



Course Name:

# **Applications of Algebra**

Curriculum Proposal Date:

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Curriculum Developed by:

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## APPLICATIONS OF ALGEBRA - FUNCTION OPERATIONS

### STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards	Transfer	
<p>CC.2.2.HS.C.1 Use the concept and notation of functions to interpret and apply them in terms of their context.</p> <p>CC.2.2.HS.C.2 Graph and analyze functions, and use their properties to make connections between the different representations.</p> <p>CC.2.2.HS.C.6 Interpret functions in terms of the situation they model.</p> <p>CC.2.2.HS.D.3 Extend the knowledge of arithmetic operations and apply to polynomials.</p>	<p><i>Students will be able to independently use their learning to keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How function families form the foundation of algebra</li> </ul>	
	Meaning	
	<p><b>UNDERSTANDINGS</b> <i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> The notation of a function and what it represents</li> <li><input type="checkbox"/> There is a connection between a function, tables of values and the visual representation of the graph.</li> <li><input type="checkbox"/> Algebraic operations carry over onto functions</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b> <i>Students will keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> What is a function?</li> <li><input type="checkbox"/> What operations can be performed with functions?</li> </ul>
Acquisition		
	<p><i>Students will know...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Key characteristics of functions (domain and range, function vs non-functions)</li> <li><input type="checkbox"/> How to evaluate functions using a graph and/or an equation</li> <li><input type="checkbox"/> How to perform algebraic operations over functions (including composition)</li> </ul>	<p><i>Students will be skilled at...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> A.2.2.1.1 Analyze and/or use patterns or relations</li> <li><input type="checkbox"/> A.2.1.1.2 Apply the order of operations in computation and in problem solving situations</li> <li><input type="checkbox"/> A.2.2.1.1.3 Determine the domain, range, or inverse of a relation</li> <li><input type="checkbox"/> A.2.1.2.2 Simplify expressions involving polynomials.</li> </ul>

## APPLICATIONS OF ALGEBRA - FUNCTION FAMILIES

## STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards	Transfer	
<p>CC.2.2.HS.C.1 Use the concept and notation of functions to interpret and apply them in terms of their context.</p> <p>CC.2.2.HS.C.2 Graph and analyze functions, and use their properties to make connections between the different representations.</p> <p>CC.2.2.HS.C.4 Interpret the effects transformations have on functions.</p> <p>CC.2.2.HS.C.6 Interpret functions in terms of the situation they model.</p>	<p><i>Students will be able to independently use their learning to keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How function families form the graphical foundation of algebra</li> </ul>	
	Meaning	
	<p><b>UNDERSTANDINGS</b></p> <p><i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> There is a connection between a function, tables of values and the visual representation of the graph.</li> <li><input type="checkbox"/> When there is a change to the nonlinear equation, there is a change in the graphical representation.</li> <li><input type="checkbox"/> The transformation rules apply to linear and nonlinear functions.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <p><i>Students will keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How does the equation relate to the graph?</li> <li><input type="checkbox"/> How do changes to an equation relate to changes in the graph?</li> </ul>
	Acquisition	
<p><i>Students will know...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How to graph the parent graphs for constant, linear, square root, absolute value, quadratic, cubic, exponential and logarithmic functions.</li> <li><input type="checkbox"/> How to graph using transformation rules related to the parent function (horizontal and vertical shifts, reflections and stretches/shrinks).</li> <li><input type="checkbox"/> How to use interval notation to represent the domain and range from a graph</li> </ul>	<p><i>Students will be skilled at...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> A.2.2.1.1.3 Determine the domain, range, or inverse of a relation</li> <li><input type="checkbox"/> A.2.2.2.1 Identify or describe the effect of changing parameters within a family of functions.</li> <li><input type="checkbox"/> A.2.2.2.2 Describe and/or determine families of functions</li> </ul>	

# STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards	Transfer	
<p>CC.2.1.HS.F.3 Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays.</p> <p>CC.2.2.HS.C.2 Graph and analyze functions, and use their properties to make connections between the different representations.</p> <p>CC.2.2.HS.C.4 Interpret the effects transformations have on functions, and find the inverses of functions.</p> <p>CC.2.2.HS.D.4 Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs.</p> <p>CC.2.2.HS.D.7 Create and graph equations or inequalities to describe numbers or relationships.</p>	<p><i>Students will be able to independently use their learning to keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> What the graphs of quadratic and polynomial functions reveal</li> </ul>	
	Meaning	
	<p><b>UNDERSTANDINGS</b> <i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> There is a connection between the quadratic function, tables of values and the visual representation of the graph.</li> <li><input type="checkbox"/> When there is a change to the quadratic equation, there is a change in the graphical representation.</li> <li><input type="checkbox"/> A quadratic function in standard form and vertex form will produce the same graph.</li> <li><input type="checkbox"/> There is a relationship between the roots of the graph and the solutions to a polynomial/quadratic equation.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b> <i>Students will keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How does the quadratic equation relate to the graph of the quadratic function?</li> <li><input type="checkbox"/> How do quadratic equations model real-world applications?</li> <li><input type="checkbox"/> How are real and non-real solutions of a quadratic equation related to the graph of the related quadratic function?</li> </ul>
	Acquisition	
<p><i>Students will know...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How to sketch the key characteristics of a polynomial function (end behavior, min/max, turning points, intervals of inc/dec, intercepts).</li> <li><input type="checkbox"/> How to graph a quadratic in standard form and vertex form.</li> <li><input type="checkbox"/> How to determine the solutions of a quadratic from the graph.</li> <li><input type="checkbox"/> How to graph the key characteristics of a quadratics (vertex, axis of symmetry, intercepts) using a table of values.</li> <li><input type="checkbox"/> How to find the inverse of a function graphically.</li> </ul>	<p><i>Students will be skilled at...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> A.2.2.2.2.1 Identify or describe the effect of changing parameters within a family of functions (e.g., <math>y = x^2</math> and <math>y = x^2 + 3</math>, or <math>y = x^2</math> and <math>y = 3x^2</math>).</li> <li><input type="checkbox"/> A.2.2.2.1.1 Create, interpret, and/or use the equation, graph, or table of a polynomial function (including quadratics).</li> <li><input type="checkbox"/> A.2.2.2.1.3 Determine, use, and/or interpret minimum and maximum values over a specified interval of a graph of a polynomial, exponential, or logarithmic function.</li> </ul>	

# APPLICATIONS OF ALGEBRA - SOLVING LINEAR, ABSOLUTE VALUE AND SQUARE ROOT EQUATIONS AND INEQUALITIES

## STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards	Transfer	
<p>CC.2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multi-step problems.</p> <p>CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.</p> <p>CC.2.2.HS.D.8 Apply inverse operations to solve equations or formulas for a given variable.</p> <p>CC.2.2.HS.D.9 Use reasoning to solve equations, and justify the solution method.</p> <p>CC.2.2.HS.D.10 Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.</p>	<p><i>Students will be able to independently use their learning to keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How do I solve an equation or an inequality?</li> </ul>	
	Meaning	
	<p><b>UNDERSTANDINGS</b> <i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> The rules and relationships of arithmetic and algebra are useful for writing equivalent forms of and solving equations and inequalities.</li> <li><input type="checkbox"/> Algebraic properties and processes are used to solve equations and inequalities.</li> <li><input type="checkbox"/> Inequalities have an infinite number of solutions and can be represented on a number line.</li> <li><input type="checkbox"/> Absolute value functions measure distance and have two solutions.</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b> <i>Students will keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How can equations be used to represent relationships and solve problems?</li> <li><input type="checkbox"/> How can inequalities be used to represent relationships and solve problems?</li> </ul>
	Acquisition	
<p><i>Students will know...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How to solve linear equations and inequalities.</li> <li><input type="checkbox"/> The difference between solutions to equations and inequalities.</li> <li><input type="checkbox"/> How to solve absolute value functions.</li> <li><input type="checkbox"/> How to solve square root functions.</li> </ul>	<p><i>Students will be skilled at...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> A2.1.3.1.2 Solve equations involving rational and/or radical expressions.</li> </ul>	

