SOUTHERN LEHIGH SCHOOL DISTRICT
5775 Main Street
Center Valley, PA 18034

Scope and Sequence for **Middle School Algebra I**

Standards for Mathematical Practice:	
MP1 Make sense of problems and persevere in solving them. **MP2** Reason abstractly and quantitatively. **MP3** Construct viable arguments and critique the reasoning of others. **MP4** Model with mathematics.	**MP5** Use appropriate tools strategically. **MP6** Attend to precision. **MP7** Look for and make use of structure. **MP8** Look for and express regularity in repeated reasoning.

N.RN – Number and Quantity – The Real Number System

CCSSM	PA Core Standards for Mathematics
Extend the properties of exponents to rational exponents. **N.RN.1** Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. ***For example***, *we define* $5^{1/3}$ *to be the cube root of 5 because we want* $(5^{1/3})^3 = 5^{(1/3)3}$ *to hold, so* $(5^{1/3})^3$ *must equal 5.* **N.RN.2** Rewrite expressions involving radicals and rational exponents using the properties of exponents.	**CC.2.1.HS.F.1** Apply and extend the properties of exponents to solve problems with rational exponents.

Pennsylvania System of School Assessment (Keystone)	Module 1 Operations and Linear Equations & Inequalities
A1.1.1 Operations with Real Numbers and Expressions	
A1.1.1.1 Represent and/or use numbers in equivalent forms (e.g., integers, fractions, decimals, percents, square roots, and exponents).	**A1.1.1.1.1** Compare and/or order any real numbers. Note: Rational and irrational may be mixed.
	A1.1.1.1.2 Simplify square roots.
A1.1.1.3 Use exponents, roots, and/or absolute values to solve problems.	**A1.1.1.3.1** Simplify/evaluate expressions involving properties/laws of exponents, roots, and/ or absolute values to solve problems. Note: Exponents should be integers from -10 to 10.

N.RN – Number and Quantity – The Real Number System – *Continued…*

CCSSM	PA Core Standards for Mathematics
Use properties of rational and irrational numbers. **N.RN.3** 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.	**CC.2.1.HS.F.2** Apply properties of rational and irrational numbers to solve real world or mathematical problems.
Pennsylvania System of School Assessment (Keystone)	Module 1 Operations and Linear Equations & Inequalities
A1.1.1 Operations with Real Numbers and Expressions	
A1.1.1.1 Represent and/or use numbers in equivalent forms (e.g., integers, fractions, decimals, percents, square roots, and exponents).	**A1.1.1.1.1** Compare and/or order any real numbers. Note: Rational and irrational may be mixed.
	A1.1.1.1.2 Simplify square roots.
A1.1.1.2 Apply number theory concepts to show relationships between real numbers in problem-solving settings.	**A1.1.1.2.1** Find the Greatest Common Factor (GCF) and/or the Least Common Multiple (LCM) for sets of monomials.
A1.1.1.3 Use exponents, roots, and/or absolute values to solve problems.	**A1.1.1.3.1** Simplify/evaluate expressions involving properties/laws of exponents, roots, and/ or absolute values to solve problems. Note: Exponents should be integers from -10 to 10.
A1.1.1.4 Use estimation strategies in problem solving situations.	**A1.1.1.4.1** Use estimation to solve problems.

N.Q – Number and Quantity – Quantities

CCSSM	PA Core Standards for Mathematics
Reason quantitatively and use units to solve problems. **N.Q.1** Use 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.2** Define appropriate quantities for the purpose of descriptive modeling. **N.Q.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	**CC.2.1.HS.F.3** Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs and data displays. **CC.2.1.HS.F.4** Use units as a way to understand problems and to guide the solution of multi-step problems. **CC.2.1.HS.F.5** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **CC.2.2.HS.D.9** Use reasoning to solve equations and justify the solution method.
Pennsylvania System of School Assessment (PSSA)	M08.B-E Expressions and Equations
A1.1.2 Linear Equations	
A1.1.2.1 Write, solve, and/or graph linear equations using various methods.	**A1.1.2.1.1** Write, solve, and/or apply a linear equation (including problem situations).
	A1.1.2.1.2 Use and/or identify an algebraic property to justify any step in an equation-solving process. Note: Linear equations only.
	A1.1.2.1.3 Interpret solutions to problems in the context of the problem situation. Note: Linear equations only.

