ALGEBRA II

Curriculum/Content Area: Mathematics	**Course Length:** 2 terms
Course Title: Algebra II Honors Algebra II	**Date last reviewed:** 2014/2015 Link Previous UbD (for work team reference)
Prerequisites: Algebra 1	**Board approval date:** 8/2020
Primary Resource: REVEAL Algebra II	

Desired Results

Course description and purpose:
Algebra II is a continuation of Algebra 1, including the solutions of equations, inequalities, and systems. An emphasis is placed upon understanding relations and functions, including quadratic functions, polynomial functions, radical functions, exponential functions, logarithmic functions and rational functions. Also, inferential statistics are introduced.

Honors Algebra II is a rigorous, fast-paced course that includes a more in-depth study of Algebra II.

Enduring Understandings:	**Essential Questions**:
Mathematicians make sense of problems and persevere in solving them.	a. How do we as mathematicians analyze the problem in order to choose the best strategy(ies) or resource to make sense of the problem? b. How do we as mathematicians persevere in solving problems?
Mathematicians attend to precision.	How do we as mathematicians know if we fully & accurately answered the problem and does the results make sense in the context of the problem?
Mathematicians reason abstractly and quantitatively.	How do we as mathematicians make sense of quantities and situations symbolically?
Mathematicians construct viable arguments and critique the reasoning of others.	a. How can we as mathematicians justify our answer(s)? b. How can we as mathematicians evaluate and question whether a mathematical argument is accurate?
Mathematicians model with mathematics.	a. What model(s) can we as mathematicians use to solve a problem? b. How can we as mathematicians determine an effective model to use to solve a problem?

Mathematicians use appropriate tools strategically.	What tools are available and efficient for us as mathematicians to use while solving a problem?
Mathematicians look for and make use of structure	How can we as mathematicians use and apply patterns and structures to solve problems?
Mathematicians look for and express regularity in repeated reasoning.	How can we as mathematicians create and apply generalizations from repeated reasoning?

Mathematical Practice Standards

The Standards for Mathematical Practice are central to the teaching and learning of mathematics. These practices describe the behaviors and habits of mind that are exhibited by students who are mathematically proficient. Mathematical understanding is the intersection of these practices and mathematics content. It is critical that the Standards for Mathematical Practice are embedded in daily mathematics instruction.

Mathematical Practice Standards		Grade Level/Course
Habits of Mind	MP.1 Make sense of problems and persevere in solving them	Understand the meaning of a problem and look for entry points to its conclusion. Analyze information (givens, constraints, relationships, goals. Make conjectures and plan a solution pathway. Monitor and evaluate the progress and change course as necessary Check answers to problems and ask, “Does this make sense?”
	MP.6 Attend to precision.	Communicate precisely using clear definitions. State the meaning of symbols, carefully specifying units of measure, and providing accurate labels. State the meaning of symbols, carefully specifying units of measure, and providing accurate labels. Calculate accurately and efficiently, expressing. numerical answers with a degree of precision. Provide carefully formulated explanations. Label accurately when measuring and graphing.
Reasoning & Explaining	MP.2 Reason abstractly and quantitatively.	Make sense of quantities and relationships in problem situations. Represent abstract situations symbolically and understand the meaning of quantities. Create a coherent representation of the problem at hand. Consider the units involved. Flexibility uses properties of operations.
	MP.3 Construct viable arguments and	Use definitions and previously established

	critique the reasoning of others.	causes/effects (results) in constructing arguments. Make conjectures and use counterexamples to build a logical progression of statements to explore and support ideas. Communicate and defend mathematical reasoning using objects, drawings, diagrams, and/or actions. Listen to or read the arguments of others. Decide if the arguments of others make sense and ask probing questions to clarify or improve the arguments.
Modeling & Using Tools	MP.4 Model with mathematics.	Apply prior knowledge to solve real world problems. Identify important quantities and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts, and/or formulas.Use assumptions and approximations to make a problem simpler. Check to see if an answer makes sense within the context of a situation and change a model when necessary.
	MP.5 Use appropriate tools strategically.	Make sound decisions about the use of specific tools (examples might include: calculator, concrete models, digital, technologies, pencil/paper, ruler, compass, protractor) Use technology tools to visualize the results of assumptions, explore consequences, and compare predictions with data. Identify relevant external math resources (digital content on a website) and use them to pose or solve problems. Use technological tools to explore and deepen understanding of concepts.
Seeing Structure & Generalizing	MP.7 Look for and make use of structure.	Look for patterns or structure, recognizing that quantities can be represented in different ways. Recognize the significance in concepts and models and use the patterns or structure for solving related problems. View complicated quantities both as single objects or compositions of several objects and use operations to make sense of problems.
	MP.8 Look for and express regularity in repeated reasoning.	Notice repeated calculations and look for general methods and shortcuts. Continually evaluate the reasonableness of intermediate results (comparing estimates), while attending to details, and make generalizations based on findings.

Priority Standard Clusters

A.SSE.A Interpret the structure of expressions.

- *(A.SSE.A.1)* Interpret expressions that represent a quantity in terms of its context. (A) Interpret parts of an expression, such as terms, factors and coefficients. (B) Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)^n as the product of P and a factor not depending on P.
- *(A.SSE.A.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.B Write expressions in equivalent forms to solve problems.

- *(A.SSE.B.4)* Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.

A.APR.A Perform arithmetic operations on polynomials.

- *(A.APR.A.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.B Understand the relationship between zeros and factors of polynomials.

- *(A.APR.B.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.B.3)* Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

A.APR.C Use polynomial identities to solve problems.

- *(A.APR.C.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.APR.C.5)* (+) Know and apply the Binomial Theorem for the expansion of (x + y)^n in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.

A.APR.D Rewrite rational expressions.

- *(A.APR.D.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.APR.D.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.CED.A Create questions that describe numbers or relationships.

- *(A.CED.A.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.CED.A.2)* Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- *(A.CED.A.3)* Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.
- *(A.CED.A.4)* Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's lae V = IR to highlight resistance R.

A.REI.A Understand solving equations as a process of reasoning and explain the reasoning.

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

A.REI.D Represent and solve equations and inequalities graphically.

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

F.IF.B Interpret functions that arise in applications in terms of the context.

- *(F.IF.B.4)* For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. 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.B.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.B.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.

F.IF.C Analyze functions using different representatives.

- *(F.IF.C.7)* Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (B) Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. (C) Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. (E) Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
- *(F.IF.C.8)* Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. (A) Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. (B) Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as y = (1.02)^t, y = (0.97)^t, y = (1.01)^12t, y = (1.2)^t/10, and classify them as representing exponential growth or decay.
- *(F.IF.C.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.

F.BF.A Build a function that models a relationship between two quantities.

- *(F.BF.A.1)* Write a function that describes a relationship between two quantities. (B) Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

S.IC.A Understand and evaluate random processes underlying statistical experiments.

- *(S.IC.A.1)* Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- *(S.IC.A.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?

Supporting Standard Clusters

N.CN.A Perform arithmetic operations with complex numbers.

- *(N.CN.A.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.A.2)* Use the relation i^2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

N.CN.C Use complex numbers in polynomial identities and equations.

- *(N.CN.C.7)* Solve quadratic equations with real coefficients that have complex solutions.
- *(N.CN.C.8)* (+) Extend polynomial identities to the complex numbers. For example, rewrite x^2 + 4 as (x + 2i)(x - 2i).
- *(N.CN.C.9)* (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

F.BF.B Build new functions from existing functions.

- *(F.BF.B.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 these effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
- *(F.BF.B.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 x^3 or f(x) = (x+1)/(x-1) for x does not = 1.

F.LE.A Construct and compare linear, quadratic, and exponential models and solve problems.

- *(F.LE.A.4)* For exponential models, express as a logarithm the solution to ab^ct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

F.TF.A Extend the domain of trigonometric functions using the unit circle.

- *(F.TF.A.1)* Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
- *(F.TF.A.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.B Model periodic phenomena with trigonometric functions.

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

F.TF.C Prove and apply trigonometric identities.

- *(F.TF.C.8)* Prove the Pythagorean identity sin^2 + cos^2 = 1 and use it to find sin, cos, or tan given sin, cos, or tan and the quadrant of the angle.

S.ID.A Summarize, represent, and interpret data on a single count or measurement variable.

- *(S.ID.A.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.

S.IC.B Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

- *(S.IC.B.3)* Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
- *(S.IC.B.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.B.5)* Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
- *(S.IC.B.6)* Evaluate reports based on data.

S.MD.B Use probability to evaluate outcomes of decisions.

- *(S.MD.B.6)* (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
- *(S.MD.B.7)* (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

Unit 1 - Relations and Functions

Essential Questions:

1. How do we as mathematicians know if we fully & accurately answered the problem and does the results make sense in the context of the problem?
2. What model(s) can we as mathematicians use to solve a problem?
3. How can analyzing a function help you understand the situation it models?

Unit Standards

Priority Standards

F.IF.B Interpret functions that arise in applications in terms of the context.

- *(F.IF.B.4)* For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. 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.B.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.C Analyze functions using different representatives.

- *(F.IF.C.7b)* 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.IF.C.7c)* 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.

A.CED.A Create questions that describe numbers or relationships.

- *(A.CED.A.3)* Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

F.IF.C Analyze functions using different representatives.

- *(F.IF.C.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.

Supporting Standards

F-BF.B Build new functions from existing functions.

- *(F.BF.B.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 these effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Learning Targets

- I can determine the continuity of functions and whether functions are one-to-one and/or onto **(F.IF.B.4 , F.IF.B.5) (L 1-1)**
  - I use different representations of functions, especially graphs, tables and symbols
  - I determine what the domain for a function should be and create a graph that displays it
  - I explain why the function for a given context has a continuous or discrete domain or a continuous or discrete range
- I can determine the linearity, intercepts, and symmetry of functions **(F.IF.B.4 , F.IF.B.5) (L 1-2)**
  - I use different representations of functions, especially graphs, tables and symbols
  - I find and interpret key features of the graphs and tables of a function such as extreme values, end behavior and intervals of increase and decrease
  - I determine what the domain for a function should be and create a graph that displays it
  - I explain why the function for a given context has a continuous or discrete domain or a continuous or discrete range
- I can identify extrema and end behavior of functions **(F.IF.B.4 , F.IF.C.7c) (L 1-3)**
  - I use different representations of functions, especially graphs, tables and symbols
  - I find and interpret key features of the graphs and tables of a function such as extreme values, end behavior and intervals of increase and decrease
  - I describe a situation that fits a given graph and explain why it does
  - I recognize linear and quadratic families from their symbolic forms and graphical forms
  - I graph linear and quadratic functions using by-hand methods and technology
- I can sketch graphs of functions and compare two functions represented in different ways **(F.IF.B.4 , F.IF.C.9) (L 1-4)**
  - I use different representations of functions, especially graphs, tables and symbols
  - I find and interpret key features of the graphs and tables of a function such as extreme values, end behavior and intervals of increase and decrease
  - I create an approximation graph for a given context and explain why it does
  - I compare key components of functions, for example the maximum value of a function given in symbolic and graphical forms
- I can graph linear functions and inequalities in two variables **(A.CED.A.3 , F.IF.B.4) (L 1-5)**
  - I determine if a solution is viable for a given context, and explain why or why not
  - I check a solution set of inequalities contextually, analytically and graphically to determine the viability of a solution
  - I compare key components of functions, for example the maximum value of a function given in symbolic and graphical forms
- I can write and graph piecewise-defined, step, and absolute value functions **(F.IF.B.4 , F.IF.C.7b) (L 1-6)**
  - I use different representations of functions, especially graphs, tables and symbols
  - I create an approximation graph for a given context and explain why it does
  - I explain an efficient process for graphing piecewise functions and for determining their

domain and range
    - I explain how to generate ordered pairs for an absolute value function and how to graph an absolute value function.
- I can identify and use transformations of functions **(F.IF.B.4, F.BF.B.3) (L 1-7)**
    - I use different representations of functions, especially graphs, tables and symbols
    - I find and interpret key features of the graphs and tables of a function such as extreme values, end behavior and intervals of increase and decrease
    - I describe a situation that fits a given graph and explain why it does
    - I create an approximation graph for a given context and explain why it does
    - I explain why f(x)+k translates the original graph of f(x) up k units and why f(x)-k translates the original graph of f(x) down k units
    - I explain why f(x+k) translates the original graph of f(x) left k units and why f(x-k) translates the original graph of f(x) down k units
    - I explain why kf(x) vertically stretches or shrinks the graph of f(x) by a factor of k and predict whether a given value of k will cause a stretch or a shrink
    - I explain why f(kx) horizontally stretches or shrinks the graph of f(x) by a factor of 1/k and predict whether a given value of k will cause a stretch or a shrink

Assessment Evidence

Performance Assessment Options & Rubrics
May include, but are not limited to the following:

- Feedback & Scoring Rubric based on Priority Standards
- Algebra II Feedback & Scoring Rubric based on Math Practice Standards
- End of Unit Assessment (3 versions with differentiation)
- Mid-unit checks/quizzes

Other assessment options
May include, but are not limited to the following:

- Classroom Exit Tickets/Quick Checks
- Quick Writes
- KWL Chart - (What I Know, Want to know, Learned)
- Marking Text
- Learning Log Reflection - Daily/Weekly
- I-Chart - Gather/Organize Information on a topic
- Focused Note Taking
- CSG - Collaborative Study Groups
- Socratic Seminar
- Philosophical Chairs
- Think/Pair/Share

Digital Tools & Supplementary Resources

- Aleks
- Desmos
- Desmos Classrooom Activities (Teacher Desmos)

Unit 2 - Linear Equations, Inequalities, and Systems

Essential Questions:

1. How do we as mathematicians analyze the problem in order to choose the best strategy(ies) or resource to make sense of the problem?
2. How can we as mathematicians determine an effective model to use to solve a problem?
3. How are equations, inequalities, and systems of equations or inequalities best used to model real-world situations?

