ALGEBRA II

Number and Quantity

The Real Number System (N-RN)

Extend the properties of exponents to rational exponents	Major

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.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• The meaning and function of exponents. • The meaning of rational expressions.	• Simplifying an exponential expression. • Simplifying radical expressions.	• Identify and attend to structure in writing and using rational exponents. • Recognize a power's corresponding root. • Relate use of rational exponents to properties of integer exponents.

ALGEBRA II

Number and Quantity

The Real Number System (N-RN)

Extend the properties of exponents to rational exponents	Major

N-RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• A single quantity can be represented by various expressions. • Facts about quantities can be expressed by different equations.	• Simplifying a radical expression.	• Rewrite radical expressions using a fractional exponent instead of a radical sign • Rewrite exponential expressions to reveal quantities of interest that may be useful.

ALGEBRA II

Number and Quantity

Quantities (N-Q)*

Reason quantitatively and use units to solve problems. — **Supporting**

N-Q.2
Define appropriate quantities for the purpose of descriptive modeling.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Quantities are contextualized by the use of units.	• Recognize and identify units. • Identify relevant quantities in any context or problem-solving task.	• Describe solutions using complete quantities (including units). • Attend to precision by the consistent use of units throughout the problem solving process.

ALGEBRA II

Number and Quantity

The Complex Number System

Perform arithmetic operations with complex numbers	Additional

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.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Every quadratic equation has complex number solutions. • Complex numbers include imaginary and real numbers. • Some solutions to quadratic equations may be imaginary. • The imaginary unit *i* is a number, not a variable .	• How to solve quadratic equations in the form of $x^2 + k = 0$, where k >0.	• Use a clear and precise vocabulary in defining of the imaginary unit. • Prove and define *i* as the square root of -1.

ALGEBRA II

Number and Quantity

The Complex Number System

Perform arithmetic operations with complex numbers	Additional

N-CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Every quadratic equation has complex number solutions. • Complex numbers include imaginary and real numbers. • Some solutions to quadratic equations may be imaginary. • The imaginary unit *i* is a number, not a variable.	• How to solve quadratic equations in the form of $x^2 + k = 0$, where $k > 0$.	• Perform operations with complex numbers. • Use a clear and precise definition of the imaginary unit. • Define *i* as the square root of -1.

ALGEBRA II

Number and Quantity

The Complex Number System

Use complex numbers in polynomial identities and equations	Additional

N-CN.7 Solve quadratic equations with real coefficients that have complex solutions.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Every quadratic equation has complex number solutions. • Complex numbers include imaginary and real numbers. • Some solutions to quadratic equations may be imaginary. • The imaginary unit *i* is a number, not a variable.	• How to solve quadratic equations in the form of $x^2 + k = 0$, where $k > 0$.	• Perform operations with complex numbers. • Use a clear and precise definition of the imaginary unit. • Define *i* as the square root of -1.

ALGEBRA II

Algebra

Seeing Structure in Expressions (A-SSE)

Interpret the structure of expressions — **Major**

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 $(x^2 – y^2)(x^2 + y^2)$.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Expressions can be factored into simpler expressions. • Factoring expressions is similar to factoring numbers.	• Factoring simple expressions. • Many quadratic trinomials can be factored into the product of two binomials.	• Recognize various forms of factoring. • Find common and binomial factors of quadratic expressions. • Factor special quadratic expressions.

ALGEBRA II

Algebra

Seeing Structure in Expressions (A-SSE)

Write expressions in equivalent forms to solve problems — **Major**

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 1.15t 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%.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Exponential growth. • Exponential decay. • Growth and decay factor. • Exponential function models growth or decay of an initial quantity.	• Creating exponential expressions. • Graphing a function (if still needed as a visual aid).	• Rewrite expressions to reveal quantities that may be more useful. • Recognize that exponential function model may be appropriate when finding the solution would require iterative multiplication. • Model in the context of real world situations, such as compound interest and radioactive decay.