A.SSE – Algebra – Seeing Structure in Expressions

CCSSM	PA Core Standards for Mathematics
Interpret the structure of expressions. **A.SSE.1** Interpret expressions that represent a quantity in terms of its context. **a.** Interpret parts of an expression, such as terms, factors, and coefficients. **b.** Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P. **A.SSE.2** Use the structure of an expression to identify ways to rewrite it. ***For example****, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$*, thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$.	**CC.2.2.HS.D.1** Interpret the structure of expressions to represent a quantity in terms of its context.
Write expressions in equivalent forms to solve problems. **A.SSE.3** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. **a.** Factor a quadratic expression to reveal the zeros of the function it defines. **b.** Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. **c.** Use the properties of exponents to transform expressions for exponential functions. ***For example*** *the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%*	**CC.2.2.HS.D.2** Write expressions in equivalent forms to solve problems.

Pennsylvania System of School Assessment (Keystone)	Module 1 Operations and Linear Equations & Inequalities
A1.1.1 Operations with Real Numbers and Expressions	
A1.1.1.5 Simplify expressions involving polynomials.	**A1.1.1.5.1** Add, subtract, and/or multiply polynomial expressions (express answers in simplest form). Note: Nothing larger than a binomial multiplied by a trinomial.
	A1.1.1.5.2 Factor algebraic expressions, including difference of squares and trinomials. Note: Trinomials are limited to the form ax^2+bx+c where a is equal to 1 after factoring out all monomial factors.
	A1.1.1.5.3 Simplify/reduce a rational algebraic expression.

A.APR – Algebra – Arithmetic with Polynomials and Rational Expressions

CCSSM	PA Core Standards for Mathematics
Perform arithmetic operations on polynomials. **A.APR.1** Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.	**CC.2.2.HS.D.3** Extend the knowledge of arithmetic operations and apply to polynomials. **CC.2.2.HS.D.5** Use polynomial identities to solve problems. **CC.2.2.HS.D.6** Extend the knowledge of rational functions to rewrite in equivalent forms.

Pennsylvania System of School Assessment (Keystone)	Module 1 Operations and Linear Equations & Inequalities
A1.1.1 Operations with Real Numbers and Expressions	
A1.1.1.5 Simplify expressions involving polynomials.	**A1.1.1.5.1** Add, subtract, and/or multiply polynomial expressions (express answers in simplest form). Note: Nothing larger than a binomial multiplied by a trinomial.
	A1.1.1.5.2 Factor algebraic expressions, including difference of squares and trinomials. Note: Trinomials are limited to the form ax^2+bx+c where a is equal to 1 after factoring out all monomial factors.
	A1.1.1.5.3 Simplify/reduce a rational algebraic expression.

A.CED – Algebra – Creating Equations

CCSSM	PA Core Standards for Mathematics
Create equations that describe numbers or relationships. **A.CED.1** Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational* **A.CED.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. **A.CED.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. ***For example****, represent inequalities describing nutritional and cost constraints on combinations of different foods.* **A.CED.4** 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.*	**CC.2.2.HS.D.7** Create and graph equations or inequalities to describe numbers or relationships.

Pennsylvania System of School Assessment (Keystone)	Module 1 Operations and Linear Equations & Inequalities
A1.1.2 Linear Equations	
A1.1.2.1 Write, solve, and/or graph linear equations using various methods.	**A1.1.2.1.1** Write, solve, and/or apply a linear equation (including problem situations).
	A1.1.2.1.2 Use and/or identify an algebraic property to justify any step in an equation-solving process. Note: Linear equations only.
	A1.1.2.1.3 Interpret solutions to problems in the context of the problem situation. Note: Linear equations only.
A1.1.2.2 Write, solve, and/or graph systems of linear equations using various methods.	**A1.1.2.2.1** Write and/or solve a system of linear equations (including problem situations) using graphing, substitution, and/or elimination. Note: Limit systems to two linear equations.
	A1.1.2.2.2 Interpret solutions to problems in the context of the problem situation. Note: Limit systems to two linear equations.
A1.1.3.1 Write, solve, and/or graph linear inequalities using various methods.	**A1.1.3.1.1** Write or solve compound inequalities and/or graph their solution sets on a number line (may include absolute value inequalities).
	A1.1.3.1.2 Identify or graph the solution set to a linear inequality on a number line.
	A1.1.3.1.3 Interpret solutions to problems in the context of the problem situation. Note: Limit to linear inequalities.
A1.1.3.2 Write, solve, and/or graph systems of linear inequalities using various methods.	**A1.1.3.2.1** Write and/or solve a system of linear inequalities using graphing. Note: Limit systems to two linear inequalities.
	A1.1.3.2.2 Interpret solutions to problems in the context of the problem situation. Note: Limit systems to two linear inequalities.

