Algebra II Overview

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Building on the understanding of linear, quadratic and exponential functions from Algebra I, this course will extend function concepts to include polynomial, rational, and radical functions.

The standards in this course continue the work of modeling situations and solving equations.

Unit 1 standards will focus on the similarities of arithmetic with rational numbers and the arithmetic with rational expressions.

Unit 2 will extend student's algebra knowledge of linear and exponential functions to include polynomial, rational, radical, and absolute value functions.

Unit 3 builds on the students' previous knowledge of functions, trigonometric ratios and circles in geometry to extend trigonometry to model periodic phenomena.

Unit 4 will explore the effects of transformations on graphs of functions and will include identifying an appropriate model for a given situation. The standards require development of models more complex than those of previous courses.

Unit 5 will relate the visual displays and summary statistics learned in prior courses to different types of data and to probability distributions. Samples, surveys, experiments and simulations will be used as methods to collect data.

Model Curriculum
Algebra II Units

Major Supporting Additional (Identified by PARCC Content Frameworks)

Unit 1: Polynomials

Perform arithmetic operations with complex numbers.	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 distributive properties to add, subtract, and multiply complex numbers.
Use complex numbers in polynomial identities and equations.	N.CN.7	Solve quadratic equations with real coefficients that have complex solutions.
	N.CN.9	(+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.
Solve equations and inequalities in one variable.	A.REI.4b	Solve quadratic equations in one variable. b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.
Interpret the structure of expressions.	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 the expression $(x^2 - y^2)(x^2 + y^2)$.*
Write expressions in equivalent forms to solve problems.	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.★*
Understand the relationship between zeros and factors of 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.
Use polynomial identities to solve problems.	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.

Unit 2: Expressions and Equations (1)

Extend the properties of exponents to rational exponents.	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. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*
	N.RN.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
Rewrite rational expressions.	A.APR.6	Rewrite rational expressions. 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.
Understand solving equations as a process of reasoning and explain the reasoning.	A.REI.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
	A.REI.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
Solve systems of equations.	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.REI.7	Solve a simple 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 $x^2 + y^2 = 3$.
Write expressions in equivalent forms to solve problems.	A.SSE.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.★ c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*
Interpret functions that arise in applications in terms of the 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. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*★
Analyze functions using different representations.	F.IF.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
Translate between the geometric description and the equation for a conic section.	G.GPE.2	Derive the equation of a parabola given a focus and directrix.
Summarize, represent, and interpret data on two categorical and quantitative variables.	S.ID.6a	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.*

Unit 3: Expressions and Equations (2)

Reason quantitatively and use units to solve problems.	N.Q.2	Define appropriate quantities for the purpose of descriptive modeling.
Represent and solve equations and inequalities graphically.	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. ★
Build a function that models a relationship between two quantities.	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. ★
Build new functions from existing functions.	F.BF.4a	Find inverse functions. 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) =2 x3 or f(x) = (x+1)/(x–1) for x* ≠ 1.
Interpret functions that arise in applications in terms of the 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. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* ★
Analyze functions using different representations.	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. ★ e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
Interpret expressions for functions in terms of the situation they model.	F.LE.5	Interpret the parameters in a linear or exponential function in terms of a context.
Extend the domain of trigonometric functions using the unit circle.	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.
Model periodic phenomena with trigonometric functions	F.TF.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. ★
Prove and apply trigonometric identities.	F.TF.8	Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.
Summarize, represent, and interpret data on two categorical and quantitative variables.	S.ID.6a	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.*

Unit 4: Functions/Inferences & Conclusions

Interpret functions that arise in applications in terms of the context.	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. ★
Analyze functions using different representations.	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.
Build a function that models a relationship between two quantities.	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.* ★
Build new functions from existing functions.	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.
Construct and compare linear, quadratic, and exponential models and solve problems.	F.LE.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 logarithm using technology.
Summarize, represent, and interpret data on a single count or measurement variable.	S.ID.4	Use the mean and standard deviation of a data set to fit it to a normal distribution, estimate population percentages, and 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).
Understand and evaluate random processes underlying statistical experiments.	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?* ★
Make inferences and justify conclusions from sample surveys, experiments, and observational studies.	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. ★

Unit 5: Probability

Understand independence and conditional probability and use them to interpret data.	S.CP.1	Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and, "not").
	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.
	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.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. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*
	S.CP.5	Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*
Use the rules of probability to compute probabilities of compound events in a uniform probability model.	S.CP.6	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.
	S.CP.7	Apply the Addition Rule, *P(A* or *B)* = *P(A)* + *P(B)* – *P(A* and *B)*, and interpret the answer in terms of the model.