ALGEBRA II

Algebra

Seeing Structure in Expressions (A-SSE)

Write expressions in equivalent forms to solve problems — **Major**

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.**

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• As with arithmetic series, geometric series are also finite • A geometric series is the sum of the terms in a geometric sequence.	• The sum of a finite number of terms can be found using the first term, number of terms, and the common ratio. • A formula can be used to find the sum of a finite geometric series.	• Define geometric series and find their sums • Use the following formula to find the sum of a finite series: $S_n = a_1(1-r^n)/1-r$

ALGEBRA II

Algebra

Arithmetic with Polynomials and Rational Expressions (A-APR)

Understand the relationship between zeros and factors of polynomials	Major

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 $p(x)$.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Synthetic division simplifies the long division process. • Algorithms are instructions in solving problems and identify algorithms used in previous courses. • Factors of polynomials are similar to factors of whole numbers.	• Writing the coefficients of polynomials in standard form. • Long division of whole numbers. • Factoring whole numbers and polynomials.	• Know and apply the Remainder Theorem. • Divide polynomials. • Use both long division and synthetic division to divide polynomials. • Attend to precision • Recognize similar structure in both division processes. • Recognize when a specific division process may not be possible.

ALGEBRA II

Algebra

Arithmetic with Polynomials and Rational Expressions (A-APR)

Understand the relationship between zeros and factors of polynomials	Major

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.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Knowing the zeros of a polynomial function can give information about its graph. • Zeros of a quadratic function are equivalent to the x-intercepts and solutions of the related quadratic equation set to zero.	• Finding x- and y-intercepts • Solving quadratic equations by factoring and by graphing. • Zeros of a quadratic function $y=ax^2+bx+c$ can be found by solving the related equation $0=ax^2+bx+c$. • Applying the Zero-Product Property. • Applying the Factor Theorem.	• Write a polynomial function from its zeros • Analyze the factored form of polynomials. • Use appropriate tools strategically to graph the function defined by the polynomial. • Represent the polynomial in a factored form, tables, and graphs.

ALGEBRA II

Algebra

Arithmetic with Polynomials and Rational Expressions (A-APR)

Use polynomial identities to solve problems	Additional

	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
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.*	• Number theory. • Consecutive numbers.	• Factoring polynomials.	• Use polynomial identities to write expressions in different forms. • Determine if an expression is even or odd by its characteristics. • Identify patterns.

ALGEBRA II

Algebra

Arithmetic with Polynomials and Rational Expressions (A-APR)

Rewrite rational expressions	Supporting

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.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Factors of polynomials are similar to factors of whole numbers.	• Division of whole numbers. • Long division of polynomials. • Synthetic division of polynomials.	• Use appropriate tools strategically, including technology. • Attend to precision in checking the factors of the expressions. • Factor rational expressions. • Rewrite rational expressions using inspection or long division. • Determine how different forms of an expression reveal useful information.

ALGEBRA II

Algebra

Creating Equations (A-CED)*

Create equations that describe numbers or relationships — **Supporting**

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.**

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Properties of Equality (Reflexive, Symmetric, Transitive, Substitution, Addition, Subtraction, Multiplication, and Division). • Properties of Inequality (Transitive, Addition, Subtraction, Multiplication, and Division). • Inverse Operations. • Variables represent unknown quantities. • Absolute value.	• How to apply the Properties of Equality. • Isolating variables. • Applying the order of operations. • Using the equal sign to represent balance or equivalence. • Using signs of inequalities to represent a domain of solutions. • Representing operations symbolically.	• Represent real world problems algebraically, and reason abstractly and quantitatively in solving them. • Find unknown quantities by relating them to known quantities.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Understand solving equations as a process of reasoning and explain the reasoning	Major

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.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Properties of Equality (Reflexive, Symmetric, Transitive, Substitution, Addition, Subtraction, Multiplication, and Division). • Inverse Operations. • Variables represent unknown quantities.	• How to apply the Properties of Equality. • Isolating variables. • Applying the order of operations. • Using the equal sign to represent balance or equivalence.	• Justify their solution method. • Reason abstractly and quantitatively. • Find unknown quantities by relating them to known quantities.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Understand solving equations as a process of reasoning and explain the reasoning	Major

A-REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• The function of exponents and radicals. • Properties of Equality (Reflexive, Symmetric, Transitive, Substitution, Addition, Subtraction, Multiplication, and Division). • Inverse Operations. • Variables represent unknown quantities.	• How to apply the Properties of Equality. • Isolating variables. • Using the equal sign to represent balance or equivalence.	• Solve square root and other radical equations • Justify their solution method. • Reason abstractly and quantitatively. • Find unknown quantities by relating them to known quantities. • Use mathematical properties and structures to create equivalent expressions.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Solve equations and inequalities in one variable — **Supporting**

A-REI.4
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.

