Algebra I

UNIT 1: Patterns and Functions

ESSENTIAL QUESTION	BIG IDEAS
How can patterns be identified and represented mathematically?	- Students recognize patterns among data, both visual and numeric. - Students understand relations and functions as operators that connect a set of inputs to a set of outputs. - Students recognize the existence of various function families and can informally differentiate among them. - Students understand the basic ways functions model mathematical situations and relationships.

GUIDING QUESTIONS

Content Objectives

- Students can identify and describe the patterns found among a set of data (displayed in a table), differentiating between additive growth, multiplicative growth, etc. **F.IF.3.**
- Students can determine if a relation is a function. **F.IF.1.**
- Students can identify the domain and range for a given function using input/output notation, such as "x" and "f(x)". **F.IF.1.**
- Students can evaluate functions at various inputs in a given domain, including combinations of function operations (e.g. f(5) + g(7) and f(g(7)), the latter evaluated from a table of values). **F.IF.2.**
- Students can interpret the meaning of information expressed in function notation, placing it in a relevant real-world context (e.g. a function determining heat in an oven over time ➜ what does it mean if f(10)<f(15)?). **F.IF.2.**
- Student can use a function rule to create an input-output table, plot points and sketch a graph. **F.IF.4.**
- Students can determine a reasonable domain for a real-world situation defined by a function. **F.IF.5.**
- Students can identify graphical representations of data and can visualize general function family patterns in these data (e.g. linear vs. quadratic). **A.REI.8.**
- Students can correctly identify independent and dependent variables, and make decisions about appropriate and accurate use of units and scales of measurement for these variables. **N.Q.1., N.Q.2., N.Q.3.**

Process

- What types of growth can be identified within a set of data? **F.IF.3.**
- What methods exist to determine whether a relation is a function depending on how it is represented? **F.IF.1.**
- How does function notation differentiate between inputs and outputs, while also connecting them? **F.IF.1.**

- Given an input value, how can the output value be determined for a defined function or set of functions? **F.IF.2.**
- What factors must be considered when determining an appropriate domain for a problem modeling a real-world situation? **F.IF.5.**
- How can one identify visual patterns in order to distinguish among the various function families? **A.REI.8.**

Reflective

- How do functions allow me to identify and describe patterns in data?
- How do functions allow me to model and represent real-world quantities?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.3 Construct viable arguments and critique the reasoning of others.
MP.7 Look for and make use of structure.

Content Standards

A.REI.8. (all) 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).
F.IF.1. (all) 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.
F.IF.2. (all) 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. (9/10/11) Recognize patterns in order to write functions whose domain is a subset of the integers. Limited to linear and quadratic. *For example, find the function given* {(-1, 4), (0,7), (1, 10), (2, 13)}.
F.IF.4. (all) For a function that models a relationship between two quantities, interpret key features of expressions, graphs and tables in terms of the quantities, and sketch graphs showing key features given a 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. (all) 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.*
N.Q.1 (all) 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.(all) Define appropriate quantities for the purpose of descriptive modeling.
N.Q.3.(all) Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

UNIT 2: Expressions, Equations, and Inequalities

ESSENTIAL QUESTION	BIG IDEAS
How can quantities be expressed, compared, and contrasted mathematically?	- Students can represent quantities using mathematical expressions. - Students understand effective, generalized problem-solving strategies that allow them to determine unknown values or quantities. - Students understand how to compare and contrast values of algebraic expressions using equations and inequalities. - Students can model solutions to problems using various types of representations, both symbolic and visual.

GUIDING QUESTIONS

Content Objectives

- Students can differentiate between relationships expressed using equations and relationships expressed using inequalities. **A.CED.1.**
- Students can identify mathematical relationships and use equations / inequalities involving variables to model these situations. **A.CED.1.**
- Students can rearrange formulas to highlight a quantity or variable of interest (i.e. literal equations). **A.CED.4.**
- Students can solve equations, inequalities (both simple and compound) and represent their solutions visually. **A.REI.1.**
- Students can assess solutions to equations and determine when a solution is extraneous or invalid with respect to the real-world situation modeled by an equation / inequality. **A.REI.2.**

Process

- What types of operations can be utilized to solve one-variable equations / inequalities? **A.REI.1.**
- How can a single-variable inequality be represented using a visual model (e.g. number line)? **A.CED.2.**
- How can order of operations guide us in solving for a specific unknown variable? **A.CED.4.**
- How does one utilize inverse operations to solve simple rational equations? (e.g. $\frac{x+3}{2x-1} = 5$) **A.REI.3a**.
- How does one utilize inverse operations to solve absolute value equations? (e.g. $3|x+1| = 15$) **A.REI.3a**.
- How does one utilize inverse operations to solve square root equations? (e.g. $2\sqrt{x-3} + 8 = 16$) **A.REI.3a**.

