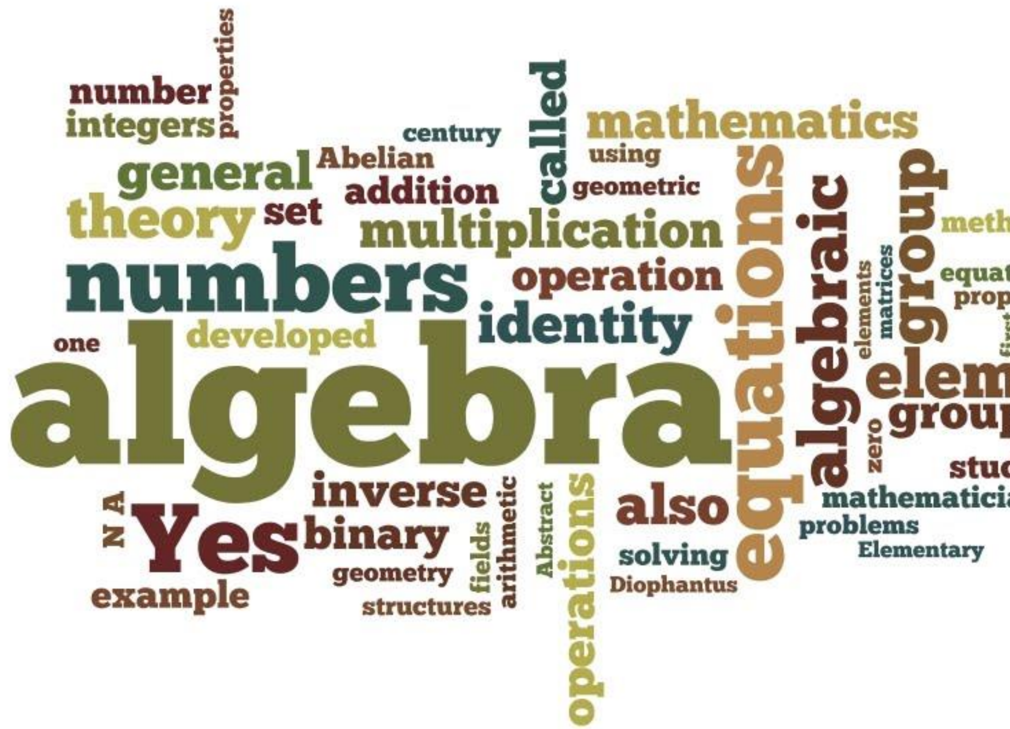
Amherst County
Public Schools

Algebra 1 (ACHS) – Curriculum Pacing



6/5/2018

Nine Week	SOL	Time Allotment
1	A.4a, b and A.5a - Properties	3 Days
	A.1b and A.3c - Order of Operations	1 Day
	A.1b - Evaluating Expression	4 Days
	8.17 and 8.18 - Simplifying Expressions	4 Days
	A.1a - Translating Expressions, Equations, and Translating	3 Days
	A.4a, c, e - Solving Equations	14 Days
	A.5a - Solving Inequalities	5 Days
	Chapter Reviews and Assessments	6 Days
	9 Weeks Review and Testing	5 Days
	Total	45 Days

Nine Week	SOL	Time Allotment
2	6.8a, b - Coordinate Plane and Function Vocabulary	1 Day
	A.7b - Domain and Range	2 Days
	A.7a - Functions	1 Day
	A.7e - Function Notation	2 Days
	A.7b, c, and d - Zeros of a Function	1 Day
	A.7a, b, c, d, e, and f - Analyzing Graphs	3 Day
	A.6a - Slope	3 Days
	A.6b, c - Writing Equations	14 Days
	A.6c and A.7f - Graphing Equations	3 Days

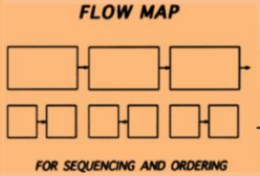
	Chapter Reviews and Assessments	4 Days
	9 Weeks Review and Test	3 Days
	Total	37 Days
		(8 Days after Christmas are included in 3rd Nine Weeks)

Nine Week	**SOL**	**Time Allotment**
2	A.4e - Word Problems	5 Days
	A.8 - Direct and Inverse Variation	3 Days
3	A.4d, e - Systems of Equations	5 Days
	A.5c, b - Linear Inequalities	2 Days
	A.5d -Systems of Inequalities	3 Days
	A.2a and A.3a - Exponent	12 Days
	A.2b - Operations on Polynomials	7 Days
	Chapter Reviews and Assessments	10 Days
	3rd Nine Weeks Review and Testing	6 Days
	Total	53 Days
		(8 Days are from 2nd Nine weeks after Christmas)

Nine Week	SOL	Time Allotment
4	A.2c - Factoring Polynomial	10 Days
	A.4b - Quadratics	10 Days
	A.9 - Statistics	5 Days
	Chapter Reviews and Assessments	5 Days
	4th Nine Weeks Review and Test	15 Days
	Total	45 Days

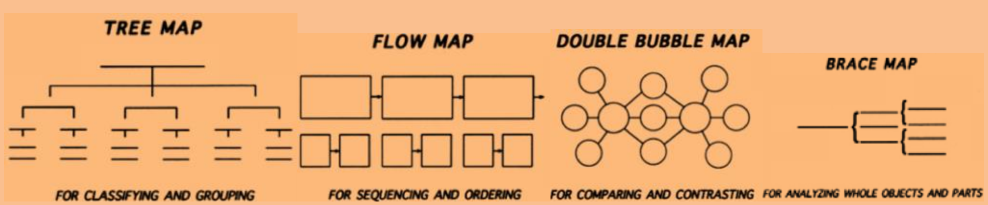
SOL	A.1
Standard	A.1 The student will a) represent verbal quantitative situations algebraically; and b) evaluate algebraic expressions for given replacement values of the variables.
Days	8 Days
Key Vocabulary	algebraic expression, numeric expression, evaluate, variable, coefficient, absolute value, square root, cube root, term
Essential Questions	• Why do we use variables in algebra? • When is it helpful to translate between verbal quantitative situations and algebraic expressions and equations? • How can you represent practical situations with algebraic expressions in a variety of ways? • Why is order of operations important?
Foundational Objectives	**8.1** The student will compare and order real numbers. **8.2** The student will describe the relationships between the subsets of the real number system. **8.14** The student will a) evaluate an algebraic expression for given replacement values of the variables; and b) simplify algebraic expressions in one variable.
Succeeding Objectives	**AII.1** The student, given rational, radical, or polynomial expressions, will a) add, subtract, multiply, divide, and simplify rational algebraic expressions; b) add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents; c) write radical expressions as expressions containing exponents and vice versa; and d) factor polynomials completely.