Unit Standards

Priority Standards

A.CED.A Create questions that describe numbers or relationships.

- *(A.CED.A.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.CED.A.2)* Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- *(A.CED.A.3)* Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

A.REI.D Represent and solve equations and inequalities graphically.

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

F.IF.B Interpret functions that arise in applications in terms of the context.

- *(F.IF.B.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.

Supporting Standards

None

Learning Targets

- I can solve linear equations and inequalities in one variable **(A.CED.A.1 , A.CED.A.2) (L 2-1)**
  - I create an equation or inequality to model a situation with one variable.
  - I create an equation, inequality or system to model a situation with two variables.
- I can solve equations and inequalities involving absolute value algebraically **(A.CED.A.1 , A.CED.A.3) (L 2-2)**
  - I create an equation or inequality to model a situation with one variable.
  - I determine if a solution is viable for a given context, and explain why or why not

- I can write linear equations in standard, slope-intercept, and point-slope forms. **(A.CED.A.2, F.IF.B.6) (L 2-3)**
    - I create an equation, inequality or system to model a situation with two variables.
    - I calculate and interpret the average rate of change from multiple representations (table, graph, and symbols)
    - I explain what the average rate of change means in the context of a problem
- I can solve systems of equations by graphing **(A.CED.A.2, A.REI.D.11) (L 2-4)**
    - I create an equation, inequality or system to model a situation with two variables.
    - I explain how the x-coordinate of a solution to the system y=f(x) and y=g(x) solves f(x)=g(x)
    - I find approximate solutions for the system y = f(x) and y = g(x) using graphs or tables
- I can solve systems of equations by using substitution or elimination **(A.CED.A.3) (L 2-5)**
    - I determine if a solution is viable for a given context, and explain why or why not
- I can solve systems of inequalities in two variables **(A.CED.A.3) (L 2.6)**
    - I determine if a solution is viable for a given context, and explain why or why not
    - I check a solution set of inequalities contextually, analytically and graphically to determine the viability of a solution.
- I can use linear programming to find maximum and minimum values of a function **(A.CED.A.3) (L 2-7)**
    - I use contexts to determine constraints and can explain why for equations or inequalities and by systems of equations and/or inequalities
    - I determine if a solution is viable for a given context, and explain why or why not
    - I check a solution set of inequalities contextually, analytically and graphically to determine the viability of a solution.
- I can solve systems of equations in three variables **(A.CED.A.3) (L 2-8)**
    - I determine if a solution is viable for a given context, and explain why or why not
- I can solve equations and inequalities involving absolute value by graphing **(A.CED.A.1) (L 2-9)**
    - I create an equation or inequality to model a situation with one variable.

Assessment Evidence

Performance Assessment Options & Rubrics
May include, but are not limited to the following:

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- Focused Note Taking
- CSG - Collaborative Study Groups
- Socratic Seminar
- Philosophical Chairs
- Think/Pair/Share

Digital Tools & Supplementary Resources

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- Desmos
- Desmos Classrooom Activities (Teacher Desmos)

Unit 3 - Quadratic Functions

Essential Questions:

1. How do we as mathematicians analyze the problem in order to choose the best strategy(ies) or resource to make sense of the problem?
2. How can we as mathematicians determine an effective model to use to solve a problem?
3. What are important characteristics of a quadratic function, and what real-world situations can be modeled by quadratic functions and equations?

Unit Standards

Priority Standards

A.CED.A Create questions that describe numbers or relationships.

- *(A.CED.A.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.CED.A.2)* Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- *(A.CED.A.3)* Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

A.SSE.A Interpret the structure of expressions.

- *(A.SSE.A.1b)* Interpret expressions that represent a quantity in terms of its context. (B) Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)^n as the product of P and a factor not depending on P.

A.REI.D Represent and solve equations and inequalities graphically.

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

F.IF.B Interpret functions that arise in applications in terms of the context.

- *(F.IF.B.4)* For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. 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.B.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.
- *(F.IF.C.8a)* Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. (A) Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

Supporting Standards

N.CN.A Perform arithmetic operations with complex numbers.
- *(N.CN.A.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.A.2)* Use the relation i^2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

N.CN.C Use complex numbers in polynomial identities and equations.
- *(N.CN.C.7)* Solve quadratic equations with real coefficients that have complex solutions.
- *(N.CN.C.8)* (+) Extend polynomial identities to the complex numbers. For example, rewrite x^2 + 4 as (x + 2i)(x - 2i).

Learning Targets

- I can graph quadratic functions **(F.IF.B.4, F.IF.B.6) (L 3-1)**
  - I use different representations of functions, especially graphs, tables and symbols
  - I find and interpret key features of the graphs and tables of a function such as extreme values, end behavior and intervals of increase and decrease
  - I calculate and interpret the average rate of change from multiple representations (table, graph, and symbols)
  - I explain what the average rate of change means in the context of a problem
- I can solve quadratic equations by graphing **(A.CED.A.2, F.IF.B.4) (L 3-2)**
  - I create an equation, inequality or system to model a situation with two variables.
  - I use different representations of functions, especially graphs, tables and symbols
  - I find and interpret key features of the graphs and tables of a function such as extreme values, end behavior and intervals of increase and decrease
- I perform operations with pure imaginary and complex numbers **(N.CN.A.1, N.CN.A.2) (L 3-3)**
  - I define i in terms of solutions to x squared is equal to -1.
  - I describe a context from which complex numbers can arise - specifically, the solution of quadratic equations of the form x^2 = a, where a is a negative real number.
  - I justify the steps in a complex number computation using the commutative, associative and distributive properties
- I can solve quadratic equations by factoring **(N.CN.C.7, N.CN.C.8, F.IF.C.8a) (L 3-4)**
  - I explain the solution of quadratics and their representations relative to roots of the quadratic
  - I use algebraic reasoning to simplify and extend polynomial identities to complex numbers
  - I flexibly use technology and symbolic manipulation to find and interpret zeros, intervals where the function is increasing or decreasing, extrema, and symmetry

