Algebra 2 College Prep Curriculum Maps

Grade: 10/11/12 Subject: Algebra 2/CP Algebra 2	**Unit 1: Polynomial, Rational, and Radical Relationships**
Big Idea/Rationale	This unit develops the structural similarities between the system of polynomials and the system of integers. Students draw on analogies between polynomial arithmetic and base-ten computation, focusing on properties of operations, particularly the distributive property. Students connect multiplication of polynomials with multiplication of multi-digit integers, and division of polynomials with long division of integers. Students identify zeros of polynomials, including complex zeros of quadratic polynomials, and make connections between zeros of polynomials and solutions of polynomial equations. The unit culminates with the fundamental theorem of algebra. Rational numbers extend the arithmetic of integers by allowing division by all numbers except 0. Similarly, rational expressions extend the arithmetic of polynomials by allowing division by all polynomials except the zero polynomial. A central theme of this unit is that the arithmetic of rational expressions is governed by the same rules as the arithmetic of rational numbers.
Enduring Understanding (Mastery Objective)	• There are several strategies to solve quadratic equations. • Simplifying expressions and solving equations allows us to take a complex situation and make it simple. • Many real-world phenomena are best modeled by a quadratic function. • Knowing the terminology and classifications for polynomials will enable you to accurately discuss mathematical ideas and problems. • The characteristics of polynomial functions and their representations are useful in solving real-world problems. • Performing basic operations (addition, subtraction, multiplication, and division) with polynomials provides for simplification of expressions making it easier to evaluate. • The roots of a polynomial function can be found using factoring and/or graphing. • Some real-world data is best modeled by higher-ordered polynomial functions. • Many real-world situations, from geometry and chemistry to engineering and agriculture, can be modeled by variation functions. • Performing operations with rational expressions is a fundamental skill for solving rational equations and inequalities. • Operations with rational expressions follow the same rules as operations with fractions. • Radical equations and inequalities are found in many scientific formulas.

Essential Questions **(Instructional Objective)**	• How do you know if a function is quadratic? • How do you graph a quadratic equation given in standard form? Vertex form? Intercept form? • How do you identify transformations from the parent graph when a parabola is given in standard form? Vertex form? • What factors do you consider when trying to decide which method to use when solving quadratics? • When is it more efficient to use standard form over vertex form (and vice versa) when graphing a parabola? • When do we use quadratic functions to solve everyday problems? • What are the important features of the graph of a polynomial function? • How can Pascal's Triangle be used to efficiently expand a binomial? • What are the differences/similarities between long division and synthetic division of polynomials? • How can synthetic substitution be used to tell whether a given binomial is a factor of a polynomial? • How can you determine the multiplicity of real roots of a polynomial from its graph? • How does determining the end behavior help you sketch the graph of a polynomial function? • How do we decide which method is most appropriate when solving rational equations? • When are asymptotes used to graph rational functions? • What is the relationship between the vertical asymptote and the domain of a rational function? Between the horizontal asymptote and the range of a rational function? • How does the domain help you determine whether the solution to a radical or rational equation is extraneous?
Content **(Subject Matter)**	• Perform arithmetic operations with complex numbers. • Use complex numbers in polynomial identities and equations. • Interpret the structure of expressions. • Write expressions in equivalent forms to solve problems. • Perform arithmetic operations on polynomials. • Understand the relationship between zeros and factors of polynomials. • Use polynomial identities to solve problems. • Rewrite rational expressions. • Understand solving equations as a process of reasoning and explain the reasoning. • Represent and solve equations and inequalities graphically. • Analyze functions using different representations.
Skills/ Benchmarks	N.CN.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. N.CN.2. Use the relation $i^2 = -1$ and the commutative, associative, and

(CCSS Standards)	distributive properties to add, subtract, and multiply complex numbers. N.CN.7. Solve quadratic equations with real coefficients that have complex solutions. A.SSE.1. Interpret expressions that represent a quantity in terms of its context.★ a. Interpret parts of an expression, such as terms, factors, and coefficients. 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*. 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* $(x^2 - y^2)(x^2 + y^2)$. A.SSE.4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*★ 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. A.APR.2. Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only *if* $(x - a)$ is a factor of p(x). A.APR.3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial. A.APR.4. Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples. 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. A.REI.2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. A.REI.11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.★ F.IF.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

Materials and Resources	Holt Algebra 2 Textbook and Resource Materials McDougal Littell Algebra 2 Concepts and Skills Textbook and Resource Materials Kuta Software Website Graph paper Document camera/projector Graphing Calculator
Notes	

Grade: 10/11/12 Subject: CP Algebra 2	Unit 2: Modeling With Functions
Big Idea/Rationale	In this unit students synthesize and generalize what they have learned about a variety of function families. They extend their work with exponential functions to include solving exponential equations with logarithms. They explore the effects of transformations on graphs of diverse functions, including functions arising in an application, in order to abstract the general principle that transformations on a graph always have the same effect regardless of the type of the underlying function. They identify appropriate types of functions to model a situation, they adjust parameters to improve the model, and they compare models by analyzing appropriateness of fit and making judgments about the domain over which a model is a good fit. *The description of modeling as "the process of choosing and using mathematics and statistics to analyze empirical situations, to understand them better, and to make decisions" is at the heart of this unit. The narrative discussion and diagram of the modeling cycle should be considered when knowledge of functions, statistics, and geometry is applied in a modeling context.*
Enduring Understanding (Mastery Objective)	• Logarithmic functions are inverses of exponential functions. Understanding the properties of exponential functions and how inverses behave explains the properties and graphs of logarithms. • Many real-world situations, such as credit card debt and bacteria growth, can be modeled by exponential functions. • Logarithms are used to compare quantities on a very large or very small scale because they represent an exponent. • Exponential and logarithmic equations and inequalities are used to represent many real-world situations. • Natural exponential and logarithmic functions are used to describe many natural growth and decay patterns. • Real-world data can be model using different functions. • Sometimes one representation of a function is more useful than another. • A real-world function may be a combination of other functions. • A mathematical model of a data set can be used to make predictions.
Essential Questions **(Instructional Objective)**	• How do the properties of exponents relate to the properties of logarithms? • How can the properties of logarithms be used to manipulate and solve equations with unknown exponents? • How can you differentiate between exponential growth and decay? • How do you determine the differences and similarities between the families of functions? • How can you use my mathematical tools to create models for real-world situations and then solve them efficiently for a given set of conditions?

