



Notes on Reading the Washington State Mathematics Standards Transition Documents

This document serves as a guide to translate between the 2008 Washington State K-8 Learning Standards for Mathematics and the Common Core State Standards (CCSS) for Mathematics. It begins with the Standards for Mathematical Practice which are the backbone of the CCSS for Mathematics. These practices highlight the change in focus, through instructional practices, of developing these 'habits of mind' in our students. One or more of these Standards for Mathematical Practice should be intentionally incorporated in the development of any concept or procedure taught.

The Standards for Mathematical Practice are followed by the key critical areas of focus for a grade-level. These critical areas are the overarching concepts and procedures that must be learned by students to be successful at the next grade level and beyond. As units are planned, one should always reflect back on these critical areas to ensure that the concept or fluency developed in the unit is tied directly to one of these. The CCSS were developed around these critical areas in order for instruction to be deep and focused on a few key topics each year. By narrowing the focus and deepening the understanding, increases in student achievement will be realized.

The body of this document includes a two-column table which indicates the alignment of the 2008 Washington State K-8 Learning Standards for Mathematics to the CCSS for Mathematics at a grade level. It is meant to be read from left to right across the columns. The right column contains all of the CCSS for Mathematics for that grade. The left column indicates the grade-level Washington standard that most aligns to it.

Bolded words are used to describe the degree of alignment between these sets of standards. If the words bolded are **Continue to**, this indicates that the CCSS standard and the Washington standard are closely aligned. The teacher should read the wording carefully on the CCSS standard because often there is a more in-depth development of the aligned Washington standard and often there are more than one standard that address a particular Washington standard. If the word **extend** is bolded that indicates that the Washington and CCSS standards are similar but the CCSS takes the concept further than the Washington standard. Lastly, if the words **Move students to** are bolded, then the CCSS standards take the Washington standard to a deeper or further understanding of this particular cluster concept. If the left-hand side is blank, the CCSS are new material that does not match the Washington standards at this grade level. Sometimes there can be a page or more of these unaligned standards. One is reminded that while this is new material for this grade level, other standards currently taught at this grade level in the 2008 Washington standards will have moved to other grades. The movement of these unaligned standards is laid out on the last pages of this document. Comments on CCSS Algebra 1 standards are often found in italics at the end of a cluster.

Washington State Algebra I Mathematics Standards Transition Document

This document serves as one guide to translate between the 2008 Washington State Standards for Mathematics and the Common Core State Standards for Mathematics.

The Standards for Mathematical Practice describes varieties of expertise that mathematics educators at all levels should seek to develop in their students. These standards should be integrated throughout the teaching and learning of the content standards of the Common Core State Standards.

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

With full implementation of the Common Core State Standards for mathematics in Algebra I, instructional time should focus on five critical areas:

- (1) developing fluency writing, interpreting, solving, and translating between various forms of linear equations and inequalities and applying related solution techniques and the laws of exponents to the creation and solution of simple exponential equations;
- (2) exploring and interpreting many examples of functions, including exponential, systems of equations and inequalities and sequences (arithmetic as linear functions and geometric as exponential functions) given graphically, numerically, symbolically, and verbally, translating between representations, and understanding the limitations of various representations;
- (3) using regression techniques to describe approximately linear relationships between quantities and looking at residuals to analyze the goodness of fit;
- (4) extending the laws of exponents to rational exponents; seeing structure in and creating quadratic and exponential expressions; and creating and solving equations, inequalities, and systems of equations involving quadratic expressions;
- (5) comparing the key characteristics of quadratic functions to those of linear and exponential functions and selecting from among these functions to model phenomena; interpreting various forms of quadratic expressions; and expanding student experience with functions to include absolute value, step, and those that are piecewise-defined.