- I can simplify quadratic expressions by using the Square Root Property and completing the square **(N.CN.C.7, F.IF.C.8a) (L 3-5)**
    - I explain the solution of quadratics and their representations relative to roots of the quadratic
    - I flexibly use technology and symbolic manipulation to find and interpret zeros, intervals where the function is increasing or decreasing, extrema, and symmetry
    - I explain how f(x) = p(x - h)^2 + k determines the extreme value, axis of symmetry and zeros of a graph
- I can use the Quadratic Formula and discriminant to solve quadratic equations and determine the number of real roots **(N.CN.C.7, N.CN.C.8, A.SSE.A.1b) (L 3-6)**
    - I use solutions to identify both the real and non-real portions of the complex number
    - I explain the solution of quadratics and their representations relative to roots of the quadratic
    - I use algebraic reasoning to simplify and extend polynomial identities to complex numbers
- I can graph and solve quadratic inequalities **(A.CED.A.1, A.CED.A.3) (L 3-7)**
    - I create an equation or inequality to model a situation with one variable.
    - I determine if a solution is viable for a given context, and explain why or why not
    - I check a solution set of inequalities contextually, analytically and graphically to determine the viability of a solution
- I can solve systems of linear and quadratic equations **(A.REI.D.11) (L 3-8)**
    - I explain how the x-coordinate of a solution to the system y=f(x) and y=g(x) solves f(x)=g(x)
    - I find approximate solutions for the system y = f(x) and y = g(x) using graphs or tables

Assessment Evidence

Performance Assessment Options & Rubrics
May include, but are not limited to the following:

- Feedback & Scoring Rubric based on Priority Standards
- Algebra II Feedback & Scoring Rubric based on Math Practice Standards
- End of Unit Assessment (3 versions with differentiation)
- Mid-unit checks/quizzes

Other assessment options
May include, but are not limited to the following:

- Classroom Exit Tickets/Quick Checks
- Quick Writes
- KWL Chart - (What I Know, Want to know, Learned)
- Marking Text
- Learning Log Reflection - Daily/Weekly
- I-Chart - Gather/Organize Information on a topic
- Focused Note Taking
- CSG - Collaborative Study Groups
- Socratic Seminar
- Philosophical Chairs
- Think/Pair/Share

Digital Tools & Supplementary Resources

- Aleks
- Desmos
- Desmos Classrooom Activities (Teacher Desmos)

Unit 4 - Polynomials and Polynomial Functions

Essential Questions:

1. How can we as mathematicians create and apply generalizations from repeated reasoning?
2. How can we as mathematicians determine an effective model to use to solve a problem?
3. How does an understanding of polynomials and polynomial functions help us understand and interpret real-world events?

Unit Standards

Priority Standards

A.APR.A Perform arithmetic operations on polynomials.

- *(A.APR.A.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.C Use polynomial identities to solve problems.

- *(A.APR.C.5)* (+) Know and apply the Binomial Theorem for the expansion of (x + y)^n in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.

A.APR.D Rewrite rational expressions.

- *(A.APR.D.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.

F.IF.B Interpret functions that arise in applications in terms of the context.

- *(F.IF.B.4)* For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. 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.C Analyze functions using different representatives.

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

Supporting Standards

None

Learning Targets

- I can analyze polynomial functions by examining key features and graphing **(F.IF.B.4, F.IF.C.7c) (L 4-1)**
    - I use different representations of functions, especially graphs, tables and symbols

    - I find and interpret key features of the graphs and tables of a function such as extreme values, end behavior and intervals of increase and decrease
    - I describe and explain the end behavior of polynomial functions based on their degree
- I can analyze the graphs of polynomial functions by identifying key features **(F.IF.B.4, F.IF.C.7c) (L 4-2)**
    - I use different representations of functions, especially graphs, tables and symbols
    - I find and interpret key features of the graphs and tables of a function such as extreme values, end behavior and intervals of increase and decrease
    - I recognize and graph, using technology, polynomial functions that, for the zeros, are not readily determined
- I can add, subtract and multiply polynomials **(A.APR.A.1) (L 4-3)**
    - I relate integer arithmetic to polynomial arithmetic and become fluent with it.
- I can divide polynomials by using long division and synthetic division **(A.APR.D.6) (L 4-4)**
    - I explain the steps in creating equivalent forms of rational expressions, including identifying the quotient by name and as q(x) and identifying the remainder as a fraction with the divisor as the denominator, r(x)/b(x)
    - I make connections between rewriting a rational expression 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) and the Remainder Theorem.
    - I gain procedural fluency and conceptual understanding of how and why to rewrite rational expressions as quotients and remainders
- I expand powers of binomials **(A.APR.C.5) (L 4-5)**
    - I explore Pascal's Triangle and identify patterns, such as the sum of any row is a power of 2 or any term is the sum of the two terms above it.
    - I explain the steps for expanding a polynomial using the Binomial Theorem
    - I find terms for an expanded product using the Binomial Theorem

Assessment Evidence	
Performance Assessment Options & Rubrics *May include, but are not limited to the following:* ● Feedback & Scoring Rubric based on Priority Standards ● Algebra II Feedback & Scoring Rubric based on Math Practice Standards ● End of Unit Assessment (3 versions with differentiation) ● Mid-unit checks/quizzes	**Other assessment options** *May include, but are not limited to the following:* ● Classroom Exit Tickets/Quick Checks ● Quick Writes ● KWL Chart - (What I Know, Want to know, Learned) ● Marking Text ● Learning Log Reflection - Daily/Weekly ● I-Chart - Gather/Organize Information on a topic ● Focused Note Taking ● CSG - Collaborative Study Groups ● Socratic Seminar ● Philosophical Chairs ● Think/Pair/Share

Digital Tools & Supplementary Resources

- Aleks
- Desmos
- Desmos Classrooom Activities (Teacher Desmos)

Unit 5 - Polynomial Equations

Essential Questions:

1. How do we as mathematicians analyze the problem in order to choose the best strategy(ies) or resource to make sense of the problem?
2. How can we as mathematicians use and apply patterns and structures to solve problems?
3. What methods are useful for solving polynomial equations and finding zeros of polynomial functions?

Unit Standards

Priority Standards

A.CED.A Create questions that describe numbers or relationships.

- *(A.CED.A.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.APR.B Understand the relationship between zeros and factors of polynomials.

- *(A.APR.B.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.B.3)* Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

A.APR.C Use polynomial identities to solve problems.

- *(A.APR.C.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.REI.D Represent and solve equations and inequalities graphically.

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

F.IF.C Analyze functions using different representatives.

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

Supporting Standards

N.CN.C Use complex numbers in polynomial identities and equations.

- *(N.CN.C.9)* (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

Learning Targets

- I can solve polynomial equations by graphing **(A.CED.A.1, A.REI.D.11) (L 5-1)**
  - I create an equation or inequality to model a situation with one variable.
  - I explain how the x-coordinate of a solution to the system y=f(x) and y=g(x) solves f(x)=g(x)
- I can solve polynomial equations by factoring and by writing them in quadratic form **(A.CED.A.1) (L 5-2)**
  - I create an equation or inequality to model a situation with one variable.
- I can prove polynomial identities and use them to describe numerical relationships **(A.APR.C.4) (L 5-3)**
  - I verify whether a given polynomial equation is true or not.
- I evaluate and factor functions by using the Remainder and Factor Theorems **(A.APR.B.2) (L 5-4)**
  - I explain in my own words what it means to factor an expression and how that connects to the factors/zeros of the polynomial
  - I understand how the quotient and the remainder of a polynomial division problem can identify factors/zeros of a polynomial
- I determine the numbers and types of roots of polynomial equations, find zeros, and use zeros to graph polynomial functions **(A.APR.B.3, F.IF.C.7c, N.CN.C.9) (L 5-5)**
  - I factor to identify zeros of polynomials
  - I use the zeros to sketch the graph
  - I understand the effect a double root has on a graph
  - I describe and explain the end behavior of polynomial functions based on their degree
  - I determine the number of roots possible for a polynomial equation based on its degree

Assessment Evidence

Performance Assessment Options & Rubrics
May include, but are not limited to the following:

- Feedback & Scoring Rubric based on Priority Standards
- Algebra II Feedback & Scoring Rubric based on Math Practice Standards
- End of Unit Assessment (3 versions with differentiation)
- Mid-unit checks/quizzes

Other assessment options
May include, but are not limited to the following:

- Classroom Exit Tickets/Quick Checks
- Quick Writes
- KWL Chart - (What I Know, Want to know, Learned)
- Marking Text
- Learning Log Reflection - Daily/Weekly
- I-Chart - Gather/Organize Information on a topic
- Focused Note Taking
- CSG - Collaborative Study Groups
- Socratic Seminar

	• Philosophical Chairs • Think/Pair/Share

Digital Tools & Supplementary Resources

- Aleks
- Desmos
- Desmos Classrooom Activities (Teacher Desmos)

Unit 6 - Inverse and Radical Functions

Essential Questions:

1. How can we as mathematicians use and apply patterns and structures to solve problems?
2. What tools are available and efficient for us as mathematicians to use while solving a problem?
3. How can the inverse of a function be used to help interpret a real-world event or solve a problem?

Unit Standards

Priority Standards

A.SSE.A Interpret the structure of expressions.

- *(A.SSE.A.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.REI.A Understand solving equations as a process of reasoning and explain the reasoning.

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

F.BF.A Build a function that models a relationship between two quantities.

- *(F.BF.A.1b)* Write a function that describes a relationship between two quantities. (B) Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

F.IF.B Interpret functions that arise in applications in terms of the context.

- *(F.IF.B.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.C Analyze functions using different representatives.

- *(F.IF.C.7b)* 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.

Supporting Standards

F.BF.B Build new functions from existing functions.

- *(F.BF.B.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 these effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
- *(F.BF.B.4a)* 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 x^3 or f(x) = (x+1)/(x-1) for x does not = 1.

Learning Targets

- I can simplify and graph operations on functions, and determine compositions of functions **(F.BF.A.1b) (L 6-1)**
  - I apply my knowledge of different families of functions to build functions that describe contexts
  - I apply my knowledge of the arithmetic of expressions to combine functions
  - I explain the process I used to build a new function from existing functions
- I can graph and verify inverse functions **(F.IF.B.5, F.BF.B.4a) (L 6-2)**
  - I determine what the domain for a function should be and create a graph that displays it
  - I understand the process of using an inverse as an operation that undoes another operation
  - I understand and use the concept of inverses flexibly
- I can simplify expressions involving radicals and rational exponents **(A.SSE.A.2) (L 6-3)**
  - I explain, in my own words, how specific structures are seen in different expressions.
  - I rewrite expressions using structures to identify important components of the expression
- I can graph and analyze square and cube root functions **(F.IF.C.7b, F.BF.B.3) (L 6-4)**
  - I identify from graphs and use when graphing the characteristics of square root and cube root functions (shape, intercepts, and end behavior)
  - I apply transformations to the parent functions in this standard to graph other functions in the same family.
  - I explain why f(x)+ k translates the original graph of f(x) up k units and why f(x)- k translates the original graph of f(x) down k units
  - I explain why f(x+k) translates the original graph of f(x) left k units and why f(x-k) translates the original graph of f(x) down k units
  - I explain why kf(x) vertically stretches or shrinks the graph of f(x) by a factor of k and predict whether a given value of k will cause a stretch or a shrink
- I can simplify and perform operations with radical expressions **(A.SSE.A.2) (L 6-5)**
  - I explain, in my own words, how specific structures are seen in different expressions
  - I rewrite expressions using structures to identify important components of the expression
- I can solve radical equations algebraically and by graphing **(A.REI.A.2) (L 6-6)**
  - I explain, in my own words, why extraneous solutions arise
  - I use technology to represent solutions to an equation and to identify valid solutions and
  - extraneous solutions
  - I explain the steps used to solve a rational equation with variables in the denominator, multiplying by common factors to remove a denominator.

Assessment Evidence

Performance Assessment Options & Rubrics
May include, but are not limited to the following:

- Feedback & Scoring Rubric based on Priority Standards
- Algebra II Feedback & Scoring Rubric based on Math Practice Standards
- End of Unit Assessment (3 versions with differentiation)
- Mid-unit checks/quizzes

Other assessment options
May include, but are not limited to the following:

- Classroom Exit Tickets/Quick Checks
- Quick Writes
- KWL Chart - (What I Know, Want to know, Learned)
- Marking Text
- Learning Log Reflection - Daily/Weekly
- I-Chart - Gather/Organize Information on a topic
- Focused Note Taking
- CSG - Collaborative Study Groups
- Socratic Seminar
- Philosophical Chairs
- Think/Pair/Share

Digital Tools & Supplementary Resources

- Aleks
- Desmos
- Desmos Classrooom Activities (Teacher Desmos)

Unit 7 - Exponential Functions

Essential Questions:

1. What tools are available and efficient for us as mathematicians to use while solving a problem?
2. How can we as mathematicians use and apply patterns and structures to solve problems?
3. How are real-world situations involving quantities that grow or decline rapidly modeled mathematically?

Unit Standards

Priority Standards

A.CED.A Create questions that describe numbers or relationships.

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

A.SSE.B Write expressions in equivalent forms to solve problems.

- *(A.SSE.B.4)* Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.

A.REI.D Represent and solve equations and inequalities graphically.

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

F.IF.B Interpret functions that arise in applications in terms of the context.

- *(F.IF.B.4)* For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. 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.B.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.

F.IF.C Analyze functions using different representatives.

- *(F.IF.C.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.