Thinking Map

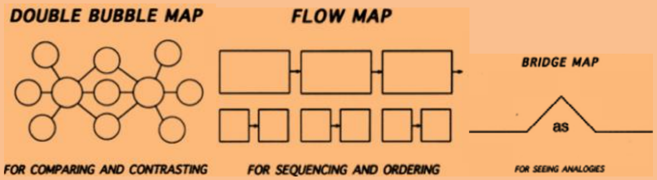


SOL	A.2
Standard	A.2 The student will perform operations on polynomials, including a) applying the laws of exponents to perform operations on expressions; b) adding, subtracting, multiplying, and dividing polynomials; and **c)** factoring completely first- and second-degree binomials and trinomials in one variable.
Days	29
Key Vocabulary	polynomial, exponent, factoring, binomial, trinomial, first degree, second degree, prime polynomial, leading coefficient, simplify
Essential Questions	• Why is it important to understand exponents? • Can two algebraic expressions that appear to be different be equivalent? • How can we use the polynomial operations in practical situations? • How is modeling operations of polynomials with concrete objects, pictures, and symbols useful? • What are some practical situations that would require operations with polynomials? • Why do we factor polynomials? • How is a difference of squares different from other polynomials? How is it the same? • What is the relationship between the factor(s) of a polynomial and the graph of the polynomial?
Foundational Objectives	**8.3 The student will** a) estimate and determine the two consecutive integers between which a square root lies; an b) determine both the positive and negative square roots of given perfect square. **8.14** The student will c) evaluate an algebraic expression for given replacement values of the variables; and d) simplify algebraic expressions in one variable.
Succeeding Objectives	**AII.1** The student will **a)** add, subtract, multiply, divide, and simplify rational algebraic expressions; **b)** add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents; and **c)** factor polynomials completely in one or two variables.

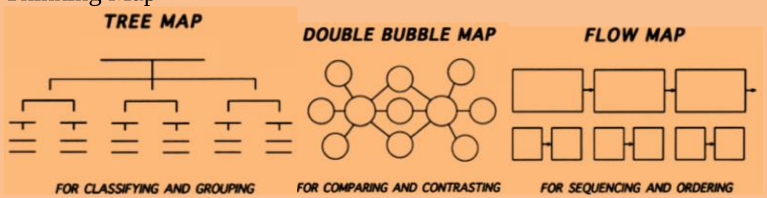
Thinking Map



SOL	A.3
Standard	A.3 The student will simplify a) square roots of whole numbers and monomial algebraic expressions; b) cube roots of integers; and **c)** numerical expressions containing square or cube roots.
Days	3
Key Vocabulary	radical, monomial, cube root, numeric expression, prime factorization, radicand, inverse
Essential Questions	• How is finding the square root of a whole number different from finding the square root of an algebraic expression? How are they the same? • What is the relationship between perfect squares and square roots? Perfect cubes and cube roots? • How does an understanding of combining like terms help when simplifying radical expressions? • How does understanding simplifying radicals help when simplifying radical expressions?
Foundational Objectives	**8.3** The student will **a)** estimate and determine the two consecutive integers between which a square root lies; and **b)** determine both the positive and negative square roots of a given perfect square.
Succeeding Objectives	**G.8** The student will solve problems, including practical problems, involving right triangles. This will include applying **a)** the Pythagorean Theorem and its converse; **b)** properties of special right triangles; and **c)** trigonometric ratios.
Thinking Map	

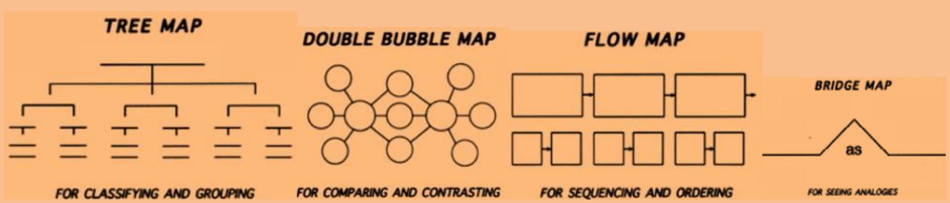


SOL	A.4
Standard	A.4 The student will solve a) multistep linear equations in one variable algebraically; b) quadratic equations in one variable algebraically; c) literal equations for a specified variable; d) systems of two linear equations in two variables algebraically and graphically; and **e)** practical problems involving equations and systems of equations
Days	37
Key Vocabulary	linear, quadratic, system of equation, properties, rational, irrational, substitution, elimination, parallel, intersect
Essential Questions	• How can you determine whether a linear equation has one, an infinite number, or no solution? • Why is it important to understand the properties of real numbers and properties of equality? • What methods can you use to solve a quadratic equation algebraically? • How would solving a literal equation for a specified variable be helpful? • When would you want to solve a literal equation for a specified variable? • How is the graph of a system of equations related to its solution? • What does it mean if a system of two linear equations has one solution? An infinite number of solutions? No solutions? • How can you determine the most efficient method for solving a system of linear equations? • Why is it important to interpret the solution to a system of equations? • How can you determine if the solution to a system of two linear equations is reasonable for a practical situation? Why is this important? • How can a system of equations be used to solve a practical problem?
Foundational Objectives	**8.4** The student will solve practical problems involving consumer applications. **8.17** The student will solve multi-step linear equations in one variable with the variable on one or both sides of the equation, including practical problems that require the solution of a multi-step linear equation in one variable.
Succeeding Objectives	**G.10** The student will solve problems, including practical problems, involving angles of convex polygons. This will include determining the **a)** sum of the interior and/or exterior angles; **b)** measure of an interior and/or exterior angle; and **c)** number of sides of a regular polygon. **G.13** The student will use surface area and volume of three-dimensional objects to solve practical problems. **G.14** The student will apply the concepts of similarity to two- or three-dimensional geometric figures. This will include; **b)** determining how changes in one or more dimensions of a figure affect area and/or volume of the figure; **c)** determining how changes in area and/or volume of a figure affect one or more dimensions of the figure; and **d)** solving problems, including practical problems, about similar geometric figures. **AII.3** The student will solve **a)** absolute value linear equations and inequalities; **b)** quadratic equations over the set of complex numbers;

	c) equations containing rational algebraic expressions; and **d)** equations containing radical expressions. **AII.4** The student will solve systems of linear-quadratic and quadratic-quadratic equations, algebraically and graphically.
Thinking Map 	