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• The function of exponents and radicals. • Properties of Equality (Multiplication and Division). • Inverse Operations. • Variables represent unknown quantities.	• How to apply the Properties of Equality. • Isolating variables. • Using the equal sign to represent balance or equivalence.	• Rewrite functions by completing the square. • Look for and express regularity in repeated reasoning and derive possible shortcuts as solving equations. • Use mathematical properties and structures to create equivalent expressions.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Solve systems of equations			Additional
A-REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	**Desired Student Performance**		
	A student should know • Variables represent unknown quantities. • Properties of Equality (Reflexive, Symmetric, Transitive, Substitution, Addition, Subtraction, Multiplication, and Division). • Inverse Operations.	**A student should understand** • Graphing on a coordinate plane. • How to apply the Properties of Equality. • Isolating variables. • Using the equal sign to represent balance or equivalence.	**A student should be able to do** • Solve linear systems using graphs and tables. • Solve linear systems algebraically. • Recognize the point of intersection of the graphs as the solution of the system. • Identify one solution, infinitely many solutions, or no solution for the system. • Use appropriate tools strategically.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Solve systems of equations	Additional

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 $x^2 + y^2 = 3$.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• A quadratic function is a stretch, compression, reflection and/or translation of $y=x^2$.	• Solving systems of linear equations.	• Solve and graph systems of linear and quadratic equations. • Identify one solution, two solutions, or no solution for the system. • Use appropriate tools strategically.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Represent and solve equations and inequalities graphically	Major

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.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Variables represent unknown quantities. • Properties of Equality (Reflexive, Symmetric, Transitive, Substitution, Addition, Subtraction, Multiplication, and Division). • Inverse Operations.	• Solving systems of linear equations. • Graphing on a coordinate plane. • How to apply the Properties of Equality. • Isolating variables. • Using the equal sign to represent balance or equivalence.	• Defend their reasoning in the context of real-world problems. • Construct viable arguments to defend their responses. • Use appropriate tools strategically.

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Understand the concept of a function and use function notation

Supporting

F-IF.3
Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by f(0)=f(1)=1, f(n+1) = f(n) + f(n-1) for n ≥ 1.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• The set of integers includes the whole numbers and their opposites. • Define domain.	• Continue or complete a given sequence by listing additional terms. • Develop a rule to yield sequence values.	• Recognize sequences as functions. • Describe/model a sequence using function notation. • Recognize a recursive function as a function that calls upon itself to produce new terms within the sequence

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Interpret functions that arise in applications in terms of the context	Major

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.**	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• A function can be used to model the relationship between two quantities. • Key features may be identified using various representations such as graphs and tables. • The end behavior of a graph may be used to determine the domain of the function.	• Identify all intercepts. • Given a function, create a table of values and sketch a graph. • Functions with degree other than 1 may contain relative maximum or relative minimums. • Identify Symmetries in graphs.	• Given key features, sketch an appropriate graph • Determine increasing and decreasing intervals. • Identify relative maximums and minimums. • Recognize periodicity (when applicable) in graphs. • Model a periodical function using the form $f(x + P) = f(x)$ where the period (P) is a non-zero constant.

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Interpret functions that arise in applications in terms of the context	Major

	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
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.*	• Recognize that the rate of change can be calculated at various points along any curve.	• Calculate the average rate of change by finding the slope of a secant line of the curve.	• Compare the rate of change associated with different intervals along the curve.

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Analyze functions using different representations — **Supporting**

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.
e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• A function can be used to model the relationship between two quantities. • The end behavior of a graph. • Definition and examples of polynomials. • Standard Form of a Polynomial Function. • Factoring polynomials. • Zero Product Property. • The Factor Theorem. • Relative maximum. • Relative minimum.	• End behavior and turning points can be determined from the degree of the polynomial. • A polynomial function of odd degree has an even number of turning points. • A polynomial function of even degree has an odd number of turning points. • Setting linear factors to zero to find the zeros.	• Determine the end behavior of polynomial function given its algebraic form. • Use the graph of a polynomial function to construct its algebraic form. • Describe the relationship between the linear factors and the zeros of a polynomial. • Identify relative maximums and minimums. • Find linear factors and graph x-intercepts. • Determine the degree of a polynomial. • Use appropriate tools strategically.

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Analyze functions using different representations — **Supporting**

F-IF.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. *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 and decay.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• The effects of a, k, and h to functions. • Properties of exponents.	• Graphing a function in the form y = ab^x. • The effects of the factor a in y = ab^x to stretch, compress, or reflect the parent graph.	• Identify the function y = ab^x, where a>0 and b>1 as exponential growth. • Identify the function y = ab^x, where a>0 and b<1 as exponential decay. • Look for and make use of structure.

