Math Common Core State Standards and Long-Term Learning Targets
High School Algebra II

Traditional Pathway; see Appendix A of the CCS Standards for information on high school course design: http://www.corestandards.org/assets/CCSSI_Mathematics_Appendix_A.pdf

Note: *Students should be able to apply all mathematical skills in context (through a word problem, open-ended real-world problem, or contextual scenario) and abstractly (in plain number problems or what the standards term "mathematical problems"). For example, when students are ask to "write, solve, and interpret two-step equations" students should be able to solve equations such as 3x + 2 = -5, and check for the validity of their solution as well as write equations from word problems.*

Unit 1: Polynomial, Rational, and Radical Relationships	
Standards: The Complex Number System	**Long-Term Target(s)**
Perform arithmetic operations with complex numbers.	
N-CN.1. Know there is a complex number *i* such that *i2* = –1, and every complex number has the form *a* + *bi* with *a* and *b* real.	I can define *i*. I can describe complex numbers in terms of their real and imaginary parts.
N-CN.2. Use the relation *i2* = –1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.	I can apply the commutative, associative, and distributive properties to complex numbers in order to add, subtract, and multiply.
Use complex numbers in polynomial identities and equations.	
N-CN.7. Solve quadratic equations with real coefficients that have complex solutions.	I can determine when a quadratic equation has a complex solution. I can determine the complex solutions of a quadratic equation with real coefficients.
N-CN.8. (+) Extend polynomial identities to the complex numbers. *For example, rewrite x2* + 4 *as* (x + 2i)(x – 2i).	I can determine the complex factors of the sum of two squares.
N-CN.9. (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.	I can explain the Fundamental Theorem of Algebra. I can show that the FTA holds for all quadratic polynomials.

Standards: Seeing Structure in Expressions	
Interpret the structure of expressions	
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.*	I can interpret algebraic expressions that describe real-world scenarios. This means: • I can interpret the parts of an expression including the factors, coefficients, and terms. • I can use grouping strategies to interpret expressions.
A-SSE.2. Use the structure of an expression to identify ways to rewrite it. *For example, see x4 – y4 as* (x2)2 – (y2)2, *thus recognizing it as a difference of squares that can be factored as* (x2 – *y2)(x2 + y2).*	I can identify common structures of an expression (such as the difference of two squares) and use that structure to rewrite it.
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.*	I can derive the formula for a finite geometric series and use it to solve problems.
Standards: Arithmetic with Polynomials and Rational Expressions	
Perform arithmetic operations on polynomials	
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.	I can describe the similarities between the set of integers and the system of polynomials. I can add, subtract, and multiply polynomials. I can determine whether a set or system is closed under a given operation.
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).*	I can explain the Remainder Theorem. I can apply the Remainder Theorem in order to determine the factors (or zeros) of a polynomial.
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.	I can determine the zeros of a polynomial from its factors. I can describe and sketch the graph of a polynomial given its zeros.

Use polynomial identities to solve problems	
A-APR.4. Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity* (x2 + *y2)2* = (x2 – *y2)2* + (2xy)2 *can be used to generate Pythagorean triples.*	I can prove polynomial identities algebraically. I can use a polynomial identity to describe 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 a positive integer *n,* where *x* and *y* are any numbers, with coefficients determined for example by Pascal's Triangle.1	I can explain the Binomial Theorem for the expansion of $(x + y)^n$, determine patterns in powers and coefficients, and use these patterns to expand binomials of the form $(x + y)^n$.
Rewrite rational expressions	
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.	I can determine the quotient and remainder of rational expressions using inspection, long division, and/or a computer algebra system.
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.	I can describe the similarities between the set of rational numbers and rational expressions. I can add, subtract, multiply, and divide rational expressions.
Standards: Reasoning with Equations and Inequalities	
A-REI.2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	I can solve rational equations in one variable and determine extraneous solutions. I can solve radical equations in one variable and determine extraneous solutions. I can explain how extraneous solutions may arise from rational or radical equations.
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.★	I can explain why the x-coordinates of a point of intersection of two graphs are the solution to the equation *f(x)=g(x).* I can determine the approximate solutions of a system of equations using technology, tables, or successive approximations.

Standards: Interpreting Functions	
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.★ a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.	I can find the key features of and then graph the following families of functions: • Linear and Quadratic (intercepts, maxima, minima) • Square root, cube root, and piecewise-defined functions. • Polynomial functions (zeros via factorization, and end behavior) • Rational functions (zeros, asymptotes, end behavior) • Exponential and logarithmic functions (intercepts, end behavior) • Trigonometric functions (period, midline, amplitude)
Unit 2: Trigonometric Functions	
CCS Standards: Trigonometric Functions	**Long-Term Target(s)**
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.	I can define the radian measure of an 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.	I can describe the importance of the unit circle for extending trigonometric functions to all real numbers.
Model periodic phenomena with trigonometric functions	
F-TF.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.★	I can determine the trigonometric function that best models a situation based on period, amplitude, frequency, and midline.
Prove and apply trigonometric identities	
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.	I can prove the Pythagorean Identity. I can determine the Sine, Cosine, or Tangent of an angle using the Pythagorean Identity and given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle.