*** denotes a “Modeling” standard throughout this document**

Unit 1 – Relationships Between Quantities and Reasoning with Expressions

Aligned current WA standards	Algebra I Common Core State Standards
<p>Students currently:</p> <p>A1.2.D Determine whether approximations or exact values of real numbers are appropriate, depending on the context, and justify the selection.</p> <p>A1.2.B Recognize the multiple uses of variables, determine all possible values of variables that satisfy prescribed conditions, and evaluate algebraic expressions that involve variables.</p>	<p>Students need to:</p> <p>Reason quantitatively and use units to solve problems.</p> <p>Continue to choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (N.Q.3)</p> <p>Extend to using units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (N.Q.1)</p> <p>Define appropriate quantities for the purpose of descriptive modeling. (N.Q.2)</p> <p><i>Working with quantities and the relationships between them provides grounding for work with expressions, equations, and functions.</i></p> <p>Interpret the structure of expressions.</p> <p>Extend to interpreting expressions that represent a quantity in terms of its context (A.SSE.1*)</p> <ol style="list-style-type: none"> a. Interpret parts of an expression, such as terms, factors, and coefficients. (A.SSE.1a) b. Interpret complicated expressions by viewing one or more of their parts as a single entity. <i>For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.</i> (A.SSE.1b) <p><i>Limit to linear expressions and to exponential expressions with integer exponents.</i></p>

<p>A1.1.B Solve problems that can be represented by linear functions, equations, and inequalities.</p> <p>A1.1.D Solve problems that can be represented by quadratic functions and equations.</p> <p>A1.1.C Solve problems that can be represented by a system of two linear equations or inequalities.</p> <p>A1.4.B Write and graph an equation for a line given the slope and the y-intercept, the slope and a point on the line, or two points on the line.</p> <p>A1.2.B Determine all possible values of variables that satisfy prescribed conditions.</p> <p>A1.7.D Solve an equation involving several variables by expressing one variable in terms of the others.</p>	<p>Create equations that describe numbers or relationships.</p> <p>Continue to create equations and inequalities in one variable and use them to solve problems. <i>Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</i> (A.CED.1)</p> <p>Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (A.CED.2)</p> <p>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. <i>For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.</i> (A.CED.3)</p> <p>Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations). <i>For example, rearrange Ohm's law $V = IR$ to highlight resistance R.</i> (A.CED.4)</p> <p><i>Limit A.CED.1 and A.CED.2 to linear and exponential equations, and, in the case of exponential equations, limit to situations requiring evaluation of exponential functions at integer inputs. Limit A.CED.3 to linear equations and inequalities. Limit A.CED.4 to formulas which are linear in the variable of interest.</i></p>
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<p>A1.4.A Write and solve linear equations and inequalities in one variable.</p>	<p>Understand solving equations as a process of reasoning and explain the reasoning.</p> <p>Move students to explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. (A.REI.1)</p> <p><i>Students should focus on and master this standard for linear equations and be able to extend and apply their reasoning to other types of equations in future courses. Students will solve exponential equations with logarithms in Algebra II.</i></p> <p>Solve equations and inequalities in one variable.</p> <p>Continue to solve linear equations and inequalities in one variable (A.REI.3)</p> <p>Extend to include equations with coefficients represented by letters. (A.REI.3)</p> <p><i>Extend earlier work with solving linear equations to solving linear inequalities in one variable and to solving literal equations that linear in the variable being solved for. Include simple exponential equations that rely only on application of the laws of exponents, such as $5^x = 125$ or $2^x = 1/16$.</i></p>
<p>Unit 2 – Linear and Exponential Relationships</p>	
<p>Aligned current WA standards</p>	<p>Algebra I Common Core State Standards</p>
<p>Students currently:</p>	<p>Students need to:</p> <p>Extend the properties of exponents to rational exponents.</p> <p>Move students to explain how the definition of the meaning of rational exponents follows from extending the properties of integer</p>