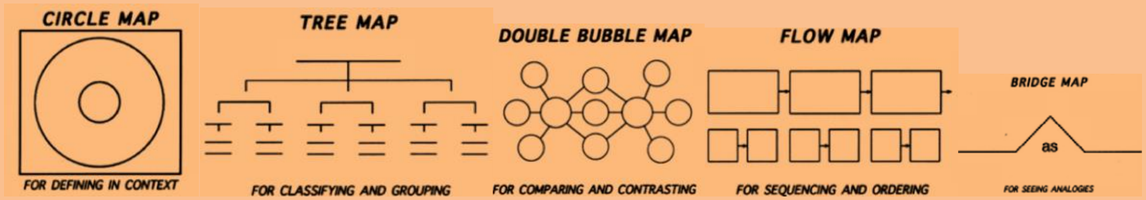
SOL	A.5
Standard	A.5 The student will a) solve multistep linear inequalities in one variable algebraically and represent the solution graphically; b) represent the solution of linear inequalities in two variables graphically; c) solve practical problems involving inequalities; and d) represent the solution to a system of inequalities graphically.
Days	11
Key Vocabulary	system of inequality, graphically
Essential Questions	• How is solving a multi-step linear inequality the same as solving a multi-step linear equation? How is it different? • Why is it important to represent the solutions to a multi-step linear inequality on a number line? • How can understanding the properties of real numbers and properties of inequality help when solving a multi-step linear inequality? • How is the graph of a linear inequality in two variables similar to the graph of a linear equation in two variables? How are they different? • What does the solution of a linear inequality represent? • What does the solution of a system of linear inequalities represent? • How can using a graphing utility help you to understand solving and representing inequalities?
Foundational Objectives	**8.18** The student will solve multistep linear inequalities in one variable with the variable on one or both sides of the inequality symbol, including practical problems, and graph the solution on a number line.
Succeeding Objectives	**AII.3** The student will solve **a)** absolute value linear equations and inequalities.

Thinking Map

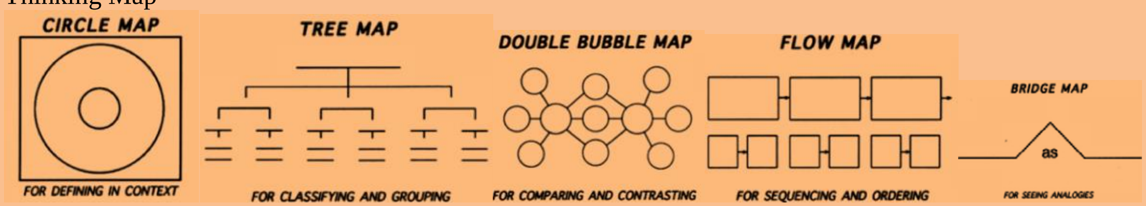


SOL	A.6
Standard	A.6 The student will a) determine the slope of a line when given an equation of the line, the graph of the line, or two points on the line; b) write the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line; and **c)** graph linear equations in two variables.
Days	20
Key Vocabulary	slope, equation of line, linear, rate of change, negative slope, positive slope, zero slope, undefined slope, vertical, horizontal, x-intercept, y-intercept, dependent, independent, standard form, slope-intercept form, point-slope form, parallel, perpendicular, parent function
Essential Questions	• How is slope the same or different in an equation of a line, graph of a line, or from two points on a line? • What does it mean if a line that has a slope that is positive, negative, zero, or undefined? • How do you determine the best method to use when writing the equation of a line? • What is the relationship between the slopes of parallel lines? • What is the relationship between the slopes of perpendicular lines? • How can you write the equation of a line parallel or perpendicular to a given line through a given point? • How can you graph a linear equation? • How do you describe transformations of linear equations based on the parent function $y = x$?
Foundational Objectives	**8.16** The student will **a)** recognize and describe the graph of a linear function with a slope that is positive, negative, or zero; **b)** identify the slope and y-intercept of a linear function, given a table of values, a graph, or an equation in $y = mx + b$ form; **c)** determine the independent and dependent variable, given a practical situation modeled by a linear function; **d)** graph a linear function given the equation in $y = mx + b$ form; and **e)** make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.
Succeeding Objectives	**G.3** The student will solve problems involving symmetry and transformation. This will include **a)** investigating and using formulas for determining distance, midpoint, and slope; **b)** applying slope to verify and determine whether lines are parallel or perpendicular; **c)** investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and **d)** determining whether a figure has been translated, reflected, rotated, or dilated, using coordinate methods.

