Algebra I ELT Overview

Essential Learning Targets	*Standards*	*Prerequisite Skills*
1. I can use *UPS Check* and dimensional analysis to solve problems when different units are involved.	**Reason quantitatively and use units to solve problems.** **MGSE9-12.N.Q.1b** Convert units and rates using dimensional analysis (English-to-English and Metric-to-Metric without conversion factor provided and between English and Metric with conversion factor) **MGSE9-12.N.Q.1** Use units of measure (linear, area, capacity, rates, and time) as a way to understand problems: a. Identify, use, and record appropriate units of measure within context, within data displays, and on graphs; c. Use units within multi-step problems and formulas; interpret units of input and resulting units of output. **MGSE9-12.N.Q.2** Define appropriate quantities for the purpose of descriptive modeling. Given a situation, context, or problem, students will determine, identify, and use appropriate quantities for representing the situation. **MGSE9-12.N.Q.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. *For example, money situations are generally reported to the nearest cent (hundredth). Also, an answers' precision is limited to the precision of the data given.*	***MGSE6.RP.3d*** *I can use rate reasoning to convert units.*
2. I can add, subtract, and multiply polynomial expressions.	**Perform arithmetic operations on polynomials.** **MGSE9-12.A.APR.1** Add, subtract, and multiply polynomials; understand that polynomials form a system analogous to the integers in that they are closed under these operations. **Interpret the structure of expressions.** **MGSE9-12.A.SSE.1** Interpret expressions that represent a quantity in terms of its context. **MGSE9-12.A.SSE.1a** Interpret parts of an expression, such as terms, factors, and coefficients, in context. **MGSE9-12.A.SSE.1b** Given situations which utilize formulas or expressions with multiple terms and/or factors, interpret the meaning (in context) of individual terms or factors.	***MGSE7.NS.1d*** *I can add, subtract, multiply, and divide integers.*
3. I can simplify, add, subtract, and multiply radical expressions with square roots.	**Extend the properties of exponents to rational exponents.** **MGSE9-12.N.RN.2** Rewrite expressions involving radicals ~~and rational exponents using the properties of exponents.~~ (i.e., simplify and/or use the operations of addition, subtraction, and multiplication, with radicals within expressions limited to square roots). **Use properties of rational and irrational numbers.** **MGSE9-12.N.RN.3** Explain why the sum or product of rational numbers is rational; why the sum of a rational number and an irrational number is irrational; and why the product of a nonzero rational number and an irrational number is irrational.	***MGSE8.EE.2*** *I can evaluate the square root of perfect squares.*
4. I can solve problems by creating, solving, and graphing the solutions of equations and inequalities in one variable.	**Create equations that describe numbers or relationships** **MGSE9-12.A.CED.1** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear, ~~quadratic, simple rational, and exponential~~ functions (integer inputs only). **MGSE9-12.A.CED.3** Represent constraints by equations or inequalities, ~~and by systems of equations and/or inequalities,~~ and interpret data points as possible (i.e. a solution) or not possible (i.e. a non-solution) under the established constraint**s.**	***MGSE7.EE.1*** I can write and solve linear equations and inequalities using variables to represent unknown values in real world situations.

	<u>Understand solving equations as a process of reasoning and explain the reasoning</u> **MGSE9-12.A.REI.1** Using algebraic properties and the properties of real numbers, justify the steps of a simple, one-solution equation. Students should justify their own steps, or if given two or more steps of an equation, explain the progression from one step to the next using properties. **<u>Solve equations and inequalities in one variable</u>** **MGSE9-12.A.REI.3** Solve linear equations and inequalities in one variable including equations with coefficients represented by letters. *For example, given ax + 3 = 7, solve for x.*	
5. I can rearrange formulas to highlight specific variables.	**<u>Create equations that describe numbers or relationships</u>** **MGSE9-12.A.CED.4** Rearrange formulas to highlight a quantity of interest using the same reasoning as in solving equations. *Examples: Rearrange Ohm's law V = IR to highlight resistance R; Rearrange area of a circle formula A = π r2 to highlight the radius* ***r.***	**MGSE7.EE.4a** I can fluently solve equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers.
6. I can solve problems by creating, graphing, and solving systems of equations and inequalities in two variables.	**<u>Solve systems of equations</u>** **MGSE9-12.A.REI.6** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. **MGSE9-12.A.REI.5** Show and explain why the elimination method works to solve a system of two-variable equations. **<u>Represent and solve equations and inequalities graphically.</u>** **MGSE9-12.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. **MGSE9-12.A.REI.11** Using graphs, tables, or successive approximations, show that the solution to the equation f(x) = g(x) is the x-value where the y-values of f(x) and g(x) are the same. **MGSE9-12.A.REI.12** Graph the solution set to a linear inequality in two variables.	**MGSE8.EE.8a** I can explain why an ordered pair is a solution to a system of two linear equations, graphically and numerically.
7. I can compare properties of two linear functions represented differently (graphs, tables, equations, verbal descriptions) and draw conclusions based on those comparisons.	**<u>Analyze functions using different representations.</u>** **MGSE9-12.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 function and an algebraic expression for another, say which has the larger maximum.* **MGSE9-12.F.IF.7** Graph functions expressed algebraically and show key features of the graph both by hand and by using technology. **MGSE9-12.F.IF.7a** Graph linear ~~and quadratic~~ functions and show intercepts, ~~maxima, and minima (as determined by the function or by context)~~. **<u>Understand the concept of a function and use function notation.</u>** **MGSE9-12.F.IF.1** Understand that a function from one set (the input, called the domain) to another set (the output, called the range) assigns to each element of the domain exactly one element of the range, i.e. each input value maps to exactly one output value. If f is a function, x is the input (an element of the domain), and f(x) is the output (an element of the range). Graphically, the graph is y = f(x). **MGSE9-12.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. **<u>Interpret functions that arise in applications in terms of the context.</u>**	**MGSE8.F.4** I can identify the average rate of change and initial value of a function from its equation, graph, or table of values.