A.REI – Algebra – Reasoning with Equations & Inequalities

CCSSM	PA Core Standards for Mathematics
Understand solving equations as a process of reasoning and explain the reasoning. **A.REI.1** 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.	**CC.2.2.HS.D.8** Apply inverse operations to solve equations or formulas for a given variable. **CC.2.2.HS.D.9** Use reasoning to solve equations and justify the solution method.
Solve equations and inequalities in one variable. **A.REI.3** Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. **A.REI.4** Solve quadratic equations in one variable. **a.** 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. **b.** Solve 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. **Solve systems of equations.** **A.REI.5** Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions. **A.REI.6** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. **Represent and solve equations and inequalities graphically.** **A.REI.10** 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). ***This section continues on the next page…***	**CC.2.2.HS.D.10** Represent, solve and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically. ***This section continues on the next page…***

A.REI – Algebra – Reasoning with Equations & Inequalities – *Continued…*

CCSSM	PA Core Standards for Mathematics
A.REI.3 – REI.6, AREI.10 ***Continued...***	**CC.2.2.HS.D.10** ***Continued...***
A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.	
A.REI.12 Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.	

Pennsylvania System of School Assessment (Keystone)	Module 1 Operations and Linear Equations & Inequalities
A1.1.2 Linear Equations	
A1.1.2.1 Write, solve, and/or graph linear equations using various methods.	**A1.1.2.1.1** Write, solve, and/or apply a linear equation (including problem situations).
	A1.1.2.1.2 Use and/or identify an algebraic property to justify any step in an equation-solving process. Note: Linear equations only.
	A1.1.2.1.3 Interpret solutions to problems in the context of the problem situation. Note: Linear equations only.
A1.1.2.2 Write, solve, and/or graph systems of linear equations using various methods.	**A1.1.2.2.1** Write and/or solve a system of linear equations (including problem situations) using graphing, substitution, and/or elimination. Note: Limit systems to two linear equations.
	A1.1.2.2.2 Interpret solutions to problems in the context of the problem situation. Note: Limit systems to two linear equations.
A1.1.3.1 Write, solve, and/or graph linear inequalities using various methods.	**A1.1.3.1.1** Write or solve compound inequalities and/or graph their solution sets on a number line (may include absolute value inequalities).
	A1.1.3.1.2 Identify or graph the solution set to a linear inequality on a number line.
	A1.1.3.1.3 Interpret solutions to problems in the context of the problem situation. Note: Limit to linear inequalities.
A1.1.3.2 Write, solve, and/or graph systems of linear inequalities using various methods.	**A1.1.3.2.1** Write and/or solve a system of linear inequalities using graphing. Note: Limit systems to two linear inequalities.
	A1.1.3.2.2 Interpret solutions to problems in the context of the problem situation. Note: Limit systems to two linear inequalities.

F.IF – Functions – Interpreting Functions

CCSSM	PA Core Standards for Mathematics
Understand the concept of function and use function notation. **F.IF.1** 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.2** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. **F.IF.3** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. ***For example**, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.*	**CC.2.2.HS.C.1** Use the concept and notation of functions to interpret and apply them in terms of their context.
Interpret functions that arise in applications in terms of the context. **F.IF.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* **F.IF.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. ***For example**, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* **F.IF.6** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. ***This section continues on the next page…***	**CC.2.2.HS.C.2** Graph and analyze functions and use their properties to make connections between the different representations. ***This section continues on the next page…***

F.IF – Functions – Interpreting Functions – *Continued…*

CCSSM	PA Core Standards for Mathematics
F.IF.4 – F.IF.6 ***Continued...*** **Analyze functions using different representations.** **F.IF.7** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. **a** Graph linear and quadratic functions and show intercepts, maxima, and minima. **b** Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. **e** Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. **F.IF.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. **a** Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. **b** Use the properties of exponents to interpret expressions for exponential functions. ***For example****, identify percent rate of change in functions such as* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, *and classify them as representing exponential growth or decay.* **F.IF.9** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). ***For example****, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.* ***This section continues on the next page…***	**CC.2.2.HS.C.2** ***Continued...*** ***This section continues on the next page…***