Thinking Map

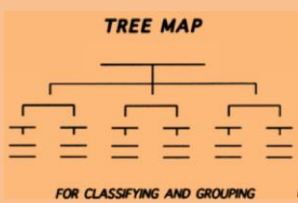


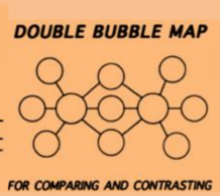
SOL	A.7
Standard	A.7 The student will investigate and analyze linear and quadratic function families and their characteristics both algebraically and graphically, including a) determining whether a relation is a function; b) domain and range; c) zeros; d) intercepts; e) values of a function for elements in its domain; and **f)** connections between and among multiple representations of functions using verbal descriptions, tables, equations, and graphs.
Days	12
Key Vocabulary	linear, quadratic, function, relation, domain, range, zeros, intercepts, root, dependent variable, independent variable, input, output, factor, set notation
Essential Questions	• What is the difference between a relation and a function? • What are the different ways functions can be represented? • How can you determine whether a relation is a function when given a set of ordered pairs, a table, or a mapping? • How can you determine whether a relation is a function when given a graph? • How can you identify the domain and range of a function? • How can you identify the zeros of a function? • How can you use the x-intercepts from a quadratic function to determine its factors? • How can you identify the intercepts of a function? • How can you use the x-intercepts from a quadratic function to determine its factors? • How can you find f(x) for a given value or set of given values of x? • How can you represent relations and functions using verbal descriptions, tables, equations, and graphs? • How do you investigate characteristics of functions with a graphing utility?
Foundational Objectives	8.15 The student will a) determine whether a given relation is a function; and b) determine the domain and range of a function. 8.16 The student will a) recognize and describe the graph of a linear function with a slope that is positive, negative, or zero; b) identify the slope and *y*-intercept of a linear function, given a table of values, a graph, or an equation in $y = mx + b$ form; c) determine the independent and dependent variable, given a practical situation modeled by a linear function; d) graph a linear function given the equation in $y = mx + b$ form; and e) make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.
Succeeding Objectives	**AII.6** For absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic functions, the student will **a)** recognize the general shape of function families; and **b)** use knowledge of transformations to convert between equations and the corresponding graphs of functions. **AII.7** The student will investigate and analyze linear, quadratic, absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic

	function families algebraically and graphically. Key concepts include **a)** domain, range, and continuity; **b)** intervals in which a function is increasing or decreasing; **c)** extrema; **d)** zeros; **e)** intercepts; **f)** values of a function for elements in its domain; **g)** connections between and among multiple representations of functions using verbal descriptions, tables, equations, and graphs; **h)** end behavior; **i)** vertical and horizontal asymptotes; **j)** inverse of a function; and **k)** composition of functions algebraically and graphically. **AII.8** The student will investigate and describe the relationships among solutions of an equation, zeros of a function, x-intercepts of a graph, and factors of a polynomial expression.
Thinking Map 	

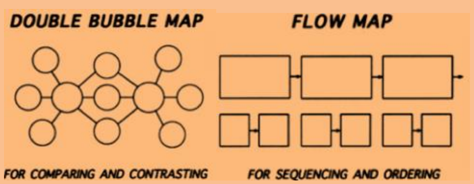
SOL	A.8
Standard	A.8 The student, given a data set or practical situation, will analyze a relation to determine whether a direct or inverse variation exists, and represent a direct variation algebraically and graphically and an inverse variation algebraically.
Days	3
Key Vocabulary	direct variation, inverse variation, constant of proportionality, directly proportional, independent variable, dependent variable
Essential Questions	• How can you determine whether a direct variation exists in a data set or practical situation? • How can you determine whether an inverse variation exists in a data set or practical situation? • What is the difference between direct and inverse variation? • How do you write an equation for a direct variation situation? • How do you write an equation for an inverse variation situation? • How do you graph an equation representing a direct variation?
Foundational Objectives	**8**.16 The Student will a) recognize and describe the graph of a linear function with a slope that is positive, negative, or zero; b) identify the stope and y-intercept of a linear function, given a table of values, a graph, or an equation in $y = mx + b$ form; c) determine the independent and dependent variable, given a practical situation modeled by a linear function; d) graph a linear function given the equation $y = mx + b$; and make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs.
Succeeding Objectives	**AII.10** The student will represent and solve problems, including practical problems, involving inverse variation, joint variation, and a combination of direct and inverse variations.

Thinking Map





SOL	A.9
Standard	A.9 The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve practical problems, using mathematical models of linear and quadratic functions.
Days	5 days
Key Vocabulary	data, line of best fit, curve of best fit, scatterplot, reasonableness,
Essential Questions	• What is the process to determine an equation of a curve of best fit? • How do you make predictions using data, scatterplots, or the equation of the curve of best fit? • How can you solve practical problems involving an equation of the curve of best fit? • How can you evaluate the reasonableness of a curve of best fit for a practical situation?
Foundational Objectives	**8.12** The student will **a)** represent numerical data in boxplots; **b)** make observations and inferences about data represented in boxplots; and **c)** compare and analyze two data sets using boxplots. **8.13** The student will **a)** represent data in scatterplots; **b)** make observations about data represented in scatterplots; and **c)** use a drawing to estimate the line of best fit for data represented in a scatterplot.
Succeeding Objectives	**AII.9** The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve practical problems, using mathematical models of quadratic and exponential functions.
Thinking Map	



Virginia 2016 *Mathematics Standards of Learning Curriculum Framework*
Introduction

The 2016 *Mathematics Standards of Learning Curriculum Framework*, a companion document to the 2016 *Mathematics Standards of Learning*, amplifies the *Mathematics Standards of Learning* and further defines the content knowledge, skills, and understandings that are measured by the Standards of Learning assessments. The standards and *Curriculum Framework* are not intended to encompass the entire curriculum for a given grade level or course. School divisions are encouraged to incorporate the standards and *Curriculum Framework* into a broader, locally designed curriculum. The *Curriculum Framework* delineates in greater specificity the minimum content that all teachers should teach and all students should learn. Teachers are encouraged to go beyond the standards as well as to select instructional strategies and assessment methods appropriate for all students.

The *Curriculum Framework* also serves as a guide for Standards of Learning assessment development. Students are expected to continue to connect and apply knowledge and skills from Standards of Learning presented in previous grades as they deepen their mathematical understanding. Assessment items may not and should not be a verbatim reflection of the information presented in the *Curriculum Framework*.

Each topic in the 2016 *Mathematics Standards of Learning Curriculum Framework* is developed around the Standards of Learning. The format of the *Curriculum Framework* facilitates teacher planning by identifying the key concepts, knowledge, and skills that should be the focus of instruction for each standard. The *Curriculum Framework* is divided into two columns: Understanding the Standard and Essential Knowledge and Skills. The purpose of each column is explained below.

Understanding the Standard
This section includes mathematical content and key concepts that assist teachers in planning standards-focused instruction. The statements may provide definitions, explanations, examples, and information regarding connections within and between grade level(s)/course(s).

