Algebra 2

U-46 Curriculum Scope and Sequence

Reporting Strand	Instructional Focus	CCSS	Pacing
Real & Complex Solutions (Radicals)	3.1 Analyze radical functions	**A.REI.2**, **F.IF.7b**, F.IF.9, F.BF.3	4 weeks
	3.2 Determine complex quadratic roots	N.CN.1, N.CN.2, **N.CN.7**	
Polynomials	6.1 Operate with polynomials	A.APR.1, A.APR.4, **A.SSE.2**, A.SSE.1	5 weeks
	6.2 Explore polynomial factors and zeros	A.SSE.3, **A.APR.2**, **A.APR.3**, A.APR.6	
	6.3 Analyze polynomial functions	**A.APR.3**, **F.IF.4**, **F.IF.7c**, F.IF.6, A.CED.1	
Rational Relationships	7.1/7.2 Develop and solve rational expressions and equations	A.APR.7, **A.REI.2**, A.SSE.2	6 weeks
	8.1/8.2 Represent and compare rational functions	**F.IF.7d**, F.IF.5, A.REI.11	
Functions	1.2 Explore inverse functions (and compositions)	F.BF.4, **F.BF.1c**	3 weeks
	1.3 Explore function transformations	F.IF.7a/b, **F.BF.3**	
Exponents & Logarithms	2.1/2.2 Represent and model exponential functions	A.CED.1, **F.IF.8**, F.LE.5, F.IF.7e, **F.BF.3**, A.REI.11	5 weeks
	2.3/2.4 Discover and apply logarithms	**F.BF.4, F.BF.5, F.LE.4,** F.IF.7e, F.BF.3	
Multivariate Equations & Inequalities	5.1 Investigate systems of linear inequalities (contextual situations)	A.CED.2, **A.CED.3,** A.REI.12	3 weeks
	5.2 Solve nonlinear systems	**A.REI.11,** A.REI.7	
Trigonometry	9.1/9.2 Explore angle measures and the Unit Circle	F.TF.1, **F.TF.2**, **F.TF.3**, F.TF.8	5 weeks
	9.2/9.3 Represent and apply trigonometric functions	**F.IF.7e**, F.IF.9, **F.TF.5**	
Probability & Statistics	10.1/10.2 Explore and apply rules of conditional probability	S.CP.1, **S.CP.2, S.CP.3**, S.CP.4, **S.CP.5, S.CP.6, S.CP.7, S.CP.8**, S.MD.6, S.MD.7	5 weeks
	11.1/11.2 Analyze statistical data and explore normal distributions	S.IC.1, S.IC.2, S.IC.3, **S.IC.4, S.IC.5, S.IC.6**, S.ID.4	

Standards that are **bolded and underlined** are the essential "power standards"

Real & Complex Solutions

3.1 Analyze radical functions

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Solve radical equations (A.REI.2)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Solve a radical equation **with multiple radicals** and identify extraneous solutions	Solve a radical equation **with a variable on both sides and identify extraneous solutions**	Solve a **multi-step radical equation**	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Graph and interpret radical functions (F.IF.7b)		Identify the meaning of a point from both graphs **and** verbal/written descriptions **in terms of the context**	Identify the meaning of a point from a graph **or** verbal/written description **in terms of the context**	Identify the meaning of a point from a graph **or** verbal/written description	
Identify Transformations (F.BF.3)		Identify the effect on a graph by replacing f(x) with **more than two** transformations: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **more than two transformations.**	Identify the effect on a graph by replacing f(x) with **two** transformations: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **two transformations.**	Identify the effect on a graph by replacing f(x) with a **single** transformation: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **a transformation**.	
Compare key features (F.IF.9)		Compare key features of two functions represented ● algebraically ● graphically ● numerically in tables ● verbal descriptions Key features include: ● intercepts ● domain/range ● increasing or decreasing ● **positive or negative** ● **symmetries** ● **end behavior**	Compare key features of two functions represented ● algebraically ● graphically ● numerically in tables ● verbal descriptions Key features include: ● intercepts ● domain/range ● **increasing or decreasing**	Compare key features of two functions represented ● algebraically ● graphically ● numerically in tables ● verbal descriptions Key features include: ● intercepts ● domain/range	

A.REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases b. Graph square root, cube root, ~~and piecewise-defined functions, including step functions and absolute value~~ functions.