Unit 3: Modeling with Functions	
CCS Standards: Creating Equations	**Long-Term Target(s)**
Create equations that describe numbers or relationships	
A-CED.1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and exponential functions.*	I can write equations in one variable and use them to solve problems. I can write inequalities in one variable and use them to solve problems.
A-CED.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	I can write equations in two or more variables to represent relationships between quantities. I can 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.*	I can represent constraints with linear equations, inequalities, and systems of equations or inequalities. I can determine whether solutions are viable or non-viable options, given the constraints provided in a modeling context.
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.*	I can solve formulas for a particular variable of interest.
CCS Standards: Interpreting Functions	
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.*	I can analyze and interpret the key features of a function using a graph or table. These key features include: • intercepts; • intervals where the function is increasing, decreasing, positive or negative; • relative maximums and minimums; • symmetries; • end behavior; • periodicity. I can describe and sketch a graphic representation of a function given a verbal description of the relationship.

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.*	I can describe an appropriate domain of a function given its real-world 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.★	I can calculate and interpret the average rate of change of a function over a specified interval. I can estimate the rate of change over a given interval from a graph.
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.★ f. Graph linear and quadratic functions and show intercepts, maxima, and minima. g. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. h. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. i. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. j. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.	See F-IF4 above.
F-IF.8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. b. Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as y = (1.02)t, y = (0.97)t, y = (1.01)12t, y = (1.2)t/10, and classify them as representing exponential growth or decay.*	I can transform a function defined by an expression to reveal and explain different properties of the function. This means: • I can factor a polynomial to reveal zeros. • I can complete the square in a quadratic function to show zeros, extreme values, and symmetry. • I can interpret an exponential function my transforming its base. I can interpret functions in context.

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.*	I can compare properties of two functions represented differently (graphs, tables, equations, verbal descriptions) and draw conclusions based on those comparisons.
CCS Standards: Building Functions	
Build a function that models a relationship between two quantities	
F-BF.1. Write a function that describes a relationship between two quantities.★ a. Determine an explicit expression, a recursive process, or steps for calculation from a context. 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.* c. (+) Compose functions. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.*	I can determine the appropriate method for writing a function that describes the relationship between two quantities. This means: • I can determine an explicit expression, a recursive process, or steps for calculation appropriate to the context. • I can combine standard function types using arithmetic operations. • I can compose functions and determine the meaning of that composition.
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.*	I can determine 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). I can determine the translation value *k,* given a graph for slides, shifts, and stretches. I can explain the translation effects on the graph of a function using technology.

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,* $f(x) = 2\ x3$ *or* $f(x) = (x+1)/(x–1)$ *for* $x \neq 1$. b. (+) Verify by composition that one function is the inverse of another. c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse. d. (+) Produce an invertible function from a non-invertible function by restricting the domain.	I can determine the inverse of a function by solving $f(x)=c$. I can determine by composition that one function is the inverse of another, $f(g(x))=x$. I can determine the values of the inverse function from a graph or a table. I can describe the domain that will produce an invertible function from a non-invertible function.
Standards: Linear, Quadratic, and Exponential Models	
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.	I can solve exponential models using logarithms with base 2, 10, or e. I can evaluate the logarithm to find a real number approximation (using technology).
Unit 4: Inferences and Conclusions from Data	
CCS Standards: Interpreting Categorical and Quantitative Data	**Long-Term Target(s)**
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 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.	I can determine when a data set warrants a normal distribution. I can determine the mean and standard deviation of a data set and fit it to a normal distribution. I can estimate population percentages based on mean, standard deviation, and distribution. I can estimate the areas under the normal curve using calculators, spreadsheets, and tables.
Standards: Making Inferences and Justifying Conclusions	
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.	I can define statistics in terms of inferences, population parameters, and random sampling.

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?*	I can decide if a model is consistent with results, given a data-generating process such as simulation.
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.	I can compare and contrast sample surveys, experiments, and observational studies. I can explain how randomization relates to sample surveys, experiments, and observational studies.
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.	I can estimate a population mean or proportion given data from a sample survey. I can determine the margin of error using 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.	I can compare two treatments using data from a randomized experiment. I can decide if differences are significant by using simulations.
S-IC.6. Evaluate reports based on data.	I can evaluate reports based on data.
Standards: Using Probability to Make Decisions	
Use probability to evaluate outcomes of decisions	
S-MD.6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).	I can analyze probabilities to make fair decisions.
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).	I can analyze decisions and strategies using probability concepts.