Essential Knowledge and Skills
This section provides a detailed expansion of the mathematics knowledge and skills that each student should know and be able to demonstrate. This is not meant to be an exhaustive list of student expectations.

Mathematical Process Goals for Students

The content of the mathematics standards is intended to support the following five process goals for students: becoming mathematical problem solvers, communicating mathematically, reasoning mathematically, making mathematical connections, and using mathematical representations to model and interpret practical situations. Practical situations include real-world problems and problems that model real-world situations.

Mathematical Problem Solving

Students will apply mathematical concepts and skills and the relationships among them to solve problem situations of varying complexities. Students also will recognize and create problems from real-world data and situations within and outside mathematics and then apply appropriate strategies to determine acceptable solutions. To accomplish this goal, students will need to develop a repertoire of skills and strategies for solving a variety of problems. A major goal of the mathematics program is to help students apply mathematics concepts and skills to become mathematical problem solvers.

Mathematical Communication

Students will communicate thinking and reasoning using the language of mathematics, including specialized vocabulary and symbolic notation, to express mathematical ideas with precision. Representing, discussing, justifying, conjecturing, reading, writing, presenting, and listening to mathematics will help students clarify their thinking and deepen their understanding of the mathematics being studied. Mathematical communication becomes visible where learning involves participation in mathematical discussions.

Mathematical Reasoning

Students will recognize reasoning and proof as fundamental aspects of mathematics. Students will learn and apply inductive and deductive reasoning skills to make, test, and evaluate mathematical statements and to justify steps in mathematical procedures. Students will use logical reasoning to analyze an argument and to determine whether conclusions are valid. In addition, students will use number sense to apply proportional and spatial reasoning and to reason from a variety of representations.

Mathematical Connections

Students will build upon prior knowledge to relate concepts and procedures from different topics within mathematics and see mathematics as an integrated field of study. Through the practical application of content and process skills, students will make connections among different areas of mathematics and between mathematics and other disciplines, and to real-world contexts. Science and mathematics teachers and curriculum writers are encouraged to develop mathematics and science curricula that support, apply, and reinforce each other.

Mathematical Representations

Students will represent and describe mathematical ideas, generalizations, and relationships using a variety of methods. Students will understand that representations of mathematical ideas are an essential part of learning, doing, and communicating mathematics. Students should make connections among different representations – physical, visual, symbolic, verbal, and contextual – and recognize that representation is both a process and a product.

Instructional Technology

The use of appropriate technology and the interpretation of the results from applying technology tools must be an integral part of teaching, learning, and assessment. However, facility in the use of technology shall not be regarded as a substitute for a student's understanding of quantitative and algebraic concepts and relationships or for proficiency in basic computations. Students must learn to use a variety of methods and tools to compute, including paper and pencil, mental arithmetic, estimation, and calculators. In addition, graphing utilities, spreadsheets, calculators, dynamic applications, and other technological tools are now standard for mathematical problem solving and application in science, engineering, business and industry, government, and practical affairs.

Calculators and graphing utilities should be used by students for exploring and visualizing number patterns and mathematical relationships, facilitating reasoning and problem solving, and verifying solutions. However, according to the National Council of Teachers of Mathematics, "… the use of calculators does not supplant the need for students to develop proficiency with efficient, accurate methods of mental and pencil-and-paper calculation and in making reasonable estimations." State and local assessments may restrict the use of calculators in measuring specific student objectives that focus on number sense and computation. On the grade three state assessment, all objectives are assessed without the use of a calculator. On the state assessments for grades four through seven, objectives that are assessed without the use of a calculator are indicated with an asterisk (*).

Computational Fluency

Mathematics instruction must develop students' conceptual understanding, computational fluency, and problem-solving skills. The development of related conceptual understanding and computational skills should be balanced and intertwined, each supporting the other and reinforcing learning.

Computational fluency refers to having flexible, efficient and accurate methods for computing. Students exhibit computational fluency when they demonstrate strategic thinking and flexibility in the computational methods they choose, understand and can explain, and produce accurate answers efficiently.

The computational methods used by a student should be based on the mathematical ideas that the student understands, including the structure of the base-ten number system, number relationships, meaning of operations, and properties. Computational fluency with whole numbers is a goal of mathematics instruction in the elementary grades. Students should be fluent with the basic number combinations for addition and subtraction to 20 by the end of grade two and those for multiplication and division by the end of grade four. Students should be encouraged to use computational methods and tools that are appropriate for the context and purpose.

Algebra Readiness

The successful mastery of Algebra I is widely considered to be the gatekeeper to success in the study of upper-level mathematics. "Algebra readiness" describes the mastery of, and the ability to apply, the *Mathematics Standards of Learning*, including the Mathematical Process Goals for Students, for kindergarten through grade eight. The study of algebraic thinking begins in kindergarten and is progressively formalized prior to the study of the algebraic content found in the Algebra I Standards of Learning. Included in the progression of algebraic content is patterning, generalization of arithmetic concepts, proportional reasoning, and representing mathematical relationships using tables, symbols, and graphs. The K-8 *Mathematics Standards of Learning* form a progression of content knowledge and develop the reasoning necessary to be well-prepared for mathematics courses beyond Algebra I, including Geometry and Statistics.

Equity

> "Addressing equity and access includes both ensuring that all students attain mathematics proficiency and increasing the numbers of students from all racial, ethnic, linguistic, gender, and socioeconomic groups who attain the highest levels of mathematics achievement."
>
> – National Council of Teachers of Mathematics

Mathematics programs should have an expectation of equity by providing all students access to quality mathematics instruction and offerings that are responsive to and respectful of students' prior experiences, talents, interests, and cultural perspectives. Successful mathematics programs challenge students to maximize their academic potential and provide consistent monitoring, support, and encouragement to ensure success for all. Individual students should be encouraged to choose mathematical programs of study that challenge, enhance, and extend their mathematical knowledge and future opportunities.

Student engagement is an essential component of equity in mathematics teaching and learning. Mathematics instructional strategies that require students to think critically, to reason, to develop problem-solving strategies, to communicate mathematically, and to use multiple representations engages students both mentally and physically. Student engagement increases with mathematical tasks that employ the use of relevant, applied contexts and provide an appropriate level of cognitive challenge. All students, including students with disabilities, gifted learners, and English language learners deserve high-quality mathematics instruction that addresses individual learning needs, maximizing the opportunity to learn.