Supporting Standards

None

Learning Targets

- I can graph exponential growth and decay functions **(F.IF.B.4, F.IF.C.7e) (L 7-1)**
  - I use different representations of functions, especially graphs, tables and symbols
  - I describe a situation that fits a given graph and explain why it does
  - I identify the exponential, logarithmic or trigonometric function that matches a given graph
  - I sketch the graphs of exponential and logarithmic functions by hand using key features while also recognizing when technology would be needed to create a graph.
  - I graph functions in exponential, logarithmic and trigonometric families by using transformations of the parent functions (a^x, loga(x) and sin x)
- I solve exponential equations and inequalities algebraically and by graphing **(A.CED.A.1, A.REI.D.11) (L 7-2)**
  - I create an equation or inequality to model a situation with one variable.
  - I explain how the x-coordinate of a solution to the system y=f(x) and y=g(x) solves f(x)=g(x)
  - I find approximate solutions for the system y = f(x) and y = g(x) using graphs or tables
- I analyze expressions and functions involving the natural base e **(A.CED.A.2, F.IF.B.6) (L 7-3)**
  - I create an equation, inequality or system to model a situation with two variables.
  - I calculate and interpret the average rate of change from multiple representations (table, graph, and symbols)
- I can generate geometric series and find their sums **(A.SSE.B.4) (L 7-4)**

- I explain the parts of a geometric sequence and a geometric series.
- I describe how to derive the formula for the sum of a geometric series in my own words
- I apply the sum for a geometric series to contextual problems.

- I choose the best function type to model sets of data by using technology **(A.CED.A.2) (L 7-5)**
  - I create an equation, inequality or system to model a situation with two variables.

Assessment Evidence	
Performance Assessment Options & Rubrics *May include, but are not limited to the following:* • Feedback & Scoring Rubric based on Priority Standards • Algebra II Feedback & Scoring Rubric based on Math Practice Standards • End of Unit Assessment (3 versions with differentiation) • Mid-unit checks/quizzes	**Other assessment options** *May include, but are not limited to the following:* • Classroom Exit Tickets/Quick Checks • Quick Writes • KWL Chart - (What I Know, Want to know, Learned) • Marking Text • Learning Log Reflection - Daily/Weekly • I-Chart - Gather/Organize Information on a topic • Focused Note Taking • CSG - Collaborative Study Groups • Socratic Seminar • Philosophical Chairs • Think/Pair/Share
Digital Tools & Supplementary Resources	
• Aleks • Desmos • Desmos Classrooom Activities (Teacher Desmos)	

Unit 8 - Logarithmic Functions
Essential Questions: 1. What tools are available and efficient for us as mathematicians to use while solving a problem? 2. How do we as mathematicians make sense of quantities and situations symbolically? 3. How are logarithms defined and used to model situations in the real world?

Unit Standards

Priority Standards

A.CED.A Create questions that describe numbers or relationships.

- *(A.CED.A.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.SSE.A Interpret the structure of expressions.

- *(A.SSE.A.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.REI.D Represent and solve equations and inequalities graphically.

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

F.IF.C Analyze functions using different representatives.

- *(F.IF.C.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.

Supporting Standards

F.LE.A Construct and compare linear, quadratic, and exponential models and solve problems.

- *(F.LE.A.4)* For exponential models, express as a logarithm the solution to ab^ct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

Learning Targets

- I can write and evaluate logarithms and graph logarithmic functions **(A.SSE.A.2, F.IF.C.7e) (L 8-1)**
  - I explain, in my own words, how specific structures are seen in different expressions
  - I rewrite expressions using structures to identify important components of the expression
  - I identify the exponential, logarithmic or trigonometric function that matches a given graph
  - I describe key components of logarithmic functions, such as domain (and the vertical asymptote), range, x-intercept, end behavior, and average rate of change while being able to explain why these properties occur.
  - I make the connection between exponential and logarithmic functions as inverses and explain graphically using reflection over y = x, as well as by other methods.
  - I sketch the graphs of exponential and logarithmic functions by hand using key features while also recognizing when technology would be needed to create a graph.
  - I graph functions in exponential, logarithmic and trigonometric families by using transformations of the parent functions (a^x, loga(x) and sin x)
- I can simplify logarithmic expressions and solve logarithmic equations **(A.CED.A.1) (L 8-2)**
  - I create an equation or inequality to model a situation with one variable.

- I can simplify logarithmic expressions and solve exponential equations by using common logarithms **(A.REI.D.11, F.LE.A.4) (L 8-3)**
    - I explain how the x-coordinate of a solution to the system y=f(x) and y=g(x) solves f(x)=g(x)
    - I apply the concept of logarithms to solve contextual problems
    - I convert between logarithmic and exponential forms of equations.
    - I use technology to evaluate logarithms
    - I solve problems of the form ab^(ct) = d where a, c, and d are real numbers and b is 2, 10 or e
- I simplify logarithmic expressions and solve exponential equations by using natural logarithms **(A.SSE.A.2, F.LE.A.4) (L 8-4)**
    - I explain, in my own words, how specific structures are seen in different expressions.
    - I rewrite expressions using structures to identify important components of the expression
    - I apply the concept of logarithms to solve contextual problems
    - I convert between logarithmic and exponential forms of equations.
    - I use technology to evaluate logarithms
    - I solve problems of the form ab^(ct) = d where a, c, and d are real numbers and b is 2, 10 or e
- I can write exponential growth and decay equations and solve them by using logarithms **(A.CED.A.1, F.LE.A.4) (L 8-5)**
    - I create an equation or inequality to model a situation with one variable.
    - I apply the concept of logarithms to solve contextual problems
    - I solve problems of the form ab^(ct) = d where a, c, and d are real numbers and b is 2, 10 or e

Assessment Evidence

Performance Assessment Options & Rubrics
May include, but are not limited to the following:

- Feedback & Scoring Rubric based on Priority Standards
- Algebra II Feedback & Scoring Rubric based on Math Practice Standards
- End of Unit Assessment (3 versions with differentiation)
- Mid-unit checks/quizzes

Other assessment options
May include, but are not limited to the following:

- Classroom Exit Tickets/Quick Checks
- Quick Writes
- KWL Chart - (What I Know, Want to know, Learned)
- Marking Text
- Learning Log Reflection - Daily/Weekly
- I-Chart - Gather/Organize Information on a topic
- Focused Note Taking
- CSG - Collaborative Study Groups
- Socratic Seminar
- Philosophical Chairs
- Think/Pair/Share

Digital Tools & Supplementary Resources

- Aleks
- Desmos
- Desmos Classrooom Activities (Teacher Desmos)

Unit 9 - Rational Functions

Essential Questions:

1. How do we as mathematicians analyze the problem in order to choose the best strategy(ies) or resource to make sense of the problem?
2. What model(s) can we as mathematicians use to solve a problem?
3. How are the rules for operations with rational numbers applied to operations with rational expressions and equations?

Unit Standards

Priority Standards

A.CED.A Create questions that describe numbers or relationships.

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

A.APR.D Rewrite rational expressions.

- *(A.APR.D.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.A Understand solving equations as a process of reasoning and explain the reasoning.

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

A.REI.D Represent and solve equations and inequalities graphically.

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

F.IF.B Interpret functions that arise in applications in terms of the context.

- *(F.IF.B.4)* For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. 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.B.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.