	MGSE9-12.F.IF.4 Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function which models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; ~~relative maximums and minimums; symmetries; end behavior; and periodicity.~~ **MGSE9-12.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.* **MGSE9-12.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.	
8. I can use linear functions to solve problems.	**Build a function that models a relationship between two quantities.** **MGSE9-12.F.BF.1** Write a function that describes a relationship between two quantities. **MGSE9-12.F.BF.1a** Determine an explicit expression and the recursive process (steps for calculation) from context. *For example, if Jimmy starts out with $15 and earns $2 a day, the explicit expression "2x+15" can be described recursively (either in writing or verbally) as "to find out how much money Jimmy will have tomorrow, you add $2 to his total today."* **Construct and compare linear, quadratic, and exponential models and solve problems.** **MGSE9-12.F.LE.1** Distinguish between situations that can be modeled with linear functions ~~and with exponential functions.~~ **MGSE9-12.F.LE.1a** Show that linear functions grow by equal differences over equal intervals ~~and that exponential functions grow by equal factors over equal intervals. (This can be shown by algebraic proof, with a table showing differences, or by calculating average rates of change over equal intervals).~~ **MGSE9-12.F.LE.1b.** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. **Interpret expressions for functions in terms of the situation they model.** **MGSE9-12.F.LE.5** Interpret the parameters in a linear ($f(x) = mx + b$) ~~and exponential ($f(x) = a \cdot d^x$)~~ function in terms of context. (In the functions above, "m" and "b" are the parameters of the linear function, ~~and "a" and "d" are the parameters of the exponential function.)~~ In context, students should describe what these parameters mean in terms of change and starting value.	***MGSE8.F.4*** I can construct a function to model a linear relationship between two quantities.
9. I can use exponential functions to solve problems.	**Construct and compare linear, quadratic, and exponential models and solve problems.** **MGSE9-12.F.LE.2** Construct ~~linear and~~ exponential functions, including ~~arithmetic and~~ geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). **Interpret expressions for functions in terms of the situation they model.** **MGSE9-12.F.LE.5** Interpret the parameters in a ~~linear ($f(x) = mx + b$) and~~ exponential ($f(x) = a \cdot d^x$) function in terms of context. (In the functions above, "~~m" and "b" are the parameters of the linear function~~, and "a" and "d" are the parameters of the exponential function.) In context, students should describe what these parameters mean in terms of change and starting value.	***MGSE6.RP.3c*** *I can change a percent to a decimal and a decimal to a percent*