A.1 The student will

a) represent verbal quantitative situations algebraically; and

b) evaluate algebraic expressions for given replacement values of the variables.

Understanding the Standard	Essential Knowledge and Skills
• Mathematical modeling involves creating algebraic representations of quantitative practical situations. • The numerical value of an expression depends upon the values of the replacement set for the variables. • There are a variety of ways to compute the value of a numerical expression and evaluate an algebraic expression using order of operations. • The operations and the magnitude of the numbers in an expression affect the choice of an appropriate computational technique (e.g., mental mathematics, calculator, paper and pencil).	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Translate between verbal quantitative situations and algebraic expressions and equations. (a) • Represent practical situations with algebraic expressions in a variety of representations (e.g., concrete, pictorial, symbolic, verbal). (a) • Evaluate algebraic expressions, using the order of operations, which include absolute value, square roots, and cube roots for given replacement values to include rational numbers, without rationalizing the denominator. (b)

A.2 The student will perform operations on polynomials, including
a) applying the laws of exponents to perform operations on expressions;
b) adding, subtracting, multiplying, and dividing polynomials; and
c) factoring completely first- and second-degree binomials and trinomials in one variable.

Understanding the Standard	Essential Knowledge and Skills

• Operations with polynomials can be represented concretely, pictorially, and symbolically.
• Polynomial expressions can be used to model practical situations.
• Factoring reverses polynomial multiplication.
• Trinomials may be factored by various methods including factoring by grouping.
  – Example of factoring by grouping
  $2x^2 + 5x - 3$
  $2x^2 + 6x - x - 3$
  $2x(x + 3) - (x + 3)$
  $(x + 3)(2x - 1)$
• Prime polynomials cannot be factored over the set of integers into two or more factors, each of lesser degree than the original polynomial.
• Polynomial expressions can be used to define functions and these functions can be represented graphically.
• The laws of exponents can be applied to perform operations involving numbers written in scientific notation.
• For division of polynomials in this standard, instruction on the use of long or synthetic division is not required, but students may benefit from experiences with these methods, which become more useful and prevalent in the study of advanced levels of algebra.
	The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to
	• Simplify monomial expressions and ratios of monomial expressions in which the exponents are integers, using the laws of exponents. (a)
	• Model sums, differences, products, and quotients of polynomials with concrete objects and their related pictorial and symbolic representations. (b)
	• Determine sums and differences of polynomials. (b)
	• Determine products of polynomials. The factors should be limited to five or fewer terms (i.e., $(4x + 2)(3x + 5)$ represents four terms and
	$(x + 1)(2x^2 + x + 3)$ represents five terms). (b)
	• Determine the quotient of polynomials, using a monomial or binomial divisor, or a completely factored divisor. (b)
	• Factor completely first- and second-degree polynomials in one variable with integral coefficients. After factoring out the greatest common factor (GCF), leading coefficients should have no more than four factors. (c)
	• Factor and verify algebraic factorizations of polynomials with a graphing utility. (c)

A.3 The student will simplify

a) square roots of whole numbers and monomial algebraic expressions;
b) cube roots of integers; and
c) numerical expressions containing square or cube roots.

Understanding the Standard	Essential Knowledge and Skills
• A radical expression in Algebra I contains the square root symbol ($\sqrt{\ }$) or the cube root symbol ($\sqrt[3]{\ }$). • A square root of a number a is a number y such that $y^2 = a$. • A cube root of a number b is a number y such that $y^3 = b$. • A square root in simplest form is one in which the radicand has no perfect square factors other than one. • The inverse of squaring a number is determining the square root. • Any non-negative number other than a perfect square has a principal square root that lies between two consecutive whole numbers. • A cube root in simplest form is one in which the radicand has no perfect cube factors other than one. • The cube root of a perfect cube is an integer. • The cube root of a nonperfect cube lies between two consecutive integers. • The inverse of cubing a number is determining the cube root.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Express the square root of a whole number in simplest form. (a) • Express the principal square root of a monomial algebraic expression in simplest form where variables are assumed to have positive values. (a) • Express the cube root of an integer in simplest form. (b) • Simplify a numerical expression containing square or cube roots. (c) • Add, subtract, and multiply two monomial radical expressions limited to a numerical radicand. (c)

A.4 The student will solve

a) multistep linear equations in one variable algebraically;
b) quadratic equations in one variable algebraically;
c) literal equations for a specified variable;
d) systems of two linear equations in two variables algebraically and graphically; and
e) practical problems involving equations and systems of equations.

Understanding the Standard	Essential Knowledge and Skills
• A solution to an equation is the value or set of values that can be substituted to make the equation true. • Each point on the graph of a linear or quadratic equation in two variables is a solution of the equation. • Practical problems may be interpreted, represented, and solved using linear and quadratic equations. • The process of solving linear and quadratic equations can be modeled in a variety of ways, using concrete, pictorial, and symbolic representations. • Properties of real numbers and properties of equality are applied to solve equations. • Properties of Real Numbers: – Associative Property of Addition – Associative Property of Multiplication – Commutative Property of Addition – Commutative Property of Multiplication – Identity Property of Addition (Additive Identity) – Identity Property of Multiplication (Multiplicative Identity) – Inverse Property of Addition (Additive Inverse) – Inverse Property of Multiplication (Multiplicative Inverse) – Distributive Property • Properties of Equality: – Multiplicative Property of Zero – Zero Product Property – Reflexive Property	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine whether a linear equation in one variable has one, an infinite number, or no solutions. (a) • Apply the properties of real numbers and properties of equality to simplify expressions and solve equations. (a, b) • Solve multistep linear equations in one variable algebraically. (a) • Solve quadratic equations in one variable algebraically. Solutions may be rational or irrational. (b) • Solve a literal equation for a specified variable. (c) • Given a system of two linear equations in two variables that has a unique solution, solve the system by substitution or elimination to identify the ordered pair which satisfies both equations. (d) • Given a system of two linear equations in two variables that has a unique solution, solve the system graphically by identifying the point of intersection. (d) • Solve and confirm algebraic solutions to a system of two linear equations using a graphing utility. (d) • Determine whether a system of two linear equations has one, an infinite number, or no solutions. (d) • Write a system of two linear equations that models a practical situation. (e) • Interpret and determine the reasonableness of the algebraic or

A.4 The student will solve

a) multistep linear equations in one variable algebraically;
b) quadratic equations in one variable algebraically;
c) literal equations for a specified variable;
d) systems of two linear equations in two variables algebraically and graphically; and
e) practical problems involving equations and systems of equations.