<p>A1.1.C Solve problems that can be represented by a system of two linear equations or inequalities.</p> <p>A1.1.E Solve problems that can be represented by exponential functions and equations.</p> <p>A1.7.B Find and approximate solutions to exponential equations.</p>	<p>approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. (A.REI.11*)</p> <p>Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. (A.REI.12)</p> <p>Extend to understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). (A.REI.10)</p> <p><i>For A.REI.10, focus on linear and exponential equations and be able to adapt and apply that learning to other types of equations in future courses. For A.REI.11, focus on cases where $f(x)$ and $g(x)$ are linear or exponential.</i></p> <p>Understand the concept of a function and use function notation.</p>
<p>A1.2.B Recognize the multiple uses of variables, determine all possible values of variables that satisfy prescribed conditions, and evaluate algebraic expressions that involve variables.</p> <p>A1.3.A Determine whether a relationship is a function and identify the domain, range, roots, and independent and dependent variables.</p> <p>A1.3.C Evaluate $f(x)$ at a (i.e., $f(a)$) and solve for x in the equation $f(x) = b$.</p>	<p>Continue to understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$. (F.IF.1)</p> <p>Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. (F.IF.2)</p> <p>Move students to recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the</p>

<p>A1.4.C Identify and interpret the slope and intercepts of a linear function, including equations for parallel and perpendicular lines.</p> <p>A1.5.A Represent a quadratic function with a symbolic expression, as a graph, in a table, and with a description, and make connections among the representations.</p> <p>A1.7.B Find and approximate solutions to exponential equations.</p>	<p>integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$. (F.IF.3)</p> <p><i>Students should experience a variety of types of situations modeled by functions. Detailed analysis of any particular class of functions at this stage is not advised. Students should apply these concepts throughout their future mathematics courses. Draw examples from linear and exponential functions. In F.IF.3, draw connection to F.BF.2, which requires students to write arithmetic and geometric sequences. Emphasize arithmetic and geometric sequences as examples of linear and exponential functions.</i></p> <p>Interpret functions that arise in applications in terms of a context.</p> <p>Continue to relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. <i>For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.</i> (F.IF.5*)</p> <p>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. <i>Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.</i> (F.IF.4*)</p> <p>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.6*)</p> <p><i>For F.IF.4 and 5, focus on linear and exponential functions. For F.IF.6, focus on linear functions and exponential functions whose domain is a subset of the integers. Unit 5 in this course and in Algebra II address other types of functions.</i></p>
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<p>A1.1.E Solve problems that can be represented by exponential functions and equations.</p> <p>A1.3.B Represent a function with a symbolic expression, as a graph, in a table, and using words, and make connections among these representations.</p> <p>A1.5.A Represent a quadratic function with a symbolic expression, as a graph, in a table, and with a description, and make connections among the representations.</p> <p>A1.5.B Sketch the graph of a quadratic function, describe the effects that changes in the parameters have on the graph, and interpret the x-intercepts as solutions to a quadratic equation.</p> <p>A1.7.A Sketch the graph for an exponential function of the form $y = ab^n$ where n is an integer, describe the effects that changes in the parameters a and b have on the graph, and answer questions that arise in situations modeled by exponential functions.</p>	<p>Analyze functions using different representations.</p> <p>Continue to graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (F.IF.7*)</p> <p>Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.</i> (F.IF.9)</p> <p>Graph linear and quadratic functions and show intercepts, maxima, and minima. (F.IF.7a*)</p> <p>Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. (F.IF.7e*)</p> <p><i>For F.IF.7a, 7e, and 9 focus on linear and exponential functions. Include comparisons of two functions presented algebraically. For example, compare the growth of two linear functions, or two exponential functions such as $y=3n$ and $y=1002$</i></p> <p>Build a function that models a relationship between two quantities.</p> <p>Continue to write a function that describes a relationship between two quantities. (F.BF.1*)</p>
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A1.7.C Express arithmetic and geometric sequences in both explicit and recursive forms, translate between the two forms, explain how rate of change is represented in each form, and use the forms to find specific terms in the sequence.