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Analyze functions using different representations	Supporting

	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
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.*	• A function can be used to model the relationship between two quantities. • The end behavior of a graph. • Relative maximum. • Relative minimum.	• Calculating slope. • Reading a function's graph or table. • Write functions algebraically various ways (point slope form, standard form).	• Identify key features of a function. • Create a viable argument comparing two functions.

ALGEBRA II

Functions

Building Functions (F-BF)

Build a function that models a relationship between two quantities	Major

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.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• A function can be used to model the relationship between two quantities. • The effects of a, k, and h to functions. • Direct variation. • Constant of variation. • Exponential decay. • Exponential growth.	• Finding slope. • Writing functions algebraically in various forms.	• Identify key features of a function. • Write functions algebraically various ways (point slope form, standard form). • Use a real world context to create a function. • Relate each term of the function to the next term.

ALGEBRA II

Functions

Building Functions (F-BF)

Build a function that models a relationship between two quantities	Major

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.*	**Desired Student Performance**		
	A student should know	A student should understand	**A student should be able to do**
	• Identifying an arithmetic or geometric pattern.	• Writing functions algebraically various ways.	• Create arithmetic and geometric sequences from real world contexts. • Reason abstractly and quantitatively, and relate the forms to one another. • Relate each term of the function to the next term.

ALGEBRA II

Functions

Building Functions (F-BF)

Build new functions from existing functions			Additional
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.*	**Desired Student Performance**		
	A student should know • The effects of a, k, and h to functions.	**A student should understand** • Interpreting the graph of a function. • Determining if a function is even or odd based on its graph or algebraic form.	**A student should be able to do** • Use appropriate tools strategically to manipulate and explain graphs of functions.

ALGEBRA II

Functions

Building Functions (F-BF)

Build new functions from existing functions	Additional

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 $x \neq 1$.*	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
	• Define inverse. • The range of the relation is the domain of the inverse. • The domain of the relation is the range of the inverse.	• Creating and solving equations. • If a function maps *a* to *b*, then its inverse maps *b* to *a*.	• Define and identify inverse relations and functions. • Create an inverse function.

ALGEBRA II

Functions

Linear, Quadratic, and Exponential Models (F-LE)

Construct and compare linear, quadratic, and exponential models and solve problems

Supporting

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).*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Creating a function given data or a contextual description. • Arithmetic and geometric sequences. • Linear functions. • Exponential functions.	• Interpreting a function's graph or table. • Creating equations. • The effects of an exponent and its graphical representation.	• Create linear and exponential functions based on a real world context.

ALGEBRA II

Functions

Linear, Quadratic, and Exponential Models (F-LE)

Construct and compare linear, quadratic, and exponential models and solve problems

Supporting

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.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Exponential equations. • Logarithmic equations. • Change of Base formula.	• An exponential function is one with the general form $y=ab^x$, $a \neq 0$, with $b>0$, and $b\neq1$. • The exponential function $y=b^x$ and the logarithmic function $y=\log_b x$ are inverse functions.	• Relate an exponential model to its logarithmic form for real world contexts. • Use appropriate tools strategically.

ALGEBRA II

Functions

Linear, Quadratic, and Exponential Models (F-LE)

Interpret expressions for functions in terms of the situation by model	Additional

F-LE.5 Interpret the parameters in a linear or exponential function in terms of a context.*	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
	• Linear functions • Exponential functions.	• Solving and graphing functions. • Linear functions in point-slope form, slope-intercept form, and standard form. • Exponential functions in the form $y=ab^x$.	• Reason abstractly and quantitatively to interpret the meaning of parameters in a real world context.

ALGEBRA II

Functions

Trigonometric (F-TF)

Extend the domain of trigonometric functions using the unit circle	Additional

	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
F-TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.	• Radian measure has no associated unit of measure. • Right triangle trigonometry.	• Radian measure is the ratio of arc length and the radius of a circle.	• Create a reference triangle on a unit circle using right triangle trigonometry.

ALGEBRA II

Functions

Trigonometric (F-TF)

Extend the domain of trigonometric functions using the unit circle — **Additional**

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.

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Unit circles are circles that have a center at the origin of a coordinate plane. • Terminating sides of angles.	• Simplicity of unit circles that have a radius of 1.	• Find any of the six trigonometric functions for any angle within any quadrant of the unit circle.