Understanding the Standard	Essential Knowledge and Skills
– Symmetric Property – Transitive Property of Equality – Addition Property of Equality – Subtraction Property of Equality – Multiplication Property of Equality – Division Property of Equality – Substitution • Quadratic equations in one variable may be solved algebraically by factoring and applying properties of equality or by using the quadratic formula over the set of real numbers (Algebra I) or the set of complex numbers (Algebra II). • Literal equations include formulas. • A system of linear equations with exactly one solution is characterized by the graphs of two lines whose intersection is a single point, and the coordinates of this point satisfy both equations. • A system of two linear equations with no solution is characterized by the graphs of two parallel lines that do not intersect. • A system of two linear equations having an infinite number of solutions is characterized by two lines that coincide (the lines appear to be the graph of one line), and the coordinates of all points on the line that satisfy both equations. These lines will have the same slope and *y*-intercept. • Systems of two linear equations can be used to model two practical conditions that must be satisfied simultaneously. • Equations and systems of equations can be used as mathematical	graphical solution of a system of two linear equations that models a practical situation. (e) • Solve practical problems involving equations and systems of equations. (e)

A.4 **The student will solve**

a) multistep linear equations in one variable algebraically;
b) quadratic equations in one variable algebraically;
c) literal equations for a specified variable;
d) systems of two linear equations in two variables algebraically and graphically; and
e) practical problems involving equations and systems of equations.

Understanding the Standard	Essential Knowledge and Skills
models for practical situations. • Solutions and intervals may be expressed in different formats, including set notation or using equations and inequalities. – Examples may include:	

Equation/ Inequality	Set Notation
$x = 3$	{3}
$x = 3$ or $x = 5$	{3, 5}
$y \geq 3$	$\{y: y \geq 3\}$
Empty (null) set ∅	{ }

A.5 The student will

a) solve multistep linear inequalities in one variable algebraically and represent the solution graphically;
b) represent the solution of linear inequalities in two variables graphically;
c) solve practical problems involving inequalities; and
d) represent the solution to a system of inequalities graphically.

Understanding the Standard

- A solution to an inequality is the value or set of values that can be substituted to make the inequality true.
- The graph of the solutions of a linear inequality is a half-plane bounded by the graph of its related linear equation. Points on the boundary are included unless the inequality contains only < or > (no equality condition).
- Practical problems may be modeled and solved using linear inequalities.
- Solutions and intervals may be expressed in different formats, including set notation or using equations and inequalities.
  - Examples may include:

Equation/ Inequality	Set Notation
$x = 3$	$\{3\}$
$x = 3$ or $x = 5$	$\{3, 5\}$
$y \geq 3$	$\{y: y \geq 3\}$
Empty (null) set $\emptyset$	$\{\ \}$

- Properties of Real Numbers and Properties of Inequality are applied to solve inequalities.
- Properties of Real Numbers:
  - Associative Property of Addition
  - Associative Property of Multiplication
  - Commutative Property of Addition
  - Commutative Property of Multiplication
  - Identity Property of Addition (Additive Identity)
  - Identity Property of Multiplication (Multiplicative Identity)
  - Inverse Property of Addition (Additive Inverse)

Essential Knowledge and Skills

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Solve multistep linear inequalities in one variable algebraically and represent the solution graphically. (a)
- Apply the properties of real numbers and properties of inequality to solve multistep linear inequalities in one variable algebraically. (a)
- Represent the solution of a linear inequality in two variables graphically. (b)
- Solve practical problems involving linear inequalities. (c)
- Determine whether a coordinate pair is a solution of a linear inequality or a system of linear inequalities. (c)
- Represent the solution of a system of two linear inequalities graphically. (d)
- Determine and verify algebraic solutions using a graphing utility. (a, b, c, d)

A.5 The student will

a) solve multistep linear inequalities in one variable algebraically and represent the solution graphically;
b) represent the solution of linear inequalities in two variables graphically;
c) solve practical problems involving inequalities; and
d) represent the solution to a system of inequalities graphically.

Understanding the Standard	Essential Knowledge and Skills
– Inverse Property of Multiplication (Multiplicative Inverse) – Distributive Property • Properties of Inequality: – Transitive Property of Inequality – Addition Property of Inequality – Subtraction Property of Inequality – Multiplication Property of Inequality – Division Property of Inequality – Substitution	

A.6 The student will

a) determine the slope of a line when given an equation of the line, the graph of the line, or two points on the line;

b) write the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line; and

c) graph linear equations in two variables.

Understanding the Standard	Essential Knowledge and Skills
• Changes in slope may be described by dilations or reflections or both. • Changes in the *y*-intercept may be described by translations. • Linear equations can be graphed using slope, *x*- and *y*-intercepts, and/or transformations of the parent function. • The slope of a line represents a constant rate of change in the dependent variable when the independent variable changes by a constant amount. • The equation of a line defines the relationship between two variables. • The graph of a line represents the set of points that satisfies the equation of a line. • A line can be represented by its graph or by an equation. Students should have experiences writing equations of lines in various forms, including standard form, slope-intercept form, or point-slope form. • Parallel lines have equal slopes. • The product of the slopes of perpendicular lines is −1 unless one of the lines has an undefined slope. • Slope can be described as a rate of change and will be positive, negative, zero, or undefined.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine the slope of the line, given the equation of a linear function. (a) • Determine the slope of a line, given the coordinates of two points on the line. (a) • Determine the slope of a line, given the graph of a line. (a) • Recognize and describe a line with a slope or rate of change that is positive, negative, zero, or undefined. (a) • Write the equation of a line when given the graph of a line. (b) • Write the equation of a line when given two points on the line whose coordinates are integers. (b) • Write the equation of a line when given the slope and a point on the line whose coordinates are integers. (b) • Write the equation of a vertical line as $x = a$. (b) • Write the equation of a horizontal line as $y = c$. (b) • Write the equation of a line parallel or perpendicular to a given line through a given point. (b) • Graph a linear equation in two variables, including those that arise from a variety of practical situations. (c) • Use the parent function $y = x$ and describe transformations defined by changes in the slope or y-intercept. (c)

A.7 The student will investigate and analyze linear and quadratic function families and their characteristics both algebraically and graphically, including

a) determining whether a relation is a function;
b) domain and range;
c) zeros;
d) intercepts;
e) values of a function for elements in its domain; and
f) connections between and among multiple representations of functions using verbal descriptions, tables, equations, and graphs.