F.IF – Functions – Interpreting Functions – *Continued…*

CCSSM	PA Core Standards for Mathematics
F.IF.4 – F.IF.9 *Continued...*	**CC.2.2.HS.C.2 *Continued...***
Pennsylvania System of School Assessment (Keystone)	Module 2 Linear Functions and Data Organization
A1.2.1 Functions	
A1.2.1.1 Analyze and/or use patterns or relations.	**A1.2.1.1.1** Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically.
	A1.2.1.1.2 Determine whether a relation is a function, given a set of points or a graph.
	A1.2.1.1.3 Identify the domain or range of a relation (may be presented as ordered pairs, a graph, or a table).
A1.2.1.2 Interpret and/or use linear functions and their equations, graphs, or tables.	**A1.2.1.2.1** Create, interpret, and/or use the equation, graph, or table of a linear function.
	A1.2.1.2.2 Translate from one representation of a linear function to another (i.e., graph, table, and equation).
A1.2.2 Coordinate Geometry	
A1.2.2.1 Describe, compute, and/or use the rate of change (slope) of a line.	**A1.2.2.1.1** Identify, describe, and/or use constant rates of change.
	A1.2.2.1.2 Apply the concept of linear rate of change (slope) to solve problems.
	A1.2.2.1.3 Write or identify a linear equation when given: the graph of the line, two points on the line, or the slope and a point on the line. Note: Linear equation may be in point slope, standard, and/or slope-intercept form.
	A1.2.2.1.4 Determine the slope and/or *y*-intercept represented by a linear equation or graph.

F.BF – Functions – Building Functions

CCSSM	PA Core Standards for Mathematics
Build a function that models a relationship between two quantities. **F.BF.1** Write a function that describes a relationship between two quantities. **a.** Determine an explicit expression, a recursive process, or steps for calculation from a context. **b.** Combine standard function types using arithmetic operations. ***For example****, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* **F.BF.2** Write arithmetic sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.	**CC.2.2.HS.C.3** Write functions or sequences that model relationships between two quantities.

Pennsylvania System of School Assessment (Keystone)	Module 1 Operations and Linear Equations & Inequalities
A1.1.2 Linear Equations	
A1.1.2.1 Write, solve, and/or graph linear equations using various methods.	**A1.1.2.1.1** Write, solve, and/or apply a linear equation (including problem situations).
	A1.1.2.1.2 Use and/or identify an algebraic property to justify any step in an equation-solving process. Note: Linear equations only.
	A1.1.2.1.3 Interpret solutions to problems in the context of the problem situation. Note: Linear equations only.

Pennsylvania System of School Assessment (Keystone)	Module 2 Linear Functions and Data Organization
A1.2.1 Functions	
A1.2.1.1 Analyze and/or use patterns or relations.	**A1.2.1.1.1** Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically.
	A1.2.1.1.2 Determine whether a relation is a function, given a set of points or a graph.
	A1.2.1.1.3 Identify the domain or range of a relation (may be presented as ordered pairs, a graph, or a table).
A1.2.1.2 Interpret and/or use linear functions and their equations, graphs, or tables.	**A1.2.1.2.1** Create, interpret, and/or use the equation, graph, or table of a linear function.
	A1.2.1.2.2 Translate from one representation of a linear function to another (i.e., graph, table, and equation).
A1.2.2 Coordinate Geometry	
A1.2.2.1 Describe, compute, and/or use the rate of change (slope) of a line.	**A1.2.2.1.1** Identify, describe, and/or use constant rates of change.
	A1.2.2.1.2 Apply the concept of linear rate of change (slope) to solve problems.
	A1.2.2.1.3 Write or identify a linear equation when given: the graph of the line, two points on the line, or the slope and a point on the line. Note: Linear equation may be in point slope, standard, and/or slope-intercept form.
	A1.2.2.1.4 Determine the slope and/or *y*-intercept represented by a linear equation or graph.

F.BF – Functions – Building Functions – *Continued…*

CCSSM	PA Core Standards for Mathematics
Build a new functions from existing functions. **F.BF.3** Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative);find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* **F.BF.4** Find inverse functions. **a.** Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. ***For example**, $f(x) = 2x^3$ or $f(x) = (x+1)/(x–1)$ for $x \neq 1$.*	**CC.2.2.HS.C.4** Interpret the effects transformations have on functions and find the inverses of functions.