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 negative and positive); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

F.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.*

Real & Complex Solutions

3.2 Determine complex quadratic roots

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Operations with complex numbers (N.CN.1, N.CN.2)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Use the relation $i^2 = -1$ and the properties of operations to add, subtract **and multiply** complex numbers and write the solution in standard form	Use the relation $i^2 = -1$ and the properties of operations to add and subtract complex numbers and **write the solution in standard form**	Use the relation $i^2 = -1$ and the properties of operations to add and subtract complex numbers, **but does not write all solutions in standard form**	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Solve quadratic equations with complex roots (N.CN.7)		Solve quadratic equations with complex roots using **both** of the following • Quadratic formula • Factoring	**Solve** quadratic equations with complex roots using **one** of the following • Quadratic formula • Factoring	**Determine** if a quadratic has complex or real roots	

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.

N.CN.7 Solve quadratic equations with real coefficients that have complex solutions.

Polynomials

6.1 Operate with polynomials

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Operations with polynomials (A.APR.1)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Add, subtract and multiply polynomials with integers **within the same problem**	Add and subtract polynomials with integers **and multiply** polynomials with integers	**Add and subtract polynomials** with integers	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Rewrite polynomial expressions (A.SSE.2, A.APR.4)		Rewrite polynomial expressions in different equivalent forms by using **all of the following:** ● greatest common factors ● difference of two squares ● trinomials ● quadratic-like trinomials (degree 4 or higher) ● sums or difference of cubes	Rewrite polynomial, rational, and exponential expressions in different equivalent forms by doing **4 of the following**: ● greatest common factors ● difference of two squares ● trinomials ● quadratic-like trinomials (degree 4 or higher) ● sums or difference of cubes	Rewrite polynomial, rational, and exponential expressions in different equivalent forms by doing **3 of the following**: ● greatest common factors ● difference of two squares ● trinomials ● quadratic-like trinomials (degree 4 or higher) ● sums or difference of cubes	
Interpret expressions (A.SSE.1)		Interpret individual parts of polynomial expressions (such as variables, coefficients, factors, etc.) **and explain their meaning in terms of the context** Group parts of polynomial expressions and interpret their meaning **in terms of the context**	**Interpret** individual parts of polynomial expressions (such as variables, coefficients, factors, etc.) Group parts of a polynomial expressions and **interpret their meaning**	**Identify** individual parts of polynomial expressions (such as variables, coefficients, factors, etc.) **Identify groups** in polynomial expressions	

A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

A.APR.4 Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity* $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ *can be used to generate Pythagorean triples.*

A.SSE.2 Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 – y^4$ *as* $(x^2)^2 – (y^2)^2$, *thus recognizing it as a difference of squares that can be factored as* $(x^2– y^2)(x^2 + y^2)$.

A.SSE.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 onP.*

Polynomials

6.2 Explore polynomial factors

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Apply the Remainder Theorem (A.APR.2, A.APR.6)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Factor a polynomial using either synthetic division or long division, writing $\frac{a(x)}{b(x)}$, in the form $q(x)+\frac{r(x)}{b(x)}$ **and identify** • if p(a) is zero, then (x-a) is a factor • if p(a) is not zero, then (x-a) is not a factor • p(a) is the remainder when dividing p(x) by x-a. • the remainder is equivalent to p(a)	Can perform synthetic or long division **correctly and are able to state the remainder, writing** $\frac{a(x)}{b(x)}$, in the form $q(x)+\frac{r(x)}{b(x)}$	Can perform synthetic or long division **with a structural error, but were able to follow through with their mistake**	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Identify zeros (A.APR.3, A.SSE.3)		Identify the zeros of a polynomial using **multiple methods of factoring, which may include using synthetic division**	Identify the zeros of a polynomial **using two methods of factoring**	Identify the zeros of a polynomial **using a single method of factoring**	

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.6 Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.

A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*

a. Factor a quadratic expression to reveal the zeros of the function it defines.