Reflective

- How do equations / inequalities allow me to model and represent real-world quantities?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.2 Reason abstractly and quantitatively.
MP.6 Attend to precision.

Content Standards

A.CED.2. (all) Apply and extend previous understanding to create equations in two or more variables to represent relationships between quantities; ~~graph equations on coordinate axes with labels and scales.~~
A.CED.4. (all) Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R.
A.REI.1. (all) Apply and extend previous understanding to solve equations, inequalities, and compound inequalities in one variable, including literal equations and inequalities.
A.REI.2. (all) Solve equations in one variable ~~and give examples showing how extraneous solutions may arise.~~
A.REI.3a. (9/10/11) Solve rational, absolute value and square root equations. Limited to simple equations.
A.CED.1. (all) Apply and extend previous understanding to create equations and inequalities in one variable and use them to solve problems.

UNIT 3: Linear Forms

ESSENTIAL QUESTION	BIG IDEAS
How can essential information of various linear relationships be uncovered, represented, and utilized?	- Students can determine rate of change in different contexts and forms - Students can evaluate the effectiveness of different linear forms and their usefulness in representing diverse situations. - How can visual models assist in the identification of key characteristics of linear functions (e.g. initial values, intercepts, etc). - Students recognize the existence of linear forms and how these can be applied to real-life situations.

GUIDING QUESTIONS

Content Objectives

- Students can identify slope or rate of change given a table, graph and/or equation. **F.IF.6.**
- Students can identify and model key features (intercepts, rate of change and end behavior) of linear functions. **F.IF.7; F.IF7a.**
- Students can use different forms of linear functions (slope-intercept, standard, and point-slope form) to find key characteristics of the function. **F.IF.8a.**
- Students can understand basic transformations of linear functions and can represent these transformations graphically. **F.BF.3.**
- Students can identify absolute value functions visually, using basic, introductory knowledge of transformations to identify their effects on absolute-value functions. **F.BF.3.**
- Students can identify a linear pattern when presented data in various forms (visual representation, table of values, etc) **A.SSE.2.**

- Students can produce an equivalent form of a linear equation as an extension of knowledge regarding solving literal equations. **A.SSE.3.**

Process

- How can key features of an equation in various linear forms be used to sketch a graph? **F.IF7a.**
- How can ideas of transformations and of symmetry assist in the graphing of absolute value functions? **F.IF7a.**
- What is the meaning of the rate of change within a real world circumstance? **F.IF.6.**
- How do modifications to linear functions affect the shape and location of these functions within a coordinate plane? **F.BF.3.**
- What factors go into deciphering which linear form is most appropriate for a given situation? **A.SSE.3.**

Reflective

- How do linear forms allow me to identify and model real-life situations?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.1 Solve problems and persevere in solving them.
MP.5 Use appropriate tools strategically.

Content Standards

F.IF.6. (9/10/11) 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.
(**9/10**) limited to linear functions.
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.
F.IF.7a. (9/10) Graph linear, ~~quadratic~~ and absolute value functions and show intercepts, maxima, minima ~~and end behavior~~.
F.BF.3. (9/10/11) Transform parent functions (f(x)) by replacing f(x) with f(x)+k, kf(x),f(kx), and f(x+k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. ~~Include recognizing even and odd functions from their graphs and algebraic expressions for them.~~ For (**9/10**) focus on linear, ~~quadratic,~~ and absolute value functions.
F.IF.8a. (9/10) Use different forms of linear functions, such as slope-intercept, standard, and point-slope form to show rate of change and intercepts.
A.SSE.2. (all) Use the structure of an expression to identify ways to rewrite it.
A.SSE.3. (all) Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

UNIT 4: Linear Inequalities and Linear Systems

ESSENTIAL QUESTION	BIG IDEAS
What information can be determined from a system of linear relationships?	- Students can solve systems of equations and inequalities in multiple ways. - Students understand the meaning of a solution to a system. - Students can compare and contrast linear systems of equatio and inequalities.