ALGEBRA II

Functions

Trigonometric (F-TF)

Model periodic phenomena with trigonometric functions — **Additional**

F-TF.5
Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Sine functions are horizontal transformations of cosine functions. • Sine and cosine functions have the same periods. • Frequency is a reciprocal of period.	• Tangent functions are not appropriate to model periodic phenomena because tangent functions are undefined for $\frac{\pi}{2}+k\pi$, where k is an integer. • Sine and cosine functions are appropriate to model periodic phenomena. • Contexts that would recreate periodic phenomena.	• Model sine or cosine functions with variations in period, frequency, or midline. • Describe similarities/differences in models based on period, frequency, or midline.

ALGEBRA II

Functions

Trigonometric (F-TF)

Prove and apply trigonometric identities — **Additional**

F-TF.8
Prove the Pythagorean identity $\sin(\Theta)^2 + \cos(\Theta)^2 = 1$ 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.

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• How to solve quadratic functions. • How to find unknown lengths of a right triangle. • How to create a reference triangle within a unit circle.	• One proof of the Pythagorean theorem. • Effects that quadrants have on positive/negative values.	• Find $\sin(\Theta)$, $\cos(\Theta)$, or $\tan(\Theta)$, given $\sin(\Theta)$, $\cos(\Theta)$, or $\tan(\Theta)$. • Prove the Pythagorean identity.

ALGEBRA II

Geometry

Expressing Geometric Properties with Equations (G-GPE)

Translate between the geometric description and the equation for a conic section	Additional

G-GPE.2 Derive the equation of a parabola given a focus and directrix.	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
	• Recognize a parabola as conic sections, formed by the intersection of a cone and a plane parallel to a side of the cone. • Distinguish between vertical and horizontal parabolas. • Define and identify the focus of a parabola, directix, and focal length. • Each point on a parabola is equidistance from both the focus and directix.	• Applying the vertex equation for a parabola.	• Use the focus and directix of a parabola to create its equation. • Attend to precision of vocabulary such as focus and directix used with parabolas.

ALGEBRA II

Statistics and Probability*

Interpreting Categorical and Quantitative Data (S-ID)

Summarize, represent, and interpret data on a single count or measurement variable			Additional
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.*	**Desired Student Performance**		
	A student should know • Define and give characteristics of mean, variance, standard deviation, and normal distribution. • Define discrete and continuous probability distribution.	**A student should understand** • How to calculate mean, variance, and standard deviation. • Give examples of discrete and continuous probability distributions in real world contexts.	**A student should be able to do** • Use appropriate tools strategically. • Apply standard deviation to create a normal distribution that models a real world scenario. • Interpret data given in a graphic display.

ALGEBRA II

Statistics and Probability*

Interpreting Categorical and Quantitative Data (S-ID)

Summarize, represent, and interpret data on two categorical and quantitative variables — **Supporting**

S-ID.6
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, quadratic, and exponential models.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Quantitative variables. • Line of best fit. • Trend line.	• Displaying data on a scatter plot. • Recognize types of correlation (weak or strong, negative or positive, or no correlation).	• Create a scatter plot to display a data set. • Match data with its graphical representation. • Describe the correlation between two variables. • Make inferences about the problem in context based on its function and data.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Understand and evaluate random processes underlying statistical experiments	Supporting

S-IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Define a population. • Define a sample. • Define a representative sample. • Define a random sample.	• Given a scenario, identify the population and sample. • Determine if a sample is representative of the population.	• Determine the population given details of the experiment. • Design a collection process to create a representative sample. • Explain the importance and usefulness of representative samples when making inferences about populations. • Apply to a real world context.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Understand and evaluate random processes underlying statistical experiments — **Supporting**

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?**

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• The probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. • Recognize that experimental probability and theoretical (expected) probability may yield different results.	• Using a frequency table or graph to display a population distribution.	• Justify discrepancies in results concerning experimental probability versus theoretical (expected) probability. • Discuss how/ when experimental probability approaches the theoretical (expected) probability. • Make sense of a real world context to justify discrepancies in experimental and theoretical probability. • Use sample data to make, justify and critique inferences and conclusions about the corresponding population.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Make inferences and justify conclusions from sample surveys, experiments, and observational studies	**Major**

