Mathematics Standard
Catalina Foothills School District
High School: Algebra 2

In Algebra 2, the focus of instructional time is on four critical areas:

1. Extending the real number system to the complex number system, representing radicals with rational exponents.
2. Solving and interpreting solutions to a variety of equations, inequalities, and systems of equations.
3. Demonstrate competency graphing and interpreting functions extending from linear, quadratic, and exponential with integer exponents to polynomial, radical, rational, exponential with real exponents, logarithmic, trigonometric functions, and piece-wise defined functions.
4. Extend simple and compound probability calculations to conditional probability.

(1) Algebra 2 students extend their knowledge of the real number system by working with complex solutions and factors of polynomials. Students expand their experience with polynomial functions, finding complex zeros and interpreting solutions. Students extend properties of exponents to using rational exponents when factoring, solving, and evaluating.

(2) Connections are made between 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 Fundamental Theorem of Algebra is examined. Students extend their understanding of solving linear equations, inequalities, and systems to include all the different function types mentioned in the standards.

(3) 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. Building on their previous work with functions and on knowledge of trigonometric ratios and circles, students now use the coordinate plane to extend trigonometry to model periodic phenomena. Students examine data on two quantitative variables to choose functions and make conclusions in context of the data.

(4) Algebra 2 students build on their foundational probability skills from middle school extending to conditional probability. Students determine independence of events and are able to apply conditional probability to everyday situations.

The Standards for Mathematical Practice complement the content standards so that students increasingly engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle, and high school years. Mathematical modeling is integrated throughout the Algebra 2 course by utilizing real world context.

Standards for Algebra 2

NUMBER AND QUANTITY: The Real Number System (N-RN)	
A2.N-RN.A.1	Explain how the definition 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.
A2.N-RN.A.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
NUMBER AND QUANTITY: Quantities (N-Q)	
A2-N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays, include utilizing real-world context.
A2.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. Include problem-solving opportunities utilizing real-world context.
A2.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities utilizing real-world context.
NUMBER AND QUANTITY: The Complex Number System (N-CN)	
A2.N-CN.A.1	Apply the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. Write complex numbers in the form (a+bi) with a and b real.
A2.N-CN.C.7	Solve quadratic equations with real coefficients that have complex solutions.
ALGEBRA: Seeing Structure in Expressions (A-SSE)	
A2.A-SSE.A.2	Use structure to identify ways to rewrite polynomial and rational expressions. Focus on polynomial operations and factoring
A2.A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. Include problem-solving opportunities utilizing real-world context and focus on expressions with rational exponents.
A2.A-SSE.B.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).
ALGEBRA: Arithmetic with Polynomials and Rational Expressions (A-APR)	
A2.A-APR.B.2	Know and apply the Remainder and Factor 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).
A2.A-APR.B.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. Focus on quadratic, cubic, and quartic polynomials including polynomials for which factors are not provided.
A2.A-APR.C.4	Prove polynomial identities and use them to describe numerical relationships.
A2.A-APR.D.6	Rewrite 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.
ALGEBRA: Creating Equations (A-CED)	
A2.A-CED.A.1	Create equations and inequalities in one variable and use them to solve problems. Include problem-solving opportunities utilizing real-world context. Focus on equations and inequalities arising from linear, quadratic, rational, and exponential functions.
ALGEBRA: Reasoning with Equations and Inequalities (A-REI)	
A2.A-REI.A.1	Explain each step in solving an equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. Extend from quadratic equations to rational and radical equations.
A2.A-REI.A.2	Solve rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
A2.A-REI.B.4	Fluently solve quadratic equations in one variable. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.
A2.A-REI.C.7	Solve a system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = -3x and the circle $x^2 + y^2 = 3$.
A2.A-REI.D.11	Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) =g(x); find the solutions approximately (e.g., using technology to graph the