Understanding the Standard	Essential Knowledge and Skills
• A relation is a function if and only if each element in the domain is paired with a unique element of the range. • Functions describe the relationship between two variables where each input is paired to a unique output. • Function families consist of a parent function and all transformations of the parent function. • The domain of a function is the set of all possible values of the independent variable. • The range of a function is the set of all possible values of the dependent variable. • For each x in the domain of f, x is a member of the input of the function f, $f(x)$ is a member of the output of f, and the ordered pair $(x, f(x))$ is a member of f. • A value x in the domain of f is an x-intercept or a zero of a function f if and only if $f(x) = 0$. • Given a polynomial function $f(x)$, the following statements are equivalent for any real number, k, such that $f(k) = 0$: – k is a zero of the polynomial function $f(x)$, located at $(k, 0)$; – $(x - k)$ is a factor of $f(x)$; – k is a solution or root of the polynomial equation $f(x) =0$; and – the point $(k, 0)$ is an x-intercept for the graph of $y = f(x)$. • The x-intercept is the point at which the graph of a relation or	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine whether a relation, represented by a set of ordered pairs, a table, a mapping, or a graph is a function. (a) • Identify the domain, range, zeros, and intercepts of a function presented algebraically or graphically. (b, c, d) • Use the x-intercepts from the graphical representation of a quadratic function to determine and confirm its factors. (c, d) • For any value, x, in the domain of f, determine $f(x)$. (e) • Represent relations and functions using verbal descriptions, tables, equations, and graph. Given one representation, represent the relation in another form. (f) • Investigate and analyze characteristics and multiple representations of functions with a graphing utility. (a, b, c, d, e, f)

A.7 The student will investigate and analyze linear and quadratic function families and their characteristics both algebraically and graphically, including

a) determining whether a relation is a function;
b) domain and range;
c) zeros;
d) intercepts;
e) values of a function for elements in its domain; and
f) connections between and among multiple representations of functions using verbal descriptions, tables, equations, and graphs.

Understanding the Standard	Essential Knowledge and Skills
function intersects with the *x*-axis. It can be expressed as a value or a coordinate. • The *y*-intercept is the point at which the graph of a relation or function intersects with the *y*-axis. It can be expressed as a value or a coordinate. • The domain of a function may be restricted by the practical situation modeled by a function. • Solutions and intervals may be expressed in different formats, including set notation or using equations and inequalities. – Examples may include:	

Equation/ Inequality	Set Notation
$x = 3$	{3}
$x = 3$ or $x = 5$	{3, 5}
$y \geq 3$	$\{y: y \geq 3\}$
Empty (null) set ∅	{ }

A.8 **The student, given a data set or practical situation, will analyze a relation to determine whether a direct or inverse variation exists, and represent a direct variation algebraically and graphically and an inverse variation algebraically.**

Understanding the Standard	Essential Knowledge and Skills
• Practical problems may be represented and solved by using direct variation or inverse variation. • A direct variation represents a proportional relationship between two quantities. The statement "y is directly proportional to x" is translated as $y = kx$. • The constant of proportionality (k) in a direct variation is represented by the ratio of the dependent variable to the independent variable and can be referred to as the constant of variation. • A direct variation can be represented by a line passing through the origin. • An inverse variation represents an inversely proportional relationship between two quantities. The statement "y is inversely proportional to x" is translated as $y = \frac{k}{x}$. • The constant of proportionality (k) in an inverse variation is represented by the product of the dependent variable and the independent variable and can be referred to as the constant of variation. • The value of the constant of proportionality is typically positive when applied in practical situations.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Given a data set or practical situation, determine whether a direct variation exists. • Given a data set or practical situation, determine whether an inverse variation exists. • Given a data set or practical situation, write an equation for a direct variation. • Given a data set or practical situation, write an equation for an inverse variation. • Given a data set or practical situation, graph an equation representing a direct variation.

A.9 The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve practical problems, using mathematical models of linear and quadratic functions.

Understanding the Standard	Essential Knowledge and Skills
• Data and scatterplots may indicate patterns that can be modeled with an algebraic equation. • Determining the curve of best fit for a relationship among a set of data points is a tool for algebraic analysis of data. In Algebra I, curves of best fit are limited to linear or quadratic functions. • The curve of best fit for the relationship among a set of data points can be used to make predictions where appropriate. • Knowledge of transformational graphing using parent functions can be used to verify a mathematical model from a scatterplot that approximates the data. • Graphing utilities can be used to collect, organize, represent, and generate an equation of a curve of best fit for a set of data. • Many problems can be solved by using a mathematical model as an interpretation of a practical situation. The solution must then refer to the original practical situation. • Data that fit linear $y = mx + b$ and quadratic $y = ax^2 + bx + c$ functions arise from practical situations. • Rounding that occurs during intermediate steps of problem solving may reduce the accuracy of the final answer. • Evaluation of the reasonableness of a mathematical model of a practical situation involves asking questions including: – "Is there another linear or quadratic curve that better fits the data?" – "Does the curve of best fit make sense?" – "Could the curve of best fit be used to make reasonable predictions?"	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Determine an equation of a curve of best fit, using a graphing utility, given a set of no more than twenty data points in a table, a graph, or a practical situation. • Make predictions, using data, scatterplots, or the equation of the curve of best fit. • Solve practical problems involving an equation of the curve of best fit. • Evaluate the reasonableness of a mathematical model of a practical situation.