Pennsylvania System of School Assessment (Keystone)	Module 2 Linear Functions and Data Organization
A1.2.1 Functions	
A1.2.1.2 Interpret and/or use linear functions and their equations, graphs, or tables.	**A1.2.1.2.1** Create, interpret, and/or use the equation, graph, or table of a linear function.
	A1.2.1.2.2 Translate from one representation of a linear function to another (i.e., graph, table, and equation).

F.LE – Functions – Linear, Quadratic, and Exponential Models

CCSSM	PA Core Standards for Mathematics
Construct and compare linear, quadratic, and exponential models and solve problems. **F.LE.1** Distinguish between situations that can be modeled with linear functions and with exponential functions. **a.** Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. **b.** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. **c.** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. **F.LE.2** 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.3** Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.	**CC.2.2.HS.C.5** Construct and compare linear, quadratic and/or exponential models to solve problems.

Pennsylvania System of School Assessment (Keystone)	Module 2 Linear Functions and Data Organization
A1.2.2 Coordinate Geometry	
A1.2.2.1 Describe, compute, and/or use the rate of change (slope) of a line.	**A1.2.2.1.1** Identify, describe, and/or use constant rates of change.
	A1.2.2.1.2 Apply the concept of linear rate of change (slope) to solve problems.
	A1.2.2.1.3 Write or identify a linear equation when given: the graph of the line, two points on the line, or the slope and a point on the line. Note: Linear equation may be in point slope, standard, and/or slope-intercept form.
	A1.2.2.1.4 Determine the slope and/or *y*-intercept represented by a linear equation or graph.

Interpret expressions for functions in terms of the situation they model. **F.LE.5** Interpret the parameters in a linear or exponential function in terms of a context.	**CC.2.2.HS.C.6** Interpret functions in terms of the situation they model.

Pennsylvania System of School Assessment (Keystone)	Module 2 Linear Functions and Data Organization
A1.2.1 Functions	
A1.2.1.2 Interpret and/or use linear functions and their equations, graphs, or tables.	**A1.2.1.2.1** Create, interpret, and/or use the equation, graph, or table of a linear function.
	A1.2.1.2.2 Translate from one representation of a linear function to another (i.e., graph, table, and equation).
A1.2.2 Coordinate Geometry	
A1.2.2.2 Analyze and/or interpret data on a scatter plot.	**A1.2.2.2.1** Draw, identify, find, and/or write an equation for a line of best fit for a scatter plot.

S.ID – Statistics and Probability – Interpreting Categorical & Quantitative Data

CCSSM	PA Core Standards for Mathematics
Summarize, represent, and interpret data on a single count or measurement variable. **S.ID.1** Represent data with plots on the real number line (dot plots, histograms, and box plots). **S.ID.2** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. **S.ID.3** Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	**CC.2.4.HS.B.1** Summarize, represent, and interpret data on a single count or measurement variable.

Pennsylvania System of School Assessment (Keystone)	Module 2 Linear Functions and Data Organization
A1.2.2 Coordinate Geometry	
A1.2.2.1 Describe, compute, and/or use the rate of change (slope) of a line.	**A1.2.2.1.1** Identify, describe, and/or use constant rates of change.
	A1.2.2.1.2 Apply the concept of linear rate of change (slope) to solve problems.
	A1.2.2.1.3 Write or identify a linear equation when given: the graph of the line, two points on the line, or the slope and a point on the line. Note: Linear equation may be in point slope, standard, and/or slope-intercept form.
	A1.2.2.1.4 Determine the slope and/or *y*-intercept represented by a linear equation or graph.
A1.2.3 Data Analysis	
A1.2.3.1 Use measures of dispersion to describe a set of data.	**A1.2.3.1.1** Calculate and/or interpret the range, quartiles, and interquartile range of data.
A1.2.3.2 Use data displays in problem-solving settings and/or to make predictions.	**A1.2.3.2.1** Estimate or calculate to make predictions based on a circle, line, bar graph, measures of central tendency, or other representations.
	A1.2.3.2.2 Analyze data, make predictions, and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots, scatter plots, measures of central tendency, or other representations).
	A1.2.3.2.3 Make predictions using the equations or graphs of best-fit lines of scatter plots.

