Unit 1 Functions

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 1**
Length: **5 weeks**
Status: **Published**

Brief Summary of Unit

Students will study the numeric and algebraic relationship between variables. Most relationships of study in this unit have the property that for a given value of the independent variable, there corresponds exactly one value of the dependent variable. Such a relationship is a function. Students will examine the domain, range, intercepts and graphing properties of functions. The goal is to ensure that students have the necessary algebraic foundation for what they will learn throughout this course.

Revised Date: July 2025

Standards

This curriculum integrates algebra, geometry, statistics, and/or data analysis with diversity, equity, and inclusion by connecting mathematical concepts to cultural, historical, and social studies content. Students may explore statistical studies and data patterns tied to different cultures, analyze geometric designs rooted in global traditions, or use algebraic and quantitative reasoning to examine issues of equity and fairness. When relevant, units may incorporate elements such as the Amistad Commission mandate to highlight African and African-American history, the Asian American and Pacific Islander History Law to recognize contributions of AAPI communities, or New Jersey's Diversity and Inclusion Law to promote tolerance, belonging, and respect across gender, sexual orientation, race, ethnicity, disabilities, and religion. Instruction may also align with the Commission on Holocaust Education when appropriate, fostering awareness of human behavior, moral responsibility, and the importance of combating prejudice and discrimination. Units may also align to the English Language Development (ELD) standards for K–12, recognizing that multilingual learners develop content and language concurrently in English-medium classrooms; in particular, Standard 1 (Language for Social and Instructional Purposes) supports students in communicating effectively for both social and academic purposes. Across all domains of mathematics, students connect rigorous problem solving with real-world contexts that highlight the value of diversity in society.

MATH.K-12.1	Make sense of problems and persevere in solving them
MATH.K-12.2	Reason abstractly and quantitatively
MATH.9-12.F.BF.A.1.a	Determine an explicit expression, a recursive process, or steps for calculation from a context.
MATH.K-12.3	Construct viable arguments and critique the reasoning of others
MATH.K-12.4	Model with mathematics

MATH.K-12.5	Use appropriate tools strategically
MATH.9-12.F.BF.B.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.
MATH.K-12.6	Attend to precision
MATH.K-12.7	Look for and make use of structure
MATH.9-12.F.BF.B.4.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.
MATH.K-12.8	Look for and express regularity in repeated reasoning
MATH.9-12.F.BF.B.4.c	Read values of an inverse function from a graph or a table, given that the function has an inverse.
MATH.9-12.F.BF.B.5	Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.
MATH.9-12.F.IF.A.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 $y = f(x)$.
MATH.9-12.F.IF.A.2	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
MATH.9-12.F.IF.A.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
MATH.9-12.F.IF.B.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.
MATH.9-12.F.IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
MATH.9-12.F.IF.C.7.a	Graph linear and quadratic functions and show intercepts, maxima, and minima.
MATH.9-12.F.IF.C.7.b	Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
MATH.9-12.F.IF.C.7.c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
MATH.9-12.F.IF.C.7.d	Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
MATH.9-12.F.IF.C.7.e	Graph exponential and logarithmic functions, showing intercepts and end behavior.
MATH.9-12.F.IF.C.8.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.
MATH.9-12.F.IF.C.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
MATH.9-12.A.SSE.A.1.a	Interpret parts of an expression, such as terms, factors, and coefficients.
MATH.9-12.A.SSE.A.1.b	Interpret complicated expressions by viewing one or more of their parts as a single entity.
MATH.9-12.F.LE.A.1.a	Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
MATH.9-12.A.SSE.A.2	Use the structure of an expression to identify ways to rewrite it.
MATH.9-12.F.LE.A.1.b	Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

MATH.9-12.F.LE.A.1.c	Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
MATH.9-12.A.SSE.B.3.a	Factor a quadratic expression to reveal the zeros of the function it defines.
MATH.9-12.F.LE.A.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.
MATH.9-12.F.LE.A.4	Understand the inverse relationship between exponents and logarithms. For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.
LA.K-12.NJSLSA.L4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.
MATH.9-12.F.LE.B.5	Interpret the parameters in a linear or exponential function in terms of a context.
LA.K-12.NJSLSA.L5	Demonstrate understanding of word relationships and nuances in word meanings.
CS.9-12.8.1.12.AP.5	Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
CS.K-12.3.a	Identify complex, interdisciplinary, real-world problems that can be solved computationally.
CS.K-12.3.b	Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or procedures.
CS.K-12.3.c	Evaluate whether it is appropriate and feasible to solve a problem computationally.
WRK.9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.
WRK.9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.