GUIDING QUESTIONS

Content Objectives

- Students can solve a system of linear equations graphically. **A.REI.6a., A.REI.9.**
- Students can solve a system of linear equations algebraically using substitution and elimination **A.REI.6b.**
- Students can define and create a system to represent a real-world situation presented as a word problem. **A.REI.6c., A.CED.3.**
- Students can interpret real-world solutions to systems of equations and discuss their viability within th context of the situation modeled. **A.CED.3.**
- Students can solve a system of inequalities graphically. **A.REI.10.**

Process

- How does one identify the solution(s) to a linear system (either equations or inequalities) from a graphical depiction? **A.REI.6a., A.REI.9., A.REI.10.**
- What does it mean for a particular coordinate pair to be a solution to a system, and what are multiple methods that could be used to assess this? **A.REI.6a., A.REI.6b., A.REI.9.**
- What considerations go into determining the most efficient solution method for solving a given linear system? **A.REI.6a., A.REI.6b.**

Reflective

- How do systems of equations / inequalities allow us to model real-world situations?
- How do systems of equations / inequalities allow us to integrate multiple real-world restrictions in ord to determine the most optimal solution?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.2 Reason abstractly and quantitatively.

MP.6 Attend to precision.

Content Standards

A.REI.6. (9/10) Analyze and solve pairs of simultaneous linear equations.

A.REI.6a. (9/10) Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

A.REI.6b. (9/10) Solve systems of two linear equations in two variables algebraically, and estimate solutions graphing the equations. Solve simple cases by inspection. *For example,* $3x + 2y = 5$ *and* $3x + 2y = 6$ *have no solution because* $3x + 2y$ *cannot simultaneously be 5 and 6.*

A.REI.6c. (9/10) 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.*

A.REI.9. (9/10/11) Solve an equation $f(x) = g(x)$ by graphing $y = f(x)$ and $y = g(x)$ and finding the *x*-value of t intersection point. Include cases where $f(x)$ and/or $g(x)$ are linear, ~~polynomial, rational, absolute value, exponential, and logarithmic functions.~~⋆ For **(9/10)** focus on linear, ~~quadratic, and absolute value.~~

A.REI.10. (9/10) Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

A.CED.3. (all) Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

UNIT 5: Polynomials

ESSENTIAL QUESTION	BIG IDEAS
How can higher-ordered expressions be manipulated and represented?	- Students can simplify expressions involving exponential terms. - Students can decompose polynomial expressions into other equival forms (i.e. factoring).

GUIDING QUESTIONS

Content Objectives

- Students can apply the properties of integer exponents. **N.RN.1.**
- Students can interpret parts of an expression, such as terms, factors, and coefficients. **A.SSE.1a**.
- Students can recognize the product of complicated expressions as separate entities in order to

correctly expand the expression (e.g. $3(1+r)^2 = 3(1+r)(1+r)$). **A.SSE.1b.**

- Students can add, subtract, and multiply polynomials. **A.APR.1.**
- Students can use knowledge of the structure of polynomial expressions to identify ways to rewrite them. **A.SSE.2.**
- Students can factor a quadratic expression. **A.SSE.3a.**
- Students can recognize factor patterns, such as difference of squares and perfect square trinomials. **A.APR.4.**

Process

- What information is embedded within the various parts of a polynomial expression? **A.SSE.1a**.
- What is the connection between multiplication of polynomials and factoring of polynomials? **A.APR.1 A.SSE.3a.**

Reflective

- When might I use the skills involved in manipulating polynomials?
- How can large quantities and ideas be represented by their smaller, foundational pieces?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.1 Solve problems and persevere in solving them.
MP.8 Look for and express regularity in repeated reasoning.

Content Standards

N.RN.1. (9/10) Know and apply the properties of integer exponents to generate equivalent numerical and algebraic expressions.

A.SSE.1. (all) Interpret expressions that represent a quantity in terms of its context.