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.~~

Polynomials

6.3 Analyze polynomial functions

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Identify zeros to construct graphs (A.APR.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Identify the zeros of a polynomial function in **standard form** and use the zeros as one of the criteria to construct a rough graph of the function	Identify the zeros of a polynomial function in **factored form** and use the zeros of the function as one of the criteria to construct a **rough graph of the function**	Identify the zeros of a polynomial function in **factored form and can only correctly graph the zeros**.	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Average rate of change (F.IF.6)		Calculate the average rate of change over a given interval **and explain the meaning in context.**	**Calculate** the average rate of change over a given interval	**Describe** the average rate of change over a given interval	
Graph and interpret polynomial functions (F.IF.4, F.IF.7c) *Can use technology*		Graph polynomial functions and **interpret all key features** of the graph in the context of a situation Translate a verbal description of a relationship to **sketch** a polynomial graph Identify an appropriate domain **based on the context** from both graphs **and** verbal/written descriptions Identify the meaning of a point from both graphs **and** verbal/written descriptions **in terms of the context**	Graph polynomial functions and **interpret some key features** of the graph in the context of a situation Translate a verbal description of a graph's key features to **sketch** a polynomial graph Identify an appropriate domain **based on the context** from graphs **or** verbal/written descriptions Identify the meaning of a point from a graph **or** verbal/written description **in terms of the context**	Graph polynomial functions and **identify key features** of the graph Translate a verbal description of a graph's key features to **identify** a polynomial graph Identify the domain from graphs **or** verbal/written descriptions Identify the meaning of a point from a graph **or** verbal/written description	
Create polynomial equations (A.CED.1)		Create a polynomial equation in **expanded form** given the zeros, multiplicity, and leading coefficient	Create a polynomial equation in factored form given the zeros, **multiplicity, and leading coefficient**	Create a polynomial equation in **factored form given the zeros**	

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.

F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*★

F.IF.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.

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.★

A.CED.1 Create equations ~~and inequalities~~ in one variable and use them to solve problems.

Rational Relationships

7.1/7.2 Develop and solve rational expressions and equations

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Operations with rational expressions (A.APR.7)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Add, subtract, multiply and divide rational expressions, **using multiple operations,** simplifying the expression **and** identifying any restricted values	Add, subtract, multiply **and** divide rational expressions, simplifying the expression **or** identifying any restricted values	Add, subtract, multiply **or** divide rational expressions **(Can perform 2 of the 4),** simplifying the expression **or** identifying any restricted values	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Solve rational equations (A.REI.2)		Solve a rational equation **involving factoring** and identify extraneous solutions	Solve a rational equation **and identify extraneous solutions**	Solve a rational equation **that is a proportion.**	
Rewrite polynomial expressions (A.SSE.2)		Rewrite polynomial expressions in different equivalent forms by using **all of the following:** ● greatest common factors ● difference of two squares ● trinomials ● quadratic-like trinomials (degree 4 or higher) ● sums or difference of cubes	Rewrite polynomial, rational, and exponential expressions in different equivalent forms by doing **4 of the following**: ● greatest common factors ● difference of two squares ● trinomials ● quadratic-like trinomials (degree 4 or higher) ● sums or difference of cubes	Rewrite polynomial, rational, and exponential expressions in different equivalent forms by doing **3 of the following**: ● greatest common factors ● difference of two squares ● trinomials ● quadratic-like trinomials (degree 4 or higher) ● sums or difference of cubes	

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.

A.REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

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* $(x^2 - y^2)(x^2 + y^2)$.

Rational Relationships

8.1/8.2 Represent and compare rational functions

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Graph and identify key features of rational functions (F.IF.5, F.IF.7d)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Graph rational functions, given the model, and interpret all related key features of a graph **in context of a real world situation**. ● zeros ● asymptotes ● intercepts ● holes ● end behavior ● domain	**Graph** rational functions, given the model, and identify all related key features of a graph. ● zeros ● asymptotes ● intercepts ● holes ● end behavior ● domain	**Given the graphs** of rational, exponential, logarithmic and trigonometric functions, and identify all related key features of a graph. ● zeros ● asymptotes ● intercepts ● holes ● end behavior ● domain	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Explain intersec-tion points (A.REI.11)		For rational functions find intersection points using technology, graphs, and tables and **explain in the context of a situation**	For rational functions find intersection points using technology, graphs, **and** tables	For rational functions find intersection points using technology, graphs **or** tables	