Essential Questions

- Are all equations functions?
- How are the relations between two variables represented in verbal, numeric, graphical, and algebraic form?
- How can functions be applied to mathematical modeling of real world problems?
- What are the defining characteristics and representations of a function?

Enduring Understandings

- A function models a relationship between two variables.
- A graph may cross a horizontal asymptote but never a vertical asymptote.
- Not all functions have inverse functions.
- The domain of a function is the set of all independent values for which the function is defined.
- There is an algebraic and graphical relationship between a function and its inverse.
- To be a function every value of the independent variable may only correspond to one value of the dependent variable.

Students Will Know

- How horizontal and vertical asymptote effect the graph of a function.
- How to build new functions from existing functions.
- How to construct and compare linear, quadratic, and exponential models.
- How to graph a piece-wise function.
- How to graph and find the equation of an inverse function.
- How to identify the domain and range of a function.
- How to present solutions in interval notation and inequality notation.
- How to represent a function by equations, graphs and tables of values.
- How transformation of graphs: shifts and stretches (both horizontally and vertically) affect the picture of a graph and the equation of a function.
- The difference between a dependent and independent variable.

Students Will Be Skilled At

- Building new functions from existing functions (composite functions).
- Comparing properties of polynomial, rational and exponential models.
- Constructing polynomial, rational, and exponential models.
- Determining the difference between a dependent and independent variable.
- Finding the equation of an inverse function.
- Finding the equations of any horizontal or vertical asymptotes.
- Graphing a piece-wise functions.
- Graphing an inverse function.
- Identifying the domain of a function: classifying the undefined values of a function.
- Using the domain of a function to identify the range of the function.
- Writing solutions in interval notation and inequality notation.

Assessment

Assessments

- Formative: Daily assessments using examples from class notes, observation of student work on problems in class, student group work
- Summative: Teacher-created assessments
- Alternative Assessments: Differentiated learning tasks in Khan Academy Edia, and/or DeltaMath

- Answer essential questions
- Class discussion of daily topic

- Classwork and homework that assess the essential questions
- Provide alternative means of assessments for certain students
- Students will be able to determine the reasonableness of a solution and provide verbal/written explanation for the validity of their solution.
- Students will demonstrate their understanding of functions by analyzing functions both algebraically and graphically.
- Students will have the knowledge and skill to compare and contrast the graphs of a function; specifically the zeros, maximum, minimum values of the function.
- Students will interpret expressions for functions in terms of the situation they model.
- Students will use technology (TI graphing calculator) to solve problems, interpret results and verify conclusions
- Teacher Observation
- Tests and quizzes that assess the essential questions
- Written assignments that assess the essential questions that involves providing explanations

Learning Plan

- Review factoring **(2 classes)**
  - Monic trinomials
  - Trinomials for a > 1
  - Factoring by by grouping
  - Differences of squares
- Use factoring for simplifying rational expressions **(1 class)**
  - Useful also for when students learn about discontinuities and the nature of removable versus non-removable discontinuities
- Sketch polynomial, radical, rational, absolute value, logarithmic, and exponential functions and identify any intercepts, vertices/starting points, domain and range expressed in interval notation. **(7 classes)**
  - Rational functions written in the form a/(x-h) + k
  - For rational functions, identify asymptotes
  - Students should be able to find the domain algebraically, and the range both algebraically and graphically.
  - Find vertex of a quadratic in standard and vertex form.
  - Use transformation rules students have learned in earlier math classes.
  - Include horizontal and vertical reflection.
    - Students should be able to sketch something like y = sqrt(9-x)
- Find domain, range, and intercepts for nonlinear functions such as radicals divided by polynomials and radicals with a polynomial radicand. **(2 classes)**
- Sketch and evaluate piece-wise functions composed of the functions in this unit. **(3 classes)**

Materials

Core Book List including Calculus Larson 12E

Supplemental materials: Khan Academy, Edia, and DeltaMath

- District approved textbook
- Khan Academy
- Teacher created activiites
- Teacher created notes

Integrated Accommodation & Modifications

Possible accommodations/modification for CP Calculus