	MGSE9-12.F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. **MGSE9-12.F.LE.1c** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. **Create equations that describe numbers or relationships.** **MGSE9-12.A.CED.1** Create equations ~~and inequalities i~~n one variable and use them to solve problems. Include equations arising from ~~linear, quadratic, simple rational, and~~ exponential functions (integer inputs only). **MGSE9-12.A.CED.2** Create ~~linear, quadratic, and~~ exponential equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (The phrase "in two or more variables" refers to formulas like the compound interest formula, in which $A = P(1 + r/n)^{nt}$ has multiple variables.) **Build a function that models a relationship between two quantities.** **MGSE9-12.F.BF.1** Write a function that describes a relationship between two quantities. **Understand the concept of a function and use function notation.** **MGSE9-12.F.IF.1** Understand that a function from one set (the input, called the domain) to another set (the output, called the range) assigns to each element of the domain exactly one element of the range, i.e. each input value maps to exactly one output value. If f is a function, x is the input (an element of the domain), and f(x) is the output (an element of the range). Graphically, the graph is y = f(x). **MGSE9-12.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.	
10. I can determine the effect of vertical translations, vertical and horizontal stretches, and reflections over the x-axis on the parent graph of exponential functions.	**Build new functions from existing functions.** **MGSE9-12.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. **Interpret functions that arise in applications in terms of the context.** **MGSE9-12.F.IF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function which models the relationship between two quantities. Sketch a graph showing key features including: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; ~~and periodicity.~~ **MGSE9-12.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.* **MGSE9-12.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. **Analyze functions using different representations.** **MGSE9-12.F.IF.7** Graph functions expressed algebraically and show key features of the graph both by hand and by using technology. **MGSE9-12.F.IF.7a** Graph ~~linear and~~ quadratic functions and show intercepts, maxima, and minima (as determined by the function or by context).	***MGSE8.G.3*** *I can describe the effect of translations and reflections using coordinates.*

11. I can write arithmetic and geometric sequences in recursive and explicit forms and use them to solve problems.	**Build a function that models a relationship between two quantities.** **MGSE9-12.F.BF.2** Write arithmetic and geometric sequences recursively and explicitly, use them to model situations, and translate between the two forms. Connect arithmetic sequences to linear functions and geometric sequences to exponential functions **MGSE9-12.F.BF.1a** Determine an explicit expression and the recursive process (steps for calculation) from context. *For example, if Jimmy starts out with $15 and earns $2 a day, the explicit expression "2x+15" can be described recursively (either in writing or verbally) as "to find out how much money Jimmy will have tomorrow, you add $2 to his total today."* **Understand the concept of a function and use function notation.** **MGSE9-12.F.IF.3** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. (Generally, the scope of high school math defines this subset as the set of natural numbers 1,2,3,4...) By graphing or calculating terms, students should be able to show how the recursive sequence $a_1=7$, $a_n=a_{n-1}+2$; the sequence $s_n = 2(n-1) + 7$; and the function $f(x) = 2x + 5$ (when x is a natural number) all define the same sequence. **Construct and compare linear, quadratic, and exponential models and solve problems.** **MGSE9-12.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).	***MGSE5.OA.3*** *I can use equations to describe numerical patterns in a table or sequence.*
12. I can determine if a function is linear or exponential given a sequence, a graph, a verbal description, or a table.	**Construct and compare linear, quadratic, and exponential models and solve problems.** **MGSE9-12.F.LE.1** Distinguish between situations that can be modeled with linear functions and with exponential functions. **MGSE9-12.F.LE.1a** Show that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals. (This can be shown by algebraic proof, with a table showing differences, or by calculating average rates of change over equal intervals). **MGSE9-12.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). **MGSE9-12.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. **Analyze functions using different representations.** **MGSE9-12.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 function and an algebraic expression for another, say which has the larger maximum.*	***MGSE8.F.5*** *I can determine if a function is linear or nonlinear.*
13. I can solve quadratic equations in one variable by inspection, factoring, completing the square, using the quadratic formula, and using graphing technology.	**Solve equations and inequalities in one variable.** **MGSE9-12.A.REI.4b** Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, factoring, completing the square, and the quadratic formula, as appropriate to the initial form of the equation (limit to real number solutions) **MGSE9-12.A.REI.4** Solve quadratic equations in one variable. **MGSE9-12.A.REI.4a** 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 $ax^2 + bx + c = 0$..	***MGE8.EE.7*** I can solve linear equations in one variable.