S-IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Define sample survey, experiment and observational study.	• Identify if a scenario describes a sample survey, experiment or observational study. • Determine major difference between sample survey, experiment and observational study. • List the strengths and weakness of each.	• Determine whether a sample survey, experiment or observational study is appropriate for a given circumstance. • Explain when and why each would be appropriate. • Modify scenarios to create appropriate circumstance for sample survey, experiment or observational study.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Make inferences and justify conclusions from sample surveys, experiments, and observational studies	**Major**

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.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Sampling types and methods (convenience, self-selected, systematic, and random sampling). • Bias and influence.	• Recognize and create proportional relationships. • Finding margin of error. • Calculating confidence interval.	• Apply data from a sample to its population by relating parts to the whole and creating proportional models. • Identify bias. • Calculate and justify margin of error via simulation models of real world contexts.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Make inferences and justify conclusions from sample surveys, experiments, and observational studies	Major

S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.*	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
	• Sampling types and methods (convenience, self-selected, systematic, and random sampling). • Z-score.	• Calculating Z-score. • Using proportions to compare data.	• Compare data to its population by relating parts to the whole and creating proportional models. • Recreate the event with various parameters to gather more data. • Create a viable argument to justify if differences in parameters are significant.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Make inferences and justify conclusions from sample surveys, experiments, and observational studies	**Major**

S-IC.6 Evaluate reports based on data.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Measures of central tendencies and their uses. • Measures of variation. • Interpreting a box-and-whiskers plot.	• Calculating measures of central tendency. • Calculating measures of variation.	• Attend to precision in use of explicit statistical vocabulary. • Decide if specified models are consistent with results from the given data-generating processes.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Understand independence and conditional probability and use them to interpret data	Additional

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").*	Desired Student Performance		
	A student should know • Conditional probability • Contingency, or two-way frequency, tables. • Addition Rule of Probability. • Independent and dependent events.	**A student should understand** • The formula to find conditional probability-- For any two events *A* and *B* with $P(A) \neq P(B|A)=\frac{P(AandB)}{P(A)}$	**A student should be able to do** • Recognize, determine, and use conditional probability in contextual problems. • Apply the Addition Rule of Probability and interprets answers in context.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Understand independence and conditional probability and use them to interpret data	Additional

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.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Define and identify examples of dependent and independent events.	• Finding the probability of a single event. • The probability of events A and B: $P(A \text{ and } B) = P(A) \bullet P(B)$.	• Determine if two real world events are independent of one another. • Give examples of real world independent events and determine the probability of them both happening.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Understand independence and conditional probability and use them to interpret data	Additional

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*.*	Desired Student Performance		
	A student should know	**A student should understand**	**A student should be able to do**
	• Conditional Probability.	• Calculating probability of compound events-- The probability of events A and B: *P*(*A* and *B*) = *P*(*A*)•*P*(*B*).	• Communicate dependency of one event to another in calculating its probability. • Identify conditional probability in real world contexts.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Understand independence and conditional probability and use them to interpret data — **Additional**

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.**

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Conditional probability. • Contingency, or two-way frequency, table. • Addition Rule of Probability. • Independent and dependent events.	• Calculating conditional probability-- For any two events *A* and *B* with $P(A) \neq P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$	• Create and interpret contingency tables based on real world contexts. • Create a viable argument as to whether two events are independent or dependent.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Understand independence and conditional probability and use them to interpret data

Additional

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.**

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Conditional probability. • Independent and dependent events.	• Calculating conditional probability-- For any two events *A* and *B* with $P(A) \neq P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$	• Determine if conditional probability exist in real world context examples. • Create a viable argument as to whether two events are independent or dependent.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Use the rules of probability to compute probabilities of compound events in a uniform probability model	Additional

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.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Conditional probability. • Contingency, or two-way frequency, table. • Addition Rule of Probability. • Independent and dependent events.	• Calculating conditional probability-- For any two events *A* and *B* with $P(A) \neq P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$	• Interpret contingency tables based on real world contexts to find the conditional probability. • Relate and explain the answer back to the real world context of the problem.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Use the rules of probability to compute probabilities of compound events in a uniform probability model	**Additional**

S-CP.7 Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, and interpret the answer in terms of the model.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Dependent events. • Independent events. • Mutually exclusive events.	• The probability of events A and B: $P(A \text{ and } B) = P(A) \bullet P(B)$. • The probability of event A or B: $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$. • The probability of event A or B if the two are mutually exclusive events: $P(A \text{ or } B) = P(A) + P(B)$.	• Identify dependent, independent, and mutually exclusive events in a real world context. • Identify events and apply the Addition Rule in real world context.