02 Function Foundations

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **2 - 3 Weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

This course is an extension of Algebra 1. Emphasis is upon the development of insights into the structure of algebra as a deductive process. The content includes function foundations, equations and inequalities, polynomial functions and equations, rational functions and equations, radical expressions and equations, exponential and logarithmic functions and equations, trigonometric functions and equations, introductory data analysis, and probability.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Objectives:

- Interpret functions that arise in applications in terms of the context
- Analyze functions using different representations
- Build functions that arise in applications in terms of the context
- Analyze functions using different representations
- Interpret functions that arise in applications in terms of the context
- Build a function that models a relationship between two quantities
- Build new functions from existing functions

Essential Questions:

- How do we model information?
- Why do we use mathematical models?
- What are functions?
- How do changes affect functions?
- What are the different types of functions?
- What are the operations that apply to all functions?
- How can you represent and describe functions?
- How can functions describe real-word situations, model predictions and solve problems?
- How can Geometric and Analytic representations be used to describe the behavior of the function?
- How are algebraic, numeric, and graphic representations of functions related?

Enduring Understanding:

- A pairing of items from two sets is special if each item from one set pairs with exactly one item from the second set.
- Some quantities are in a relationship where the ratio of corresponding values is constant.
- Sometimes it is possible to model data from a real-world situation with a linear equation.
- There are sets of functions, called families, in which each function is a transformation of a special function called the parent.
- Just as absolute value of x is its distance from 0, the absolute value of f(x) gives the distance from the line y = 0 for each value of f(x).
- You can add, subtract, multiply, and divide functions based on how you perform these operations for real numbers. One difference, however, is that you must consider the domain of each function.

CONTENT AREA STANDARDS

HS Functions

F.BF

A. Build a function that models a relationship between two quantities

B. Build new functions from existing functions

F.IF

A. Understand the concept of a function and use function notation

B. Interpret functions that arise in applications in terms of the context

C. Analyze functions using different representations

MA.K-12.2	Reason abstractly and quantitatively.
MA.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 $y = f(x)$.
MA.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.

MA.K-12.4	Model with mathematics.
MA.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.
MA.K-12.5	Use appropriate tools strategically.
MA.F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
MA.K-12.6	Attend to precision.
MA.F-IF.B.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.
MA.K-12.7	Look for and make use of structure.
MA.F-IF.C.7a	Graph linear and quadratic functions and show intercepts, maxima, and minima.
MA.F-IF.C.7b	Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
MA.F-IF.C.7c	Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
MA.F-BF.A.1b	Combine standard function types using arithmetic operations.
MA.F-BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, 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.
MA.F-BF.B.4a	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.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

9.1.8.PB.3: Explain how to create budget that aligns with financial goals.

LA.K-12.NJSLSA.R7	Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
CS.K-12.2.a	Cultivate working relationships with individuals possessing diverse perspectives, skills, and personalities.
CS.K-12.2.b	Create team norms, expectations, and equitable workloads to increase efficiency and effectiveness.
CS.K-12.2.c	Solicit and incorporate feedback from, and provide constructive feedback to, team members and other stakeholders.
CS.K-12.2.d	Evaