysis and Statistics** **15 total days (+): add 1 day**	N.Q.2	Define appropriate quantities for the purpose of descriptive modeling.	• Statistics Questions and Variables • Categorical variable, parameter, population, quantitative variable, sample, statistical variable • Statistical Studies and Sampling Methods • New Vocabularies such as: bias, control group, experimental group, observational study, sample survey, simple random sample • Data Distributions • Normal distribution, skewed distribution, standard deviation, symmetrical distribution	11.1 Define and recognize a statistical question. Define and identify the type of statistical variable that is represented by a question or the data represented on a graph. Distinguish between quantities such as population/sample and parameter/statistic for the purpose of descriptive modeling. **(2 days)** ❖ **MP 6: Attend to precision.** ❖ **MP 8: Look for and express regularity in repeated reasoning.** 11.2 Identify experiments, sample surveys, and observational studies. Recognize bias in sampling methods. Identify a sampling method that provides a random sample from a population. **(2 days)** ❖ **MP 1: Make sense of problems and persevere in solving them.** ❖ **MP 3: Construct viable arguments.** 11.3: Find measures of center and spread, such as median, mean, interquartile range, and standard deviation. Compare data sets using statistical measures that are appropriate for the distribution of the data. **(2 days)** ❖ **MP 4: Reason abstractly and quantitatively.** ❖ **MP 6: Attend to precision.**
	S.IC.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.		
	S.IC.3	Recognize the purposes of and differences among sample surveys, experiments and observational studies; explain how randomization relates to each.		
	S.IC.6	Evaluate reports based on data.		
	S.ID.1	Represent data with plots on the real number line (dot plots, histograms, and box plots)		
	S.ID.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.		
	S.ID.4	Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets and tables to estimate areas under the normal curve.		

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Essential Questions for this Unit:
4. How can students recognize that normal distributions can be used to analyze data values that cannot be compared directly by comparing their relative position within each distribution?
5. How can students recognize that only one hypothesis can be true and that statistical measures can be used to determine which hypothesis is true?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 11 (May) **Data Analysis and Statistics**	S.IC.6	Evaluate reports based on data.	• Normal Distributions • Percentile, standard normal distribution, z-score • Key features of a normal distributions • Margin of Errors • Sampling distribution • Introduction to Hypothesis Testing • Key features to hypothesis testing • Mathematical Modeling in 3 Acts: Mark and Recapture	11.4 Fit a normal distribution to data. Compare and evaluate data values using z-scores. Use technology to calculate the area under the standard normal distribution curve. **(2 days)** ❖ **MP 5: Use appropriate tools strategically.** ❖ **MP 7: Look for and make use of structures** 11.5 Evaluate reports by estimating population parameters. Use multiple samples to make an inference about a population. Calculate the margin of error from quantitative or categorical data. ❖ **MP 5: Use appropriate tools strategically. (2 days)** ❖ **MP 8: Look for and express regularity in repeated reasoning.** 11.6 Formulate two hypotheses for a statistical question and test using statistic to draw a conclusion. Use graphs and simulation to determine whether differences between parameters are significant. Use data from a randomized experiment to evaluate a report. **(2 days)** ❖ **MP 5: Use appropriate tools strategically.** ❖ **MP 6: Attend to precision.** • Use mathematical modeling to represent a problem situation and to propose a solution. • Test and verify the appropriateness of their mathematical models • Explain why the results from their mathematical models night not align exactly with the problem situation. **(1 day)**
	S.ID.4	Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.		
	S.IC.4	Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.		
	S.IC.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.		
	S.IC.2	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.		
	S.IC.5	Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.		

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Essential Questions for this Unit:
1. How can students realize that the Commutative Property of Addition holds for matrix addition, but the Commutative Property of Multiplication does not hold for matrix multiplication?
2. How can students understand that a vector written in component form (x, y) indicates a horizontal change of x and a vertical change of y?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 10 (May) **(Optional) Matrices** **11 total days** **(+): add 1 day**	N.VM.6	(+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.	• Operations of Matrices • Key features of matrices • Simplifying matrices • Matrix Multiplication • Identity matrix, square matrix • Solving radical equations • Linear functions vs. radical functions	10.1 Use a matrix to represent data. Apply scalar multiplication to produce a new matrix. Add and subtract matrices by adding and subtracting the corresponding elements. Translate and dilate figures using matrices. **(2 days)** ❖ **MP 4: Model with mathematics** ❖ **MP 6: Attend to precision.** 10.2 Multiply two matrices when the number of columns in the first matrix is equal to the number of rows in the second matrix. Understand the identity matrix and recognize that it is similar to the role of 1 in multiplication of real numbers. **(2 days)** ❖ **MP 3: Construct viable arguments** ❖ **MP 7: Look for and make use of structure** 10.3 Use vectors to represent quantities with both magnitude and direction. Add and subtract vectors graphically, algebraically and by the Parallelogram Rule. Apply scalar multiplication to produce a new vector. Transform a vector using matrix multiplication. **(2 days)** ❖ **MP 2: Reason abstractly and quantitatively** ❖ **MP 7: Look for and make use of structure**
	N.VM.7	(+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.		
	N.VM.8	(+) Add, subtract, and multiply matrices of appropriate dimensions.		
	N.VM.9	(+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.		
	N.VM.10	(+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.		
	N.VM.1	(+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., $\boldsymbol{v}$, $\lvert\boldsymbol{v}\rvert$, $\lVert\boldsymbol{v}\rVert$, v).		

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Essential Questions for this Unit:
3. How can students understand that they can use inverse matrices to solve systems of linear equations?

Unit (Time)	Standard	Standard Description	Content	Objectives and Resources
Chapter 10 (Jun) **(Optional) Matrices**	N.VM.4	Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.	• Inverses and Determinants • Applications of determinant of 2 x 2 matrix, inverse matrix • Key features determinants • Inverse Matrices and System of Equations • Finding the inverse of a matrix • Solving systems of linear equations • Linear functions vs. Matrices • Mathematical Modeling in 3 Acts: The Big Burger	10.4 Determine if a matrix has an inverse, and if it does, find it. Use the absolute value of the determinant of a matrix to find the areas of triangles and parallelograms. **(2 days)** ❖ **MP 5: Use appropriate tools strategically** ❖ **MP 7: Look for and make use of structure** 10.5 Represent a system of equations, in two or three variables, as a single matrix equation. Find the inverse of a matrix and use it to solve a system of linear equations. **(2 days)** ❖ **MP 6: Attend to precision** ❖ **MP 7: Look for and make use of structure** • Use mathematical modeling to represent a problem situation and to propose a solution. • Test and verify the appropriateness of their math models • Explain in why the results from their mathematical models might not align exactly with the problem situation. **(1 day)** **Quarterly Assessment #4**
	N.VM.5	Multiply a vector by a scalar.		
	A.REI.9	(+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).		
	N.VM.12	(+) Work with 2 × 2 matrices as a transformations of the plane, and interpret the absolute value of the determinant in terms of area.		
	A.REI.8	(+)Find the inverse of matrix, if it exists, and use it to solve a systems of linear equations (using technology for matrices of dimension 3 x 3 or greater)		
	A.CED.3	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.		

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