Content **(Subject Matter)**	• Create equations that describe numbers or relationships. • Interpret functions that arise in applications in terms of a context. • Analyze functions using different representations. • Build a function that models a relationship between two quantities. • Build new functions from existing functions. • Construct and compare linear, quadratic, and exponential models and solve problems.
Skills/ Benchmarks **(CCSS Standards)**	A.CED.1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.* A.CED.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. A.CED.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. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* A.CED.4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.* 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; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*★ F.IF.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*★ F.IF.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.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. F.IF.8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. F.IF.9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For

	example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum. F.BF.1. Write a function that describes a relationship between two quantities.* b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* F.BF.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. F.BF.4. Find inverse functions. a. Solve an equation of the form *f(x) = c* for a simple function *f* that has an inverse and write an expression for the inverse. *For example,* $f(x) = 2x^3$ *or* $f(x) = (x+1)/(x-1)$ *for* $x \neq 1$. F.LE.4. For exponential models, express as a logarithm the solution to a *bct = d* where *a, c,* and *d* are numbers and the base *b* is 2, 10, or *e*; evaluate the logarithm using technology.
Materials and Resources	Holt Algebra 2 Textbook and Resource Materials McDougal Littell Algebra 2 Concepts and Skills Textbook and Resource Materials Kuta Software Website Graph paper Document camera/projector Graphing Calculator
Notes	

Grade: 10/11/12 Subject: CP Algebra 2	**Unit 3: Inferences and Conclusions from Data**
Big Idea/Rationale	In this unit, students see how the visual displays and summary statistics they learned in earlier grades relate to different types of data and to probability distributions. They identify different ways of collecting data—including sample surveys, experiments, and simulations—and the role that randomness and careful design play in the conclusions that can be drawn.
Enduring Understanding (Mastery Objective)	• There are infinite numbers of normal distributions with data but only one standard normal distribution based upon z-scores. • Percentiles can be used to find specific values in a normal distribution using z-scores. • In a normal model, the majority of data lies within two standard deviations of the mean. • The normal model can be used to predict specific outcomes with a distribution of symmetrical data. • Well-designed experiments can yield causal relationships whereas observational studies cannot. • Randomization allows data from samples to represent the views of entire populations. • Margin of error can be used to determine statistical significance.
Essential Questions **(Instructional Objective)**	• What are the parameters needed to create a standard normal distribution of data? • How are z-scores used in the analysis of data? • How can the normal model be used to predict outcomes? • How do qualitative and quantitative data differ? • How do experimental and observational studies differ? • What are the components of good experimental design? How do sampling methodologies differ?
Content **(Subject Matter)**	• Summarize, represent, and interpret data on single count or measurement variable. • Understand and evaluate random processes underlying statistical experiments. • Make inferences and justify conclusions from sample surveys, experiments and observational studies. • Use probability to evaluate outcomes of decisions.
Skills/ Benchmarks **(CCSS Standards)**	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.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. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?* S.IC.3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. 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.5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. S.IC.6. Evaluate reports based on data.
Materials and Resources	McDougal Littell Algebra 2 Concepts and Skills Textbook and Resource Materials Kuta Software Website Graph paper Document camera/projector Graphing Calculator
Notes	

Grade: 10/11/12 Subject: CP Algebra 2	**Unit 4: Trigonometric Functions**
Big Idea/Rationale	Building on their previous work with functions, and on their work with trigonometric ratios and circles in Geometry, students now use the coordinate plane to extend trigonometry to model periodic phenomena.
Enduring Understanding (Mastery Objective)	• Trigonometric functions and their reciprocals are used in many real-world careers that involve angular measures. • Angles can be measured in degrees and radians with radians having an advantage since there are real-number measures. • Inverse trigonometric functions can be used to solve equations involving angle measures. • Many natural phenomena can be modeled using trigonometric functions. • Trigonometric identities can be used to simplify processes when finding angle measures.
Essential Questions **(Instructional Objective)**	• How can you determine the values of the six trigonometric functions for an angle in standard position? • When an angle is drawn in standard position, how do you know which angle is its reference angle? How do you determine angles that are coterminal with the angle? • What is the advantage of representing an angle measure in radians versus degrees? • How can you use the unit circle to determine the values of trigonometric functions? • How can trigonometric equations and inverse trigonometric functions be used to solve problems? • What are the distinguishing features of the graphs of the sine, cosine, and tangent functions? • How can fundamental trigonometric identities be used to simplify, rewrite and evaluate expressions and to verify other identities?
Content **(Subject Matter)**	• Extend the domain of trigonometric functions using the unit circle. • Model periodic phenomena with trigonometric function. • Prove and apply trigonometric identities.
Skills/ Benchmarks **(CCSS Standards)**	F.TF.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. 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. F.TF.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.★

	F.TF.8. Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ 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.
Materials and Resources	Holt Algebra 2 Textbook and Resources Protractor/Ruler Handouts Graphing Calculator Graph Paper
Notes	