S.ID – Statistics and Probability – Interpreting Categorical & Quantitative Data – *Continued…*

CCSSM	PA Core Standards for Mathematics
Summarize, represent, and interpret data on two categorical and quantitative variables. **S.ID.5** 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.6** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. **a.** Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.* **b.** Informally assess the fit of a function by plotting and analyzing residuals. **c.** Fit a linear function for a scatter plot that suggests a linear association.	**CC.2.4.HS.B.2** Summarize, represent, and interpret data on two categorical and quantitative variables.

Pennsylvania System of School Assessment (Keystone)	Module 2 Linear Functions and Data Organization
A1.2.1 Functions	
A1.2.1.1 Analyze and/or use patterns or relations.	**A1.2.1.1.1** Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically.
	A1.2.1.1.2 Determine whether a relation is a function, given a set of points or a graph.
	A1.2.1.1.3 Identify the domain or range of a relation (may be presented as ordered pairs, a graph, or a table).
A1.2.1.2 Interpret and/or use linear functions and their equations, graphs, or tables.	**A1.2.1.2.1** Create, interpret, and/or use the equation, graph, or table of a linear function.
	A1.2.1.2.2 Translate from one representation of a linear function to another (i.e., graph, table, and equation).
A1.2.2 Coordinate Geometry	
A1.2.2.2 Analyze and/or interpret data on a scatter plot.	**A1.2.2.2.1** Draw, identify, find, and/or write an equation for a line of best fit for a scatter plot.

S.ID – Statistics and Probability – Interpreting Categorical & Quantitative Data – *Continued…*

CCSSM	PA Core Standards for Mathematics
Interpret linear models. **S.ID.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. **S.ID.8** Compute (using technology) and interpret the correlation coefficient of a linear fit. **S.ID.9** Distinguish between correlation and causation.	**CC.2.4.HS.B.3** Analyze linear models to make interpretations based on the data.

Pennsylvania System of School Assessment (Keystone)	Module 2 Linear Functions and Data Organization
A1.2.2 Coordinate Geometry	
A1.2.2.2 Analyze and/or interpret data on a scatter plot.	**A1.2.2.2.1** Draw, identify, find, and/or write an equation for a line of best fit for a scatter plot.
A1.2.3 Data Analysis	
A1.2.3.1 Use measures of dispersion to describe a set of data.	**A1.2.3.1.1** Calculate and/or interpret the range, quartiles, and interquartile range of data.
A1.2.3.2 Use data displays in problem-solving settings and/or to make predictions.	**A1.2.3.2.1** Estimate or calculate to make predictions based on a circle, line, bar graph, measures of central tendency, or other representations.
	A1.2.3.2.2 Analyze data, make predictions, and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots, scatter plots, measures of central tendency, or other representations).
	A1.2.3.2.3 Make predictions using the equations or graphs of best-fit lines of scatter plots.

S.CP – Statistics and Probability – Conditional Probability and Rules of Probability

CCSSM	PA Core Standards for Mathematics
Explain volume formulas and use them to solve problems. **S.CP.1** Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not"). **S.CP.2** Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent. **S.CP.3** Understand the conditional probability of *A* given *B* as *P*(*A* and *B*)/*P*(*B*), and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A*, and the conditional probability of *B* given *A* is the same as the probability of *B*. **S.CP.4**Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.* **S.CP.5** Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*	**2.4.HS.B.6** Use the concepts of independence and conditional probability to interpret data.
Use the rules of probability to computer probabilities of compound events. **S.CP.6** Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model. **S.CP.7** Apply the Addition Rule, P(A or B) = P(A) + P(B) - P(A and B), and interpret the answer in terms of the model.	**CC.2.4.HS.B.4** Recognize and evaluate random process underlying statistical experiments. **CC.2.4.HS.B.7** Apply the rules of probability to compute probabilities of compound events in a uniform probability model.

Pennsylvania System of School Assessment (Keystone)	Module 2 Linear Functions and Data Organization
A1.2.3 Data Analysis	
A1.2.3.3 Apply probability to practical situations.	**A1.2.3.3.1** Find probabilities for compound events (e.g., find probability of red and blue, find probability of red or blue) and represent as a fraction, decimal, or percent

8.EE – Expressions and Equations

CCSSM	PA Core Standards for Mathematics
Expressions and Equations Work with radicals and integer exponents. **8.EE.1** Addressed through standard **N.RN.2** **8.EE.2** Use square root and cube roots symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational. **8.EE.3** Use numbers expressed in the form of a single digit times a whole-number power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. ***For example,*** *estimate the population of the United States as 3 times 10^8 and the population of the world as 7 times 10^9, and determine that the world population is more than 20 times larger.* **8.EE.4** Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.	**CC.2.2.8.B.1** Apply concepts of radicals and integer exponents to generate equivalent expressions.