F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*★

F.IF.7d Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases
d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

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.*

Functions

1.2 Explore inverse functions (and compositions)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Produce inverse functions (F.BF.4)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Can do **all** of the following: • Read values of an inverse function from a graph and table • Given a simple function, find its inverse • Compose functions to verify if one function is the inverse of another function	Can do **2** of the following: • Read values of an inverse function from a graph and table • Given a simple function, find its inverse • Compose functions to verify if one function is the inverse of another function	Can do **1** of the following: • Read values of an inverse function from a graph and table • Given a simple function, find its inverse • Compose functions to verify if one function is the inverse of another function	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Evaluate composed functions (F.BF.1c)		Evaluate the composition of 2 functions **in context of a situation**	Evaluate the **composition of 2 functions**	Evaluate a function for a given value and use that result to **evaluate** a second function	

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.

F.BF.1c Write a function that describes a relationship between two quantities.

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.

Functions

1.3 Explore function transformations

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Identify transform-ations and key features of graphs (F.IF.7a/b, F.BF.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Identify the effect on a graph by replacing f(x) with **more than two** transformations: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **more than two transformations.** Graph function transformations (quadratics, square root, cube root, linear, absolute value) and identify all related key features of a graph **in context of a situation**. ● lines of symmetry ● intercepts ● domain/range	Identify the effect on a graph by replacing f(x) with **two** transformations: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **two transformations.** **Graph function transformations** (quadratics, square root, cube root, linear, absolute value) and identify all related key features of a graph. ● lines of symmetry ● intercepts ● domain/range	Identify the effect on a graph by replacing f(x) with a **single** transformation: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **a transformation**. **Given the graphs** of functions (quadratics, square root, cube root, linear, absolute value) identify all related key features of a graph. ● lines of symmetry ● intercepts ● domain/range	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1

F.IF.7a/b 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.

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.~~

Exponents & Logarithms

2.1/2.2 Represent and model exponential functions

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Create and solve exponent-tial functions (A.CED.1)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Create exponential equations **and use them in a contextual situations to solve problems.**	**Create** exponential equations to model a contextual situation.	**Identify** exponential equations to model a contextual situation.	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Rewrite and solve exponent-tial functions (F.IF.8)		**Write an exponential function in equivalent forms** to reveal key features (ie. rate of change, decay, growth) and use them in a **contextual situation to solve problems.**	Identify key features (ie. rate of change, decay, growth) from a function **and interpret the features in context of the situation.**	**Identify key features** (ie. rate of change, decay, growth) from a function	
Graph, interpret exponential functions (F.IF.7e, F.LE.5) *Can use technology for more complex cases*		Graph exponential functions and **interpret all key features** of the graph in the context of a situation	Graph exponential functions and **interpret some key features of the graph in the context of a situation**	Graph exponential and logarithmic functions and **identify key features** of the graph	
Identify transformations (F.BF.3)		Identify the effect on a graph by replacing f(x) with **more than two** transformations: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **more than two transformations.**	Identify the effect on a graph by replacing f(x) with **two** transformations: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **two transformations.**	Identify the effect on a graph by replacing f(x) with a **single** transformation: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **a transformation**.	
Find intersection points involving exponential functions (A.REI.11)		For exponential functions, find intersection points using technology, graphs, and tables and **explain in the context of a situation**	For exponential functions, find intersection points using technology, graphs, **and** tables	For exponential functions, find intersection points using technology, graphs **or** tables	

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 $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12^t$, $y = (1.2)^t/10$, and classify them as representing exponential growth or decay.

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.

F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.

A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions*.

A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*

F.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.