Determine an explicit expression, a recursive process, or steps for calculation from a context (F.BF.1A*)

Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. (F.BF.2*)

Move students to 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.BF.1b*)

Limit to F.BF.1a, 1b, and 2 to linear and exponential functions. In F.BF.2, connect arithmetic sequences to linear functions and geometric sequences to exponential functions.

Build new functions from existing functions.

A1.4.E Describe how changes in the parameters of linear functions and functions containing an absolute value of a linear expression affect their graphs and the relationships they represent.

Continue to identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* (F.BF.3)

A1.5.B Sketch the graph of a quadratic function, describe the effects that changes in the parameters have on the graph, and interpret the x -intercepts as solutions to a quadratic equation.

Focus on vertical translations of graphs of linear and exponential functions. Relate the vertical translation of a linear function to its y -intercept.

A1.7.A Sketch the graph for an exponential function of the form $y = ab^n$ where n is an integer, describe the effects that changes in the parameters a and b have on the graph, and answer questions that arise in situations modeled by exponential functions.

While applying other transformations to a linear graph is appropriate at this level, it may be difficult for students to identify or distinguish between the effects of the other transformations included in this standard.

A1.1.B Solve problems that can be represented by linear functions, equations, and inequalities.

A1.1.E Solve problems that can be represented by exponential functions and equations.

A1.4.B Write and graph an equation for a line given the slope and the y -intercept, the slope and a point on the line, or two points on the line, and translate between forms of linear equations.

A1.7.A Sketch the graph for an exponential function of the form $y = ab^n$ where n is an integer, describe the effects that changes in the parameters a and b have on the graph, and answer questions that arise in situations modeled by exponential functions.

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

Continue to construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). (F.LE.2)

Extend to distinguish between situations that can be modeled with linear functions and with exponential functions. (F.LE.1)

Prove that linear functions grow by equal differences over equal intervals; and that exponential functions grow by equal factors over equal intervals. (F.LE.1a)

Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. (F.LE.1b)

Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. (F.LE.1c)

Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. (F.LE.3)

*For F.LE.3, limit to comparisons between linear and **exponential** models. In constructing linear functions in F.LE.2, draw on and consolidate previous work in Grade 8 on finding equations for lines and linear functions (8.EE.6, 8.F.4).*

<p>A1.4.E Describe how changes in the parameters of linear functions and functions containing an absolute value of a linear expression affect their graphs and the relationships they represent.</p> <p>A1.7.A Describe the effects that changes in the parameters a and b have on the graph, and answer questions that arise in situations modeled by exponential functions.</p>	<p>Interpret expressions for functions in terms of the situation they model.</p> <p>Continue to interpret the parameters in a linear or exponential function in terms of a context. (F.LE.5)</p> <p><i>Limit exponential functions to those of the form $f(x) = b^x + k$.</i></p>
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Unit 3 – Descriptive Statistics

Aligned current WA standards	Algebra I Common Core State Standards
<p><i>Students currently:</i></p> <p>A1.6.A Use and evaluate the accuracy of summary statistics to describe and compare data sets.</p> <p>A1.6.C Describe how linear transformations affect the center and spread of univariate data.</p>	<p><i>Students need to:</i></p> <p>Summarize, represent, and interpret data on a single count or measurement variable.</p> <p>Continue to represent data with plots on the real number line (dot plots, histograms, and box plots). (S.ID.1)</p> <p>Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) or two or more different data sets. (S.ID.2)</p> <p>Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). (S.ID.3)</p>