Pennsylvania System of School Assessment (PSSA)	M08.B-E Expressions and Equations
M08.B-E.1 Demonstrate an understanding of expressions and equations with radicals and integer exponents.	
M08.B-E.1.1 Represent and use expressions and equations to solve problems involving radicals and integer exponents.	**M08.B-E.1.1.1** Apply one or more properties of integer exponents to generate equivalent numerical expressions without a calculator (with final answers expressed in exponential form with positive exponents). **Properties will be provided.** ***Example:*** $3^{12} \times 3^{-15} = 3^{-3} = 1/(3)^3$
	M08.B-E.1.1.2 Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of perfect squares (up to and including 12^2) and cube roots of perfect cubes (up to and including 5^3) without a calculator. ***Example:*** *If $x^2 = 25$ then $x = \pm\sqrt{25}$.*
	M08.B-E.1.1.3 Estimate very large or very small quantities by using numbers expressed in the form of a single digit times an integer power of 10, and express how many times larger or smaller one number is than another. ***Example:*** *Estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger than the United States population.*
	M08.B-E.1.1.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Express answers in scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology (e.g., interpret 4.7EE9 displayed on a calculator as 4.7×10^9).

8.EE – Expressions and Equations – *Continued…*

CCSSM	PA Core Standards for Mathematics
Understand the connections between proportional relationships, lines, and linear equations. **8.EE.6** Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation y = mx for a line through the origin and the equation y = mx + b for a line intercepting the vertical axis at b.	**CC.2.2.8.B.2** Understand the connections between proportional relationships, lines, and linear equations.

Pennsylvania System of School Assessment (PSSA)	M08.B-E Expressions and Equations
M08.B-E.2 Understand the connections between proportional relationships, lines, and linear equations.	
M08.B-E.2.1 Analyze and describe linear relationships between two variables, using slope.	**M08.B-E.2.1.2** Use similar right triangles to show and explain why the slope *m* is the same between any two distinct points on a non-vertical line in the coordinate plane.
	M08.B-E.2.1.3 Derive the equation *y = mx* for a line through the origin and the equation *y = mx + b* for a line intercepting the vertical axis at *b*.

8.EE.8 Analyze and solve pairs of simultaneous linear equations. **a.** Understand that solutions to a system of two linear equations in two variable correspond to points of intersection of their graphs, because points of intersection satisfy both equations simulataneously. **b.** Addressed in A.REI.7 **c.** Solve real-world and mathematical problems leading to two linear equations in two variables. ***For example****, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*	

Pennsylvania System of School Assessment (PSSA)	M08.B-E Expressions and Equations
M08.B-E.3 Analyze and solve linear equations and pairs of simultaneous linear equations.	
M08.B-E.3.1 Write, solve, graph, and interpret linear equations in one or two variables, using various methods.	**M08.B-E.3.1.3** Interpret solutions to a system of two linear equations in two variables as points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
	M08.B-E.3.1.4 Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. ***Example:*** *3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.*
	M08.B-E.3.1.5 Solve real-world and mathematical problems leading to two linear equations in two variables. ***Example:*** *Given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.*

8.F – Functions

CCSSM	PA Core Standards for Mathematics
Define, evaluate, and compare functions. **8.F.2** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). ***For example****, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.* **8.F.3** Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. ***For example****, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.*	**CC.2.2.8.C.1** Define, evaluate, and compare functions.

Pennsylvania System of School Assessment (PSSA)	M08.B-F Functions
M08.B-F.1Analyze and interpret functions.	
M08.B-F.1.1 Define, evaluate, and compare functions displayed algebraically, graphically, numerically in tables, or by verbal descriptions.	**M08.B-F.1.1.2** Compare properties of two functions each represented in a different way (i.e., algebraically, graphically, numerically in tables, or by verbal descriptions). ***Example:*** *Given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*
	M08.B-F.1.1.3 Interpret the equation $y = mx + b$ as defining a linear function whose graph is a straight line; give examples of functions that are not linear.