Exponents & Logarithms

2.3/2.4 Discover and apply logarithms

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Solve exponential and logarithmic equations (F.BF.4, F.BF.5, F.LE.4)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Use the inverse relationship of logarithmic and exponential functions to solve problems **in contextual situations.**	Use the inverse relationship of logarithmic and exponential functions to **solve problems.**	**Rewrite logarithmic and exponential functions as inverses**	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Graph and interpret log functions (F.IF.7e) *Can use technology for more complex cases*		Graph logarithmic functions and **interpret all key features** of the graph in the context of a situation	Graph logarithmic functions and **interpret some key features** of the graph in the context of a situation	Graph logarithmic functions and **identify key features** of the graph	
Identify transformations (F.BF.3)		Identify the effect on a graph by replacing f(x) with **more than two** transformations: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **more than two transformations.**	Identify the effect on a graph by replacing f(x) with **two** transformations: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **two transformations.**	Identify the effect on a graph by replacing f(x) with a **single** transformation: $f(x) + k$, $a\,f(x)$, $f(bx)$, $f(x + h)$ for specific positive and negative values of the constants a, b, h, and k Write a function given **a transformation**.	

F.IF.7e 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.

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.

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.

F.BF.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

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.

Multivariate Equations & Inequalities

5.1 Investigate systems of linear inequalities (contextual situations)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Identify, graph, and interpret solutions of systems of inequalities (A.CED.3, A.CED.2, A.REI.12)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Create and graph a system of inequalities for contextual situations Interpret solutions **as viable or nonviable options** in context of the situation (maximizing/minimizing)	**Create and graph** a system of inequalities for contextual situations Interpret solutions **in context of the situation.**	**Identify a system of inequalities** for contextual situations **Identify solutions**	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1

A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes ~~with labels and scales.~~

A.REI.12 ~~Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and~~ graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Multivariate Equations & Inequalities

5.2 Solve nonlinear systems

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Solve non-linear systems (A.REI.11)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	For polynomial, rational, absolute value, exponential, and logarithmic functions, find intersection points using technology, graphs, and tables and **explain in the context of a situation.**	For polynomials, rational, absolute value, exponential, and logarithmic functions, find intersection points using technology, graphs, **and** tables	For polynomial, rational, absolute value, exponential, and logarithmic functions, find intersection points using technology, graphs **or** tables	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Solve systems of linear and quadratic equations (A.REI.7)		Solve a system of a linear equation and quadratic equation in two variables algebraically, **when completing the square is necessary**.	Solve a system of a linear equation and quadratic equation in two variables algebraically, **when having to solve for y**.	Solve a system of a linear equation and quadratic equation in two variables algebraically, **when one equation is solved for y**.	

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.★

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 x2 + y2 = 3.

Trigonometry

9.1/9.2 Explore angle measures and the unit circle

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Understand radians (F.TF.1)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	**Explain** and use the relationship between radian measures and degrees/arc lengths to solve problems	**Use the relationship** between radian measures and degrees/arc lengths to solve problems	**Convert** between radians and degrees	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Create the unit circle (F.TF.2, F.TF.3)		Use special triangles to determine **and explain** the values of sine, cosine, tangent for **anything between 0 and 2π** on the unit circle	Use special right triangles to determine the values of sine, cosine, tangent for **0**, π/6, π/4, π/3 and **π/2** on the unit circle	Use special right triangles to determine the values of sine, cosine and tangent **for π/6, π/4 and π/3** on the unit circle	
Pythagorean identity of sine and cosine (F.TF.8)		**Prove** the Pythagorean identity $sin^2(\theta) + cos^2(\theta) = 1$ and use it to find $sin(\theta)$, $cos(\theta)$, and $tan(\theta)$	Use the Pythagorean identity $sin^2(\theta) + cos^2(\theta) = 1$ to find $sin(\theta)$, $cos(\theta)$, **and** $tan(\theta)$	**Use** the Pythagorean identity $sin^2(\theta) + cos^2(\theta) = 1$ to find $sin(\theta)$, $cos(\theta)$, **or** $tan(\theta)$	

F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

F.TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

F.TF.3 (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, ~~and use the unit circle to express the values of sine, cosine, and tangent for π−x, π+x, and 2π−x in terms of their values for x, where x is any real number.~~

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.