<p>A1.6.B Make valid inferences and draw conclusions based on data.</p> <p>A1.6.D Find the equation of a linear function that best fits bivariate data that are linearly related, interpret the slope and y-intercept of the line, and use the equation to make predictions.</p>	<p><i>In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution such as the shape of the distribution or the existence of extreme data points.</i></p> <p>Summarize, represent, and interpret data on two categorical and quantitative variables.</p> <p>Continue to represent data on two quantitative variables on a scatter plot, and describe how the variables are related. (S.ID.6)</p> <p>Fit a function to the data; use functions fitted to data to solve problems in the context of the data. <i>Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.</i> (S.ID.6a)</p> <p>Fit a linear function for a scatter plot that suggests a linear association. (S.ID.6c)</p> <p>Move students to informally assess the fit of a function by plotting and analyzing residuals. <i>Should be focused on linear models, but may be used to preview quadratic functions in Unit 5 of this course.</i> (S.ID.6b)</p> <p>Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. (S.ID.5)</p> <p><i>Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals.</i></p>
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<p>A1.4.C Identify and interpret the slope and intercepts of a linear function, including equations for parallel and perpendicular lines.</p> <p>A1.6.D Find the equation of a linear function that best fits bivariate data that are linearly related, interpret the slope and y-intercept of the line, and use the equation to make predictions.</p> <p>A1.6.E Describe the correlation of data in scatterplots in terms of strong or weak and positive or negative.</p>	<p>Interpret linear models.</p> <p>Continue to interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. (S.ID.7)</p> <p>Extend to compute (using technology) and interpret the correlation coefficient of a linear fit. (S.ID.8)</p> <p>Distinguish between correlation and causation. (S.ID.9)</p> <p><i>Build on students' work with linear relationship in eighth grade and introduce the correlation coefficient. The focus here is on the computation and interpretation of the correlation coefficient as a measure of how well the data fit the relationship. The important distinction between a statistical relationship and a cause-and-effect relationship arises in S.ID.9.</i></p>
<p>Unit 4 – Expressions and Equations</p>	
<p>Aligned current WA standards</p>	<p>Algebra I Common Core State Standards</p>
<p>Students currently:</p> <p>A1.2.C Interpret and use integer exponents and square and cube roots, and apply the laws and properties of exponents to simplify and evaluate exponential expressions.</p>	<p>Students need to:</p> <p>Interpret the structure of expressions.</p> <p>Continue to use the structure of an expression to identify ways to rewrite it. <i>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 $(x^2 - y^2)(x^2 + y^2)$. Focus on quadratic and exponential expressions. (A.SSE.2)</i></p> <p>Extend to interpreting expressions that represent a quantity in terms of its context. (A.SSE.1*)</p> <p>Interpret parts of an expression, such as terms, factors, and coefficients. (A.SSE.1a*)</p>

<p>A1.2.E Use algebraic properties to factor and combine like terms in polynomials.</p> <p>A1.5.C Solve quadratic equations that can be factored as $(ax + b)(cx + d)$ where a, b, c, and d are integers.</p> <p>A1.5.D Solve quadratic equations that have real roots by completing the square and by using the quadratic formula.</p>	<p>Interpret complicated expression by viewing one or more of their parts as a single entity. <i>For example, interpret $P(1 + r)^n$ as the product of P and a factor not depending on P.</i> (A.SSE.1B*)</p> <p><i>Focus on quadratic and exponential expressions. Exponents are extended from the integer exponents found in Unit 1 to rational exponents focusing on those that represent square or cube roots.</i></p> <p>Write expressions in equivalent forms to solve problems.</p> <p>Continue to factor a quadratic expression to reveal the zeros of the function it defines. (A.SSE.3a*)</p> <p>Extend to choosing and producing an equivalent form of an expression to reveal and explain properties of the quantity represented by the expressions. (A.SSE.3*)</p> <p>Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. (A.SSE.3b*)</p> <p>Use the properties of exponents to transform expression for exponential functions. <i>For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} = 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.</i> (A.SSE.3c*)</p> <p><i>It is important to balance conceptual understanding and procedural fluency in work with equivalent expressions. For example, development of a skill in factoring and completing the square goes hand-in-hand with understanding what different forms of a quadratic expression reveal.</i></p>
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A1.2.F Add, subtract, and multiply polynomials.

A1.1.B Solve problems that can be represented by linear functions, equations, and inequalities.

A1.1.D Solve problems that can be represented by quadratic functions and equations.

A1.4.B Write and graph an equation for a line given the slope and the y-intercept, the slope and a point on the line, or two points on the line, and translate between forms of linear equations.