Supporting Standards

F.BF.B Build new functions from existing functions.

- *(F.BF.B.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 these effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Learning Targets

- I can multiply and divide rational expressions **(A.APR.D.7) (L 9-1)**
  - I relate rational number arithmetic to rational expression arithmetic and become fluent with rational expressions
- I can add and subtract rational expressions **(A.APR.D.7) (L 9-2)**
  - I relate rational number arithmetic to rational expression arithmetic and become fluent with rational expressions
- I can graph and analyze reciprocal functions **(F.IF.B.5, F.BF.B.3) (L 9-3)**
  - I determine what the domain for a function should be and create a graph that displays it
  - I explain why f(x)+k translates the original graph of f(x) up k units and why f(x)-k translates the original graph of f(x) down k units
  - I explain why f(x+k) translates the original graph of f(x) left k units and why f(x-k) translates the original graph of f(x) down k units
  - I explain why kf(x) vertically stretches or shrinks the graph of f(x) by a factor of k and predict whether a given value of k will cause a stretch or a shrink
- I can graph and analyze rational functions **(F.IF.B.4, F.IF.B.5) (L 9-4)**
  - I use different representations of functions, especially graphs, tables and symbols
  - I find and interpret key features of the graphs and tables of a function such as extreme values, end behavior and intervals of increase and decrease
  - I determine what the domain for a function should be and create a graph that displays it
- I can recognize and solve direct, joint, inverse and combined variation equations **(A.CED.A.1, A.CED.A.2) (L 9-5)**
  - I create an equation or inequality to model a situation with one variable.
  - I create an equation, inequality or system to model a situation with two variables.
- I can solve rational equations and inequalities algebraically and by graphing **(A.CED.A.1, A.REI.A.2, A.REI.D.11) (L 9-6)**
  - I create an equation or inequality to model a situation with one variable.
  - I use technology to represent solutions to an equation and to identify valid solutions and extraneous solutions
  - I explain the steps used to solve a rational equation with variables in the denominator, multiplying by common factors to remove a denominator, and identifying restrictions on the replacement set of the variables.
  - I explain how the x-coordinate of a solution to the system y=f(x) and y=g(x) solves f(x)=g(x)

Assessment Evidence

Performance Assessment Options & Rubrics
May include, but are not limited to the following:

- Feedback & Scoring Rubric based on Priority Standards
- Algebra II Feedback & Scoring Rubric based on Math Practice Standards
- End of Unit Assessment
  (3 versions with differentiation)
- Mid-unit checks/quizzes

Other assessment options
May include, but are not limited to the following:

- Classroom Exit Tickets/Quick Checks
- Quick Writes
- KWL Chart - (What I Know, Want to know, Learned)
- Marking Text
- Learning Log Reflection - Daily/Weekly
- I-Chart - Gather/Organize Information on a topic
- Focused Note Taking
- CSG - Collaborative Study Groups
- Socratic Seminar
- Philosophical Chairs
- Think/Pair/Share

Digital Tools & Supplementary Resources

- Aleks
- Desmos
- Desmos Classrooom Activities (Teacher Desmos)

Unit 10 - Inferential Statistics

Essential Questions:

1. How do we as mathematicians make sense of quantities and situations symbolically?
2. How can we as mathematicians evaluate and question whether a mathematical argument is accurate?
3. How can data be collected and interpreted so that it is useful to a specific audience?

Unit Standards

Priority Standards

S.IC.A Understand and evaluate random processes underlying statistical experiments.

- *(S.IC.A.1)* Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- *(S.IC.A.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?

Supporting Standards

S.IC.B Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

- *(S.IC.B.3)* Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
- *(S.IC.B.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.B.5)* Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
- *(S.IC.B.6)* Evaluate reports based on data.

S.ID.A Summarize, represent, and interpret data on a single count or measurement variable.

- *(S.ID.A.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.

Learning Targets

- I can classify and identify bias in surveys and studies **(S.IC.A.1, S.IC.B.3) (L 10-1)**
    - I propose sampling techniques and explore their nature to produce biased or unbiased results.
    - I recognize the need to use random sampling techniques and understand their applicableness to population parameter estimates
    - I recognize the ability of voluntary or non-voluntary survey designs to make inferences about a population through random sampling procedures
    - I recognize the ability of different experimental designs to make inferences about a treatment through random allocation procedures
- I can collect, analyze, and use data to compare theoretical and experimental probabilities **(S.IC.A.2, S.IC.B.5) (L 10-2)**
    - I understand the concept of plausibility
    - I explore natural variability in different contexts using models to describe the data-generating process
    - I relate characteristics of the distribution to the relative frequency
    - I use software or in-class tools to test for differences by conducting a randomization simulation.
    - I conduct experiments to determine if differences exist between two treatments
- I can use statistics to summarize, represent, and compare sets of data **(S.IC.B.4) (L 10-3)**
    - I compare different sample results, margins of error and their ability to accurately measure population parameter estimates to further understand the interpretation of margin of error
- I can use statistics and normal distribution to analyze data **(S.ID.A.4, S.IC.B.6) (L 10-4)**
    - I use geometric concepts of irregular area to estimate and calculate area under the curve
    - I learn to see visually the relationship between the area under a curve in terms and probabilistic inequalities
    - I use standardization to transform data for calculation of area under a curve using tables
    - I represent normal distribution by their mean and standard deviation and relate to contextual probability distributions

    - I use the frequencies of real-world data to make probability distributions
    - I ensure evaluation of reports are unbiased, systematic and objective
- I can use sample data to make inferences about population **(S.IC.B.4, S.IC.B.6) (L 10-5)**
    - I compare different sample results, margins of error and their ability to accurately measure population parameter estimates to further understand the interpretation of margin of error
    - I find relationships between the margin of error and the confidence level of a simulation model
    - I challenge their existing ideas that media outlets are unbiased and fair
    - I ensure evaluation of reports are unbiased, systematic and objective
    - I provide justification for the analysis of good and bad reports

Assessment Evidence	
Performance Assessment Options & Rubrics *May include, but are not limited to the following:* • Feedback & Scoring Rubric based on Priority Standards • Algebra II Feedback & Scoring Rubric based on Math Practice Standards • End of Unit Assessment (3 versions with differentiation) • Mid-unit checks/quizzes	**Other assessment options** *May include, but are not limited to the following:* • Classroom Exit Tickets/Quick Checks • Quick Writes • KWL Chart - (What I Know, Want to know, Learned) • Marking Text • Learning Log Reflection - Daily/Weekly • I-Chart - Gather/Organize Information on a topic • Focused Note Taking • CSG - Collaborative Study Groups • Socratic Seminar • Philosophical Chairs • Think/Pair/Share
Digital Tools & Supplementary Resources	
• Aleks • Desmos • Desmos Classrooom Activities (Teacher Desmos)	

EXTENSION UNIT

Unit 11 - Trigonometric Functions

Essential Questions:

1. How do we as mathematicians make sense of quantities and situations symbolically?
2. How can we as mathematicians use and apply patterns and structures to solve problems?
3. What are the key features of the graph of a trigonometric function and how do they represent real-world situations?