A.SSE.1a. (all) Interpret parts of an expression, such as terms, factors, and coefficients.

A.SSE.1b. (all) 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 $(1+r)^n$.*

A.SSE.2. (all) Use the structure of an expression to identify ways to rewrite it.

A.SSE.3a. (9/10) Factor a quadratic expression ~~to reveal the zeros of the function it defines~~.

A.APR.1. (9/10) Add, subtract, and multiply polynomials.

A.APR.4. (9/10/11) Generate polynomial identities from a pattern. *For example, difference of squares, perfect square trinomials.*

UNIT 6: Quadratics

ESSENTIAL QUESTION	BIG IDEAS
How can essential information of various quadratic relationships be uncovered, represented, and utilized?	Students can determine solutions of quadratics in different contexts and forms, using various methods. Students can evaluate the effectiveness of different quadratic forms and the usefulness in representing diverse situations. Students can generate visual models to assist in the identification of key characteristics of quadratic functions (e.g. initial values, intercepts, etc). Students can apply basic knowledge of transformations.

GUIDING QUESTIONS

Content Objectives

- Student can convert an equation from standard to factored to vertex form. (**A.SSE.3**)
- Student can factor a quadratic to reveal the zeros of the function. (**A.SSE.3a**)
- Students can solve quadratic equations by using multiple algebraic methods. (**A.REI.5, A.REI.5a**)
- Students can graph quadratic and absolute value functions, identifying the key features. (**F.IF.7, F.IF.7a**)
- Students can transform parent functions of quadratic and absolute value functions. (**F.BF.3**)

Process

- How do you determine which algebraic method to use to solve a quadratic equation? (**A.REI.5a**)
- What connections can be made between the algebraic solutions of a quadratic and the key characteristics of a corresponding graph? (**A.REI.5a**)
- What factors go into deciphering which quadratic form is most appropriate for a given situation? (**A.SSE.3**)

Reflective

- How do quadratic forms allow me to identify and model real-life situations?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.4 Model with mathematics.

MP.7 Look for and make use of structure.
Content Standards

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.SSE.3a. (9/10)** Factor a quadratic expression to reveal the zeros of the function it defines.

A.REI.5. Solve quadratic equations ~~and inequalities.~~
- **A.REI.5a. (9/10)** Solve quadratic equations by inspection *(e.g. for $x^2 = 49$)*, taking square roots, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives no real solutions.

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.
- **F.IF.7a.(9/10)** Graph ~~linear~~, quadratic and absolute value functions and show intercepts, maxima, minima and end behavior.

F.BF.3. (9/10/11) Transform parent functions (f(x)) by replacing f(x) with f(x)+k, kf(x),f(kx), and f(x+k) for specif 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~~. For **(9/10)** focus on ~~linear~~, quadratic, and absolute value functions.

UNIT 7: Statistics and Data Analysis

ESSENTIAL QUESTION	BIG IDEAS
How can real-world information be represented, analyzed, and interpreted using various data models and techniques?	Students can compare and contrast data sets (e.g. centers and spread). Students can represent data using various models, and can identify key advantages of these models. Students can use data models to make predictions and extrapolate key tre from a set of data. Students can identify and describe notions of accuracy regarding a model' representation of a given data set.

GUIDING QUESTIONS

Content Objectives

- Students can calculate center (median, mean) and spread (Interquartile range, standard deviation) two or more different data sets. (**S.ID.1**)

- Students can create dot plots, histograms and box plots given a specific data set, accounting for possible effects of outliers. (**S.ID.2**)
- Students can create and interpret the meaning of two-way frequency tables of two categorical variables. (**S.ID.4**)
- Students can create a scatter plot involving two quantitative variables and use technology to calcul a line of regression to pattern the data. (**S.ID.5**)
- Students can describe the real-world context of the slope and intercept values from a calculated lir regression model. (**S.ID.6, S.ID.5b**)
- Students can use a given linear function to make predictions based on the data pattern. (**S.ID.5**)

Process

- What do the differences in shape, center, and spread of various statistical models reveal about the data? (**S.ID.1, S.ID.2**)
- How can a linear regression model explain trends in a data set and assist in predicting future outcomes? (**S.ID.6, S.ID.5b**)

Reflective

- How can one determine which visual model best represents data for a given purpose?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.3 Construct viable arguments and critique the reasoning of others.
MP.5 Use appropriate tools strategically.