A1.7.D Solve an equation involving several variables by expressing one variable in terms of the others.

Perform arithmetic operations on polynomials.

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.1)

*Focus on polynomial expressions that simplify to forms that are **linear** or **quadratic** in a positive integer power of x .*

Create equations that describe numbers or relationships.

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

Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law $V = IR$ to highlight resistance R .* (A.CED.4)
Extend to formulas involving squared variables.

Move students to 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.1)

Extend work on linear and exponential equations in Unit 1 to quadratic equations.

A1.5.C Solve quadratic equations that can be factored as $(ax + b)(cx + d)$ where a , b , c , and d are integers.

A1.5.D Solve quadratic equations that have real roots by completing the square and by using the quadratic formula.

Solve equations and inequalities in one variable.

Continue to solve quadratic equations in one variable. (A.REI.4)

Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. (A.REI.4a)

Extend to solving quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b . (A.REI.4B)

Students should learn of the existence of the complex number system, but will not solve quadratics with complex solutions until Algebra II.

Solve systems of equations.

Move students to solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.* (A.REI.7)

Include systems consisting of one linear and one quadratic equation. Include systems that lead to work with fractions. For example, finding the intersections between $x^2 + y^2 = 1$ and $y = (x+1)/2$ leads to the point $(3/5, 4/5)$ on the unit circle, corresponding to the Pythagorean triple $3^2 + 4^2 = 5^2$.

Unit 5 – Quadratic Functions and Modeling	
Aligned current WA standards	Algebra I Common Core State Standards
<p>Students currently:</p> <p>A1.3.A Determine whether a relationship is a function and identify the domain, range, roots, and independent and dependent variables.</p> <p>A1.3.C Evaluate $f(x)$ at a (i.e., $f(a)$) and solve for x in the equation $f(x) = b$.</p> <p>A1.5.A Represent a quadratic function with a symbolic expression, as a graph, in a table, and with a description, and make connections among the representations.</p> <p>A.1.7.B Find and approximate solutions to exponential equations.</p>	<p>Students need to:</p> <p>Use properties of rational and irrational numbers.</p> <p>Move students to explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. (N.RN.3)</p> <p><i>Connect N.RN.3 to physical situations, e.g., finding the perimeter of a square of area 2.</i></p> <p>Interpret functions that arise in applications in terms of a context.</p> <p>Continue to relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. <i>For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.</i> (F.IF.5*)</p> <p>Extend 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. <i>Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.</i> (F.IF.4*)</p> <p>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.6*)</p>