Unit Standards

Priority Standards

F.IF.B Interpret functions that arise in applications in terms of the context.

- *(F.IF.B.4)* For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. 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.C Analyze functions using different representatives.

- *(F.IF.C.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.

Supporting Standards

F.TF.A Extend the domain of trigonometric functions using the unit circle.

- *(F.TF.A.1)* Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
- *(F.TF.A.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.B Model periodic phenomena with trigonometric functions.

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

F.BF.B Build new functions from existing functions.

- *(F.BF.B.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 these effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Also addresses F.TF.3, F.TF.7,

Learning Targets

- I can draw angles in standard position and convert between degree and radian measures of angles **(F.TF.A.1) (L 11-1)**
  - I explain the definition of a radian with pictures and words
  - I determine the length of the arc on a circle given the measure of the central angle and the length of the radius
- I can find the values of trigonometric functions by using general angles and reference angles **(F.TF.3) (L 11-2) -** Not a priority or supporting standard but important for future lessons.

- I can find trigonometric values by using the unit circle and the properties of periodic functions **(F.TF.A.2, F.TF.B.5) (L 11-3)**
    - I transfer my knowledge of right triangle trigonometry to right triangles drawn in standard position on circles centered at the origin. (Find the sine, cosine, and tangent for such a triangle)
    - I construct angles in standard position of any degree measure using a protractor (e.g. 60, -60, 810)
    - I construct angles in standard position in radian measure (start with angles such as pi, 1, pi/2)
    - I determine the sine, cosine and tangent for an angle in standard position on the unit circle whose x and/or y coordinate is given. Explain the process for calculating these results.
- I can graph and analyze sine and cosine functions **(F.IF.B.4, F.IF.C.7e) (L 11-4)**
    - I use different representations of functions, especially graphs, tables and symbols
    - I identify the exponential, logarithmic or trigonometric function that matches a given graph
    - I practice graphing different trigonometric functions with technology and by hand to grow facility with describing special properties such as period, amplitude and midline.
    - I describe key components of sinusoidal functions, such as domain, range, y-intercept, x-intercepts, periodicity, amplitude, extrema, and the relationship of the graph with the midline.
    - I describe the effects of changing parameters for sinusoidal curves of the form f(x) = A sin (Bx) + D
    - I sketch the graphs of sine and cosine functions by hand using key features while also recognizing when technology would be needed to create a graph
    - I graph functions in exponential, logarithmic and trigonometric families by using transformations of the parent functions (a^x, loga(x) and sin x)
- I can graph and analyze tangent and reciprocal trigonometric functions. **(F.IF.B.4, F.IF.C.7e) (L 11-5)**
    - I use different representations of functions, especially graphs, tables and symbols
    - I identify the exponential, logarithmic or trigonometric function that matches a given graph
    - I practice graphing different trigonometric functions with technology and by hand to grow facility with describing special properties such as period, amplitude and midline.
- I can graph translations of trigonometric functions **(F.IF.C.7e, F.BF.B.3) (L 11-6)**
    - I identify the exponential, logarithmic or trigonometric function that matches a given graph
    - I practice graphing different trigonometric functions with technology and by hand to grow facility with describing special properties such as period, amplitude and midline.
    - I describe key components of sinusoidal functions, such as domain, range, y-intercept, x-intercepts, periodicity, amplitude, extrema, and the relationship of the graph with the midline.
    - I describe the effects of changing parameters for sinusoidal curves of the form f(x) = A sin (Bx) + D
    - I graph functions in exponential, logarithmic and trigonometric families by using transformations of the parent functions (a^x, loga(x) and sin x)
    - I explain why f(x)+k translates the original graph of f(x) up k units and why f(x)-k translates the original graph of f(x) down k units
    - I explain why f(x+k) translates the original graph of f(x) left k units and why f(x-k) translates the original graph of f(x) down k units
    - I explain why kf(x) vertically stretches or shrinks the graph of f(x) by a factor of k and predict whether a given value of k will cause a stretch or a shrink

    - I explain why f(kx) horizontally stretches or shrinks the graph of f(x) by a factor of 1/k and predict whether a given value of k will cause a stretch or a shrink
- I can find the values of angle measures by using inverse trigonometric functions **(F.TF.7) (L 11-7)** Not a priority or supporting standard

Assessment Evidence	
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Digital Tools & Supplementary Resources	
● Aleks ● Desmos ● Desmos Classrooom Activities (Teacher Desmos)	

EXTENSION UNIT

Unit 12 - Trigonometric Identities and Equations

Essential Questions:

1. How do we as mathematicians make sense of quantities and situations symbolically?
2. How do we as mathematicians analyze the problem in order to choose the best strategy(ies) or resource to make sense of the problem?
3. How are trigonometric identities similar to and different from other equations?

Unit Standards

Priority Standards
None

Supporting Standards

F.TF.C Prove and apply trigonometric identities.

- *(F.TF.C.8)* Prove the Pythagorean identity sin^2 + cos^2 = 1 and use it to find sin, cos, or tan given sin, cos, or tan and the quadrant of the angle.

Also addresses F.TF.9

Learning Targets

- I can find trigonometric values and simplify trigonometric expressions by using trigonometric identities **(F.TF.C.8) (L 12-1)**
    - I explain how to use technology, graphs and the Pythagorean Identity to determine values of trigonometric functions when given one trigonometric function and the quadrant of the angle
- I can verify trigonometric identities by transforming equations **(F.TF.C.8) (L 12-2)**
    - I explain how to use technology, graphs and the Pythagorean Identity to determine values of trigonometric functions when given one trigonometric function and the quadrant of the angle
- I can find trigonometric values and verify identities by using the sum and difference identities **(F.TF.C.9) (L 12-3)** not a priority or supporting standard
- I can find values of sine and cosine by using double-angle and half-angle identities **(F.TF.C.9) (L 12-4)** not a priority or supporting standard
- I can solve equations and determine extraneous solutions by using trigonometric identities **(F.TF.C.8) (L 12-5)**
    - I explain how to use technology, graphs and the Pythagorean Identity to determine values of trigonometric functions when given one trigonometric function and the quadrant of the angle

Assessment Evidence

Performance Assessment Options & Rubrics
May include, but are not limited to the following:

- Feedback & Scoring Rubric based on Priority Standards
- Algebra II Feedback & Scoring Rubric based on Math Practice Standards
- End of Unit Assessment (3 versions with differentiation)
- Mid-unit checks/quizzes

Other assessment options
May include, but are not limited to the following:

- Classroom Exit Tickets/Quick Checks
- Quick Writes
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Digital Tools & Supplementary Resources
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