# APPLICATIONS OF ALGEBRA - SOLVING QUADRATICS AND POLYNOMIALS

## STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards	Transfer	
<p>CC.2.2.HS.D.2 Write expressions in equivalent forms to solve problems.</p> <p>CC.2.2.HS.C.5 Construct and compare linear, quadratic, and exponential models to solve problems.</p> <p>CC.2.2.HS.D.8 Apply inverse operations to solve equations or formulas for a given variable.</p> <p>CC.2.2.HS.D.9 Use reasoning to solve equations, and justify the solution method.</p> <p>CC.2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multi-step problems.</p>	<p><i>Students will be able to independently use their learning to keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How do I solve an equation?</li> </ul>	
	Meaning	
	<p><b>UNDERSTANDINGS</b> <i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> What a solution to a quadratic and polynomial equation represents (real and non-real).</li> <li><input type="checkbox"/> Multiple solving methods can obtain the same solution to the quadratic equation.</li> <li><input type="checkbox"/> Difference between a quadratic and polynomial equation</li> <li><input type="checkbox"/> A polynomial equation can be broken down into products of linear and/or quadratic factors to solve.</li> <li><input type="checkbox"/> Recognizing when factors are solvable.</li> <li><input type="checkbox"/> Quadratic can be used to model real world situations (vertical motion)</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b> <i>Students will keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How do you algebraically solve a quadratic?</li> <li><input type="checkbox"/> How do you algebraically solve a polynomial equation?</li> <li><input type="checkbox"/> How are quadratics used in everyday life?</li> </ul>
	Acquisition	
<p><i>Students will know...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How to solve quadratics by factoring (different two perfect squares, trinomials where <math>a = 1</math> and <math>a \neq 1</math> and GCF), square root method and quadratic formula</li> <li><input type="checkbox"/> How to solve polynomials using factoring (GCF, grouping, difference of perfect squares where the exponent is greater than 2, higher degree trinomials where <math>a=1</math> and <math>a \neq 1</math>).</li> </ul>	<p><i>Students will be skilled at...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> A2.1.3.1.1 Write and/or solve quadratic equations (including factoring and using the Quadratic Formula).</li> <li><input type="checkbox"/> A2.1.2.2.1 Factor algebraic expressions, including difference of squares and trinomials. <u>Note:</u> Trinomials limited to the form <math>ax^2 + bx + c</math> where <math>a</math> is not equal to 0.</li> </ul>	

## STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards	Transfer	
<p>CC.2.2.HS.C.3 Write functions or sequences that model relationships between two quantities.</p> <p>CC.2.2.HS.C.5 Construct and compare linear, quadratic, and exponential models to solve problems.</p> <p>CC.2.2.HS.C.6 Interpret functions in terms of the situations they model.</p>	<p><i>Students will be able to independently use their learning to keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How mathematics models real world situations</li> </ul>	
	Meaning	
	<p><b>UNDERSTANDINGS</b></p> <p><i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> There is a connection between the exponential function, tables of values and the visual representation of the graph.</li> <li><input type="checkbox"/> Graphs can be used to solve an exponential function</li> <li><input type="checkbox"/> Exponential functions can be used to predict real world outcomes</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <p><i>Students will keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How do exponential functions model real world applications?</li> </ul>
	Acquisition	
<p><i>Students will know...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How to solve an exponential function graphically</li> <li><input type="checkbox"/> How to apply exponential formulas for money, growth/decay, and half-life</li> <li><input type="checkbox"/> How to differentiate between exponential growth &amp; decay</li> </ul>	<p><i>Students will be skilled at...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> A2.1.3.1.3 Write and/or solve a simple exponential or logarithmic equation (including common and natural logarithms).</li> <li><input type="checkbox"/> A2.1.3.1.4 Write, solve, and/or apply linear or exponential growth or decay (including problem situations).</li> </ul>	

## STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards	Transfer	
<p>CC.2.4.HS.B.2 Summarize, represent, and interpret data on two categorical and quantitative variables.</p> <p>CC.2.4.HS.B.3 Analyze Linear models to make interpretations based on the data.</p> <p>CC.2.1.HS.F.5 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>	<p><i>Students will be able to independently use their learning to keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How mathematics models real world situations</li> </ul>	
	Meaning	
	<p><b>UNDERSTANDINGS</b></p> <p><i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Real world data can be modeled using graphs and algebraic functions</li> <li><input type="checkbox"/> Different regression functions are used based upon the trend observed in the data</li> <li><input type="checkbox"/> Regression models can be used to predict future outcomes</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <p><i>Students will keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How algebraic regression is used to model real world data</li> </ul>
	Acquisition	
	<p><i>Students will know...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How to create a graphical representation of data using technology</li> <li><input type="checkbox"/> How to identify which regression model best fits the data presented</li> <li><input type="checkbox"/> How to use technology to create the algebraic function that models the given data/graph</li> <li><input type="checkbox"/> How to make predictions using mathematical modeling</li> </ul>	<p><i>Students will be skilled at...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> A2.2.1.1.1 Analyze a set of data for the existence of a pattern, and represent the pattern with a rule algebraically and/or graphically.</li> <li><input type="checkbox"/> A2.2.3.1.1 Draw, identify, find, interpret, and/or write an equation for a regression model (lines and curves of best fit) for a scatter plot.</li> <li><input type="checkbox"/> A2.2.3.1.2 Make predictions using the equations or graphs of regression models (lines and curves of best fit) of scatter plots.</li> </ul>



## STAGE 1 | DESIRED RESULTS

Context and relevance for student learning

Standards	Transfer	
<p>CC.2.4.HS.B.4 Recognize and evaluate random processes underlying statistical experiments.</p> <p>CC.2.4.HS.B.5 Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.</p> <p>CC.2.4.HS.B.6 Use the concepts of independence and conditional probability to interpret data.</p> <p>CC.2.4.HS.B.7 Apply the rules of probability to compute probabilities of compound events in a uniform probability model.</p>	<p><i>Students will be able to independently use their learning to keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How mathematics models real world situations</li> </ul>	
	Meaning	
	<p><b>UNDERSTANDINGS</b></p> <p><i>Students will understand that...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Probability models are useful tools for making decisions and predictions.</li> <li><input type="checkbox"/> There is a difference between odds and probability</li> <li><input type="checkbox"/> Different probability formulas apply to different situations</li> </ul>	<p><b>ESSENTIAL QUESTIONS</b></p> <p><i>Students will keep considering...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> How can we base decisions on chance?</li> <li><input type="checkbox"/> How can probability be used to simulate events and to predict future happenings?</li> </ul>
	Acquisition	
<p><i>Students will know...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> When to use probability of compound events vs singular event</li> <li><input type="checkbox"/> How to differentiate between combinations, permutations and the fundamental counting principle</li> <li><input type="checkbox"/> How to differentiate between odds and probability, and find one given the other</li> <li><input type="checkbox"/> Rules of probability</li> <li><input type="checkbox"/> What the difference is between and independent/dependent event.</li> </ul>	<p><i>Students will be skilled at...</i></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> A2.2.3.2.1 Use combinations, permutations, and the fundamental counting principle to solve problems involving probability.</li> <li><input type="checkbox"/> A2.2.3.2.2 Use odds to find probability and/or use probability to find odds.</li> <li><input type="checkbox"/> A2.2.3.2.3 Use probability for independent, dependent, or compound events to predict outcomes.</li> </ul>	