<p>A1.1.E Solve problems that can be represented by exponential functions and equations.</p> <p>A1.3.A Determine whether a relationship is a function and identify the domain, range, roots, and independent and dependent variables.</p> <p>A1.3.B Represent a function with a symbolic expression, as a graph, in a table, and using words, and make connections among these representations.</p> <p>A1.5.A Represent a quadratic function with a symbolic expression, a graph, in a table, and with a description, and make connections among the representations.</p> <p>A1.5.B Sketch the graph of a quadratic function, describe the effects that changes in the parameters have on the graph, and interpret the x-intercepts as solutions to a quadratic equation.</p> <p>A1.4.C Identify and interpret the slope and intercepts of a linear function, including equations for parallel and perpendicular lines.</p> <p>A1.7.A Sketch the graph for an exponential function of the form $y = ab^n$ where n is an integer, describe the effects that changes in the parameters a and b have on the graph, and answer questions that arise in situations modeled by exponential functions.</p>	<p><i>Focus on quadratic functions; compare with linear and exponential functions studied in Unit 2.</i></p> <p>Analyze functions using different representations.</p> <p>Continue to graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (F.IF.7*)</p> <p>Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. (F.IF.8)</p> <p>Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.</i> (F.IF.9)</p> <p>Continue to graph linear and quadratic functions and show intercepts, maxima, and minima. (F.IF.7a*)</p> <p>Graph square root, cube root, and extend to piecewise-defined functions, including step functions and absolute value functions. (F.IF.7b*)</p> <p>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. (F.IF.8a)</p> <p>Use the properties of exponents to interpret expressions for exponential functions. <i>For example, identify percent rate of change</i></p>
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<p>A1.1.A Select and justify functions and equations to model and solve problems.</p> <p>A1.7.C Express arithmetic and geometric sequences in both explicit and recursive forms, translate between the two forms, explain how rate of change is represented in each form, and use the forms to find specific terms in the sequence.</p>	<p><i>in functions such as $y = (1.02)^t$, $y = (.097)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay. (F.IF.8B)</i></p> <p><i>For F.IF.7b, compare and contrast absolute value, step and piecewise defined functions with linear, quadratic, and exponential functions. Highlight issues of domain, range, and usefulness when examining piecewise defined functions. Note that this unit, and in particular in F.IF.8b, extends the work begun in Unit 2 on exponential functions with integer exponents. For F.IF.9, focus on expanding the types of functions considered to include linear, exponential, and quadratic. Extend work with quadratics to include the relationship between coefficients and roots, and that once roots are known, a quadratic equation can be factored.</i></p> <p>Build a function that models a relationship between two quantities.</p> <p>Continue to write a function that describes a relationship between two quantities. (F.BF.1*)</p> <p>Determine an explicit expression, a recursive process, or steps for calculation from a context. (F.BF.1a*)</p> <p>Combine standard function types using arithmetic operations. <i>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.</i> (F.BF.1b*)</p> <p>Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. (F.BF.2*)</p> <p><i>Focus on situations that exhibit a quadratic relationship.</i></p>
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A1.3.C Evaluate $f(x)$ at a (i.e., $f(a)$) and solve for x in the equation $f(x) = b$.

A1.4.E Describe how changes in the parameters of linear functions and functions containing an absolute value of a linear expression affect their graphs and the relationships they represent.

A1.5.B Sketch the graph of a quadratic function, describe the effects that changes in the parameters have on the graph, and interpret the x -intercepts as solutions to a quadratic equation.

Build new functions from existing functions.

Continue to identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* (F.BF.3)

Find inverse functions. (F.BF.4)

Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. *For example, $f(x) = 2x^3$ or $f(x) = (x + 1)/(x - 1)$ for $x \neq 1$.* (F.BF.4a)

*For F.BF.3, focus on **quadratic** functions, and consider including **absolute value** functions. For F.BF.4a, focus on **linear** functions but consider simple situations where the domain of the function must be restricted in order for the inverse to exist, such as $f(x) = x^2$, $x > 0$.*

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

Move students to observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. (F.LE.3)

*Compare **linear** and **exponential** growth to **quadratic** growth.*

With full implementation of the CCSS, Algebra 1 teachers will no longer be responsible for teaching students the standards listed below. The grade level where these standards will be emphasized is in parentheses.

A1.2.A Know the relationship between real numbers and the number line, and compare and order real numbers with and without the number line. (Grade 6, Grade 8)

With full implementation of the CCSS, only a portion of these WA Algebra 1 learning standards is taught. The portion not taught will be emphasized at the grade level indicated in parentheses.

A1.1.C Solve problems that can be represented by a system of two linear equations or inequalities. (Begun in Grade 8 and expanded in Algebra 1)

A1.2.B Recognize the multiple uses of variables. (Grade 6)

A1.2.C Interpret and use integer exponents and square and cube roots, and apply the laws and properties of exponents to simplify and evaluate exponential expressions. (Begun in Grade 8 and expanded to fractional exponents in Algebra 1)

A1.2.D Determine whether approximations or exact values of real numbers are appropriate, depending on the context, and justify the selection. (Begun in Grade 7 and 8 but used throughout mathematics)

A1.2.F Divide polynomials. (Algebra 2)

A1.3.B Represent a function with a symbolic expression, as a graph, in a table, and using words, and make connections among these representations. (Begun in Grade 8)