	functions, make tables of values, or find successive approximations). Include problems in real-world context. Extend from linear, quadratic, and exponential functions to cases where f(x) and/or g(x) are polynomial, rational, exponential, and logarithmic functions.
FUNCTIONS: Interpreting Functions (F-IF)	
A2.F-IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Include problem-solving opportunities utilizing a real-world context. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. Extend from linear, quadratic and exponential to include polynomial, radical, logarithmic, rational, sine, cosine, tangent, square root, cube root, and piecewise-defined functions.
A2.F-IF.B.6	Calculate and interpret the average rate of change of a continuous function (presented symbolically or as a table) on a closed interval. Estimate the rate of change from a graph. Include problem-solving opportunities utilizing real-world context. Extend from linear, quadratic and exponential to include polynomial, radical, logarithmic, rational, sine, cosine, tangent, square root, cube root, and piecewise-defined functions.
A2.F-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Extend from linear, quadratic and exponential functions to include square root, cube root, polynomial, rational, exponential, logarithmic, sine, cosine, tangent and piecewise-defined functions.
A2.F-IF.C.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. b. Use the properties of exponents to interpret expressions for exponential functions and classify those functions as exponential growth or decay.
A2.F-IF.C.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). Extend from linear, quadratic and exponential functions to include polynomial, radical, logarithmic, rational, trigonometric, exponential, sine, cosine, tangent, square root, and piecewise-defined functions.
FUNCTIONS: Building Functions (F-BF)	
A2.F-BF.A.1	Write a function that describes a relationship between two quantities. Extend from linear, quadratic and exponential functions to include polynomial, radical, logarithmic, rational, sine, cosine, exponential, and piecewise-defined functions. Include problem-solving opportunities utilizing real-world context. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. Combine function types using arithmetic operations and function composition
A2.F-BF.A.2	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
A2.F-BF.B.3	Identify the effect on the graph of replacing f(x) by f(x) + k, kf(x), f(kx), and f(x+k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. Extend from linear, quadratic and exponential functions to include polynomial, square root, cube root, radical, logarithmic, rational, sine, cosine, tangent, and exponential functions, and piecewise-defined functions.
A2.F-BF.B.4	Find inverse functions. a. Understand that an inverse function can be obtained by expressing the dependent variable of one function as the independent variable of another, recognizing that functions f and g are inverse functions if and only if f(x) = y and g(y) = x for all values of x in the domain of f and all values of y in the domain of g. b. Understand that if a function contains a point (a,b), then the graph of the inverse relation of the function contains the point (b,a). c. Interpret the meaning of and relationship between a function and its inverse utilizing real-world context.
FUNCTIONS: Linear, Quadratic, and Exponential Models (F-LE)	
A2.F-LE.A.4	For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithms that are not readily found by hand or observation using technology.
A2.F-LE.B.5	Interpret the parameters in an exponential function with rational exponents utilizing real-world context.

FUNCTIONS: Trigonometric Functions (F-TF)	
A2.F-TF.A.1	Understand radian measure of an angle as the length of the arc on any circle subtended by the angle, measured in units of the circle's radius.
A2.F-TF.A.2	Explain how the unit circle in the coordinate plane enables the extension of sine and cosine functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
A2.F-TF.B.5	Create and interpret sine, cosine, and tangent functions that model periodic phenomena with specified amplitude, frequency, and midline.
A2.F-TF.C.8	Use the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and the quadrant of the angle θ to find sin(θ), cos(θ), or tan(θ) given sin(θ) or cos(θ).
STATISTICS AND PROBABILITY: Interpreting Categorical and Quantitative Data (S-ID)	
A2.S-ID.A.4	Use the mean and standard deviation of a data set to fit it to a normal curve and use properties of the normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, or tables to estimate areas under the normal curve.
A2.S-ID.B.6	Represent data of two quantitative variables on a scatter plot and describe how the quantities are related. Extend to polynomial and exponential models. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or chooses a function suggested by the context.
A2.S-ID.C.10	Interpret parameters of exponential models.
STATISTICS AND PROBABILITY: Making Inferences and Justifying Conclusions (S-IC)	
A2.S-IC.A.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
A2.S-IC.A.2	Explain whether a specified model is consistent with results from a given data-generating process.
A2.S-IC.B.3	Recognize the purposes of and differences between designed experiments, sample surveys and observational studies
A2.S-IC.B.4	Use data from a sample survey to estimate a population mean or proportion; recognize that estimates are unlikely to be correct and the estimates will be more precise with larger sample sizes.
STATISTICS AND PROBABILITY: Conditional Probability and the Rules of Probability (S-CP)	
A2.S-CP.A.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.
A2.S-CP.A.4	Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.
A2.S-CP.A.5	Recognize and explain the concepts of conditional probability and independence utilizing real-world context.
A2.S-CP.B.6	Use Bayes Rule to find the conditional probability of A given B as the fraction of B's outcomes that also belong to A and interpret the answer in terms of the model.
A2.S-CP.B.7	Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of
A2.S-CP.B.8	Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B) and interpret the answer in terms of the model.
STANDARDS FOR MATHEMATICAL PRACTICE	
HS.MP.1	Make sense of problems and persevere in solving them.
HS.MP.2	Reason abstractly and quantitatively.
HS.MP.3	Construct viable arguments and critique the reasoning of others.
HS.MP.4	Model with mathematics.
HS.MP.5	Use appropriate tools strategically.
HS.MP.6	Attend to precision.
HS.MP.7	Look for and make use of structure.
HS.MP.8	Look for an express regularity in repeated reasoning.