Use functions to model relationships between quantities. **8.F.5** Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	

Pennsylvania System of School Assessment (PSSA)	M08.B-F Functions
M08.B-F.2 Use functions to model relationships between quantities.	
M08.B-F.2.1 Represent or interpret functional relationships between quantities using tables, graphs, and descriptions.	**M08.B-F.2.1.2** Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch or determine a graph that exhibits the qualitative features of a function that has been described verbally.

8.G – Geometry

CCSSM	PA Core Standards for Mathematics
Understand congruence and similarity using physical models, transparencies, or geometry software. **8.G.1** Verify experimentally the properties of rotations, reflections, and translations: **a.** Lines are taken to lines, and line segments to line segments of the same length. **b**. Angles are taken to angles of the same measure. **c.** Parallel lines are taken to parallel lines. **8.G.2** Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. **8.G.3** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. **8.G.4** Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. **8.G.5** Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. ***For example****, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.*	**CC.2.3.8.A.2** Understand and apply congruence and similarity using various tools.

Pennsylvania System of School Assessment (PSSA)	M08.C-G Geometry
M08.C-G.1 Demonstrate an understanding of geometric transformations.	
M08.C-G.1.1 Apply properties of geometric transformations to verify congruence or similarity.	**M08.C-G.1.1.1** Identify and apply properties of rotations, reflections, and translations. ***Example:*** *Angle measures are preserved in rotations, reflections, and translations.*
	M08.C-G.1.1.2 Given two congruent figures, describe a sequence of transformations that exhibits the congruence between them.
	M08.C-G.1.1.3 Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures, using coordinates.
	M08.C-G.1.1.4 Given two similar two-dimensional figures, describe a sequence of transformations that exhibits the similarity between them.

8.G – Geometry – *Continued…*

CCSSM	PA Core Standards for Mathematics
Understand and apply the Pythagorean Theorem. **8.G.6** Explain a proof of the Pythagorean Theorem and its converse. **8.G.8** Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.	**CC.2.3.8.A.3** Understand and apply the Pythagorean Theorem to solve problems.
Pennsylvania System of School Assessment (PSSA)	M08.C-G Geometry
M08.C-G.1 Demonstrate an understanding of geometric transformations.	
M08.C-G.2.1 Solve problems involving right triangles by applying the Pythagorean theorem.	**M08.C-G.2.1.1** Apply the converse of the Pythagorean theorem to show a triangle is a right triangle.
	M08.C-G.2.1.3 Apply the Pythagorean theorem to find the distance between two points in a coordinate system.
Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres. **8.G.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.	**CC.2.3.8.A.3** Apply the concepts of volume of cylinders, cones, and spheres to solve real-world and mathematical problems.
Pennsylvania System of School Assessment (PSSA)	M08.C-G Geometry
M08.C-G.3 Solve real-world and mathematical problems involving volume.	
M08.C-G.3.1 Apply volume formulas of cones, cylinders, and spheres.	**M08.C-G.3.1.1** Apply formulas for the volumes of cones, cylinders, and spheres to solve real-world and mathematical problems. ***Formulas will be provided.***

8.SP – Statistics and Probability

CCSSM	PA Core Standards for Mathematics
Investigate patterns of association in bivariate data. **8.SP.1** Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. **8.SP.2** Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. **8.SP.3** Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. ***For example****, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*	**CC.2.4.8.B.1** Analyze and/or interpret bivariate data displayed in multiple representations.
8.SP.4. Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. ***For example****, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*	**CC.2.4.8.B.2** Understand that patterns of association can be seen in bivariate data utilizing frequencies.

Pennsylvania System of School Assessment (PSSA)	M08.D-S Statistics and Probability
M08.D-S.1 Investigate patterns of association in bivariate data.	
M08.D-S.1.1 Analyze and interpret bivariate data displayed in multiple representations.	**M08.D-S.1.1.1** Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative correlation, linear association, and nonlinear association.
	M08.D-S.1.1.2 For scatter plots that suggest a linear association, identify a line of best fit by judging the closeness of the data points to the line.
	M08.D-S.1.1.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. ***Example****: In a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*
M08.D-S.1.2 Understand that patterns of association can be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table.	**M08.D-S.1.2.1** Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible associations between the two variables. ***Example:*** *Given data on whether students have a curfew on school nights and whether they have assigned chores at home, is there evidence that those who have a curfew also tend to have chores?*