Summatively assess after completing Explore and Investigation 1 in Concept 9.2

The remaining portion of Concept 9.2 is within Represent and Apply Trigonometric Functions

Trigonometry

9.2/9.3 Represent and apply trigonometric functions

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Create trigonometric functions (F.TF.5)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Given a specified amplitude, frequency, and midline for a real world situation, **create a sine, cosine and/or tangent function**	Given the sine, cosine or tangent function for a real world situation, identify the amplitude, frequency **and** midline	Given the sine, cosine or tangent function for a real world situation, identify the amplitude, frequency **or** midline	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Graph and identify key features of trig functions (F.IF.7e)		Graph a sine, cosine, **and tangent** function, with an amplitude change, period change, and midline change.	Graph a sine and cosine function with an amplitude change, period change, **and** midline change.	Graph a sine and cosine function with an amplitude change, period change, **or** midline change.	
Compare key features (F.IF.9)		Compare key features of two functions represented ● algebraically ● graphically ● numerically in tables ● verbal descriptions **in context of a situation** Key features include: ● midline ● amplitude ● minimums and maximums	Compare key features of two functions represented ● algebraically ● graphically ● numerically in tables ● verbal descriptions Key features include: ● midline ● amplitude ● **minimum and maximums** ● **increasing or decreasing**	Compare key features of two functions represented ● algebraically ● graphically ● numerically in tables ● verbal descriptions Key features include: ● midline ● amplitude	

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

F.IF.7e 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.

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.

Probability & Statistics

10.1/10.2 Explore and apply rules of conditional probability

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Describe sample space (S.CP.1)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Describe events within the sample space using characteristics **or as unions, intersections, or complements of other events (with and without notation)**	**Describe** events within the sample space using characteristics	**Identify** events in a sample space	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Independent and conditional probability (S.CP.2, S.CP.3, S.CP.5, S.CP.6, S.MD.6, S.MD.7)		Recognize, determine **and use** independent and conditional probability in contextual problems Apply probability concepts to **analyze and make fair decisions** related to real-world situations	Recognize and determine independent **and conditional probability** in contextual problems	Recognize and determine **independent probability** in contextual problems.	
Construct frequency tables (S.CP.4)		Construct a two-way frequency table for data, use the table to determine independence, **and** calculate conditional probabilities from the table	Construct a two-way frequency table for data **and use the table** to determine independence or calculate conditional probabilities from the table	**Construct a two-way frequency table** for data	
Apply rules of probability (S.CP.7, S.CP.8)		Apply the addition and multiplication rules in a probability model **and interpret the answer in context of the situation**	Apply the addition **and** multiplication rules in a probability model	Apply the addition **or** multiplication rules in a probability model	

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.*

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.

S.CP.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.

S.MD.6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).

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).

Probability & Statistics

11.1/11.2 Analyze statistical data and explore normal distributions

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Understand statistical data and models (S.IC.1, S.IC.2, S.IC.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Use sample data to make inferences about a population **Explain** using randomization why a sample survey, experiment or observational study is most appropriate **Decide** if data models are consistent with the results	**Use** sample data to make inferences about a population **Determine** whether a sample survey, experiment or observational study is most appropriate Determine whether **experimental probabilities match given theoretical probabilities**	**Identify** when sample data can be used to make inferences about a population **Identify** whether a given scenario represents a sample survey, experiment or observational study **Identify** experimental and theoretical probabilities	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Use data (S.IC.4, S.IC.5, S.IC.6, S.ID.4)		Can do **all** of the following: • 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. • Use data from a randomized experiment to compare two treatments • Use simulations to decide if differences between parameters are significant. • Evaluate reports based on data. • Uses the means and standard deviations of data sets to fit them to normal distributions • Fits functions to data in order to solve contextual problems	Can do **five** of the following: • 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. • Use data from a randomized experiment to compare two treatments • Use simulations to decide if differences between parameters are significant. • Evaluate reports based on data. • Uses the means and standard deviations of data sets to fit them to normal distributions • Fits functions to data in order to solve contextual problems	Can do **four** of the following: • 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. • Use data from a randomized experiment to compare two treatments • Use simulations to decide if differences between parameters are significant. • Evaluate reports based on data. • Uses the means and standard deviations of data sets to fit them to normal distributions • Fits functions to data in order to solve contextual problems	

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.
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.
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.