Content Standards

S.ID.1. (9/10) Use statistics appropriate to the shape of the data distribution to compare center (median, m and spread (interquartile range, standard deviation) of two or more different data sets.
S.ID.2. (9/10) Interpret differences in shape, center, and spread in the context of the data sets using dot pl histograms, and box plots, accounting for possible effects of extreme data points (outliers).
S.ID.4. (9/10) Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
S.ID.5. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
- **S.ID.5a. (9/10)** Use a given linear function to solve problems in the context of data.

- **S.ID.5b. (9/10)** Fit a linear function to data and use it to solve problems in the context of the data.

S.ID.6. (9/10) Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

UNIT 8: Modeling Functions

ESSENTIAL QUESTION	BIG IDEAS
Having studied the basic function families, how can functions be appropriately selected and utilized to model various real-world situations?	Students can evaluate various function families in order to determine the effective choice for a given situation. Students can compare properties of different types of functions using var methods and techniques (e.g. algebra, graphs, tables of values, verbal, et Students can combine multiple functions to model more complex relationships. Students can determine reasonable bounds, units, and real-world restricti to understand problems and interpret the solutions to these problems.

GUIDING QUESTIONS

Content Objectives

- Students can determine an effective function to model data and patterns presented in various for **(F.IF.3).**
- Students can identify the essential information needed to create mathematical models used to visualize patterns and data. **(F.BF.1)**
- Students can compare functions from different families using a variety of representations and appropriate mathematical vocabulary. **(F.IF.9)**
- Students can combine multiple types of functions to model real world relationships (For example, p(x)=r(x)-c(x);(profit=revenue-cost). **(F.BF.1a)**
- Students can correctly identify independent and dependent variables, and make decisions about appropriate and accurate use of units and scales of measurement for these variables. **(N.Q.1, N.Q N.Q.3)**
- Students can compare and contrast discrete and continuous functions, and recognize reasonable domain and range within the context of a real-world situation. **(A.CED.3)**
- Students can solve a system involving various types of function families by graphing. **(A.REI.9)**

Process

- How do you determine which type of function will best model data showing a pattern? **(F.IF.3, (F.F**
- What factors must be considered when creating a graphical representation of a real-world situatio
  (N.Q.1, N.Q.2, N.Q.3).
- What strategies are most helpful in assessing the best function to model a situation? **(F.IF.9)**

Reflective

- Where do each of the basic function families exist in the real world?
- What types of patterns can be observed in the real-world and how can these be represented mathematically?

FOCUS STANDARDS

Standards of Mathematical Practice

MP.4 Model with mathematics.
MP.8 Look for and express regularity in repeated reasoning.

Content Standards

F.IF.3. (9/10/11) Recognize patterns in order to write functions whose domain is a subset of the integers.
(9/10) Limited to linear and quadratic. *For example, find the function given* {(-1, 4), (0,7), (1, 10), (2, 13)}.
F.IF.9. (all) Compare properties of two functions using a variety of representations (algebraically, graphica
numerically in tables, or by verbal descriptions). *For example, a quantity increasing [quadratically] eventu
exceeds a quantity increasing linearly.*
F.BF.1 Use functions to model real-world relationships.
- **F.BF.1a. (9/10)** Combine multiple functions to model complex relationships. *For example, p(x)=r(x)*
  (profit=revenue-cost).
N.Q.1 (all) 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 graph
and data displays.
N.Q.2.(all) Define appropriate quantities for the purpose of descriptive modeling.
N.Q.3.(all) Choose a level of accuracy appropriate to limitations on measurement when reporting quantiti
A.CED.3. (all) Represent constraints by equations or inequalities, and by systems of equations and/or
inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example,
represent inequalities describing nutritional and cost constraints on combinations of different foods.*

A.REI.9 (9/10/11) Solve an equation f(x)=g(x) by graphing y=f(x) and y=g(x) and finding the *x*-value of the
intersection point. Include cases where f(x) and/or g(x) are linear, polynomial, ~~rational,~~ absolute value,

~~exponential, and logarithmic functions.~~ For (9/10) focus on linear, quadratic, and absolute value