	Interpret the structure of expressions. **MGSE9-12.A.SSE.2** Use the structure of an expression to rewrite it in different equivalent forms. 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 $(x^2 - y^2)(x^2 + y^2)$. **Write expressions in equivalent forms to solve problems.** **MGSE9-12.A.SSE.3** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. **MGSE9-12.A.SSE.3a** Factor any quadratic expression to reveal the zeros of the function defined by the expression. **MGSE9-12.A.SSE.3b** Complete the square in a quadratic expression to reveal the maximum or minimum value of the function defined by the expression.	
14. I can use quadratic functions to solve problems.	**Create equations that describe numbers or relationships.** **MGSE9-12.A.CED.2** Create ~~linear,~~ quadratic~~, and exponential~~ equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (The phrase "in two or more variables" refers to formulas like the compound interest formula, in which $A = P(1 + r/n)^{nt}$ has multiple variables.) **MGSE9-12.A.CED.1** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from ~~linear~~, quadratic, ~~simple rational, and exponential~~ functions ~~(integer inputs only)~~. **MGSE9-12.A.CED.4** Rearrange formulas to highlight a quantity of interest using the same reasoning as in solving equations. *Examples: Rearrange Ohm's law $V = IR$ to highlight resistance R; ~~Rearrange area of a circle formula $A = \pi r^2$ to highlight the radius r~~. Rearrange area of a circle formula $A = \pi r^2$ to highlight the radius r.* **Build a function that models a relationship between two quantities.** **MGSE9-12.F.BF.1** Write a function that describes a relationship between two quantities. **Understand the concept of a function and use function notation.** **MGSE9-12.F.IF.1** Understand that a function from one set (the input, called the domain) to another set (the output, called the range) assigns to each element of the domain exactly one element of the range, i.e. each input value maps to exactly one output value. If f is a function, x is the input (an element of the domain), and f(x) is the output (an element of the range). Graphically, the graph is y = f(x). **MGSE9-12.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.	***MGSE7.EE.4a*** *I can use UPS Check to solve problems involving linear equations.*
15. I can determine the effect of vertical and horizontal translations, vertical and horizontal stretches, and reflections over the x-axis on the parent graph of quadratic functions.	**Build new functions from existing functions.** **MGSE9-12.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. **Interpret functions that arise in applications in terms of the context.** **MGSE9-12.F.IF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function which models the relationship between two quantities. Sketch a graph showing key	***MGSE8.F.2*** *I can determine the effects of changing the slope and y-intercepts on the equations and graphs of linear equations*

	features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; ~~and periodicity.~~ **MGSE9-12.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.* **MGSE9-12.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. **Analyze functions using different representations.** **MGSE9-12.F.IF.7** Graph functions expressed algebraically and show key features of the graph both by hand and by using technology. **MGSE9-12.F.IF.7a** Graph ~~linear and~~ quadratic functions and show intercepts, maxima, and minima (as determined by the function or by context). **MGSE9-12.F.IF.8** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. **MGSE9-12.F.IF.8a** 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. *For example, compare and contrast quadratic functions in standard, vertex, and intercept forms.*	
16. I can compare key features of two functions (linear, exponential, or quadratic) represented differently (graphs, tables, equations, verbal descriptions) and draw conclusions based on those comparisons.	**Interpret functions that arise in applications in terms of the context.** **MGSE9-12.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 function and an algebraic expression for another, say which has the larger maximum.* **Interpret functions that arise in applications in terms of the context.** **MGSE9-12.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.	***MGSE8.EE.5*** *I can compare two different proportional relationships represented in different ways.*
17. I can display and analyze univariate (single variable) data using dot plots, histograms, or box plots.	**Summarize, represent, and interpret data on a single count or measurement variable.** **MGSE9-12.S.ID.1** Represent data with plots on the real number line (dot plots, histograms, and box plots).	***MGSE6.SP.4*** *I can display numerical data on a number line, dot plot, histogram, and box plot.*
18. I can compare two univariate data sets using shape, unusual features, measures of center, and/or measures of spread.	**Summarize, represent, and interpret data on a single count or measurement variable.** **MGSE9-12.S.ID.2** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, mean absolute deviation, ~~standard deviation~~) of two or more different data sets. **MGSE9-12.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).	***MGSE6.SP.2*** *I can find the center, spread, and overall shape of a data distribution.*

19. I can use linear, exponential, or quadratic regressions to make predictions and solve problems involving bivariate data.	**<u>Summarize, represent, and interpret data on two categorical and quantitative variables.</u>** **MGSE9-12.S.ID.6a** Decide which type of function is most appropriate by observing graphed data, charted data, or by analysis of context to generate a viable (rough) function of best fit. Use this function to solve problems in context. Emphasize linear, quadratic and exponential models. **MGSE9-12.S.ID.6** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. **MGSE9-12.S.ID.6c** Using given or collected bivariate data, fit a linear function for a scatter plot that suggests a linear association. **<u>Interpret linear models.</u>** **MGSE9-12.S.ID.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. **MGSE9-12.S.ID.8** Compute (using technology) and interpret the correlation coefficient "r" of a linear fit. (For instance, by looking at a scatterplot, students should be able to tell if the correlation coefficient is positive or negative and give a reasonable estimate of the "r" value.) After calculating the line of best fit using technology, students should be able to describe how strong the goodness of fit of the regression is, using "r". **MGSE9-12.S.ID.9** Distinguish between correlation and causation.	***MGSE8.SP.3*** *I can use the equation of a linear model to solve problems involving bivariate data.*
20. I can use two-way frequency tables to solve problems involving categorical data.	**<u>Summarize, represent, and interpret data on two categorical and quantitative variables.</u>** **MGSE9-12.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.	***MGSE8.SP.4*** *I can construct and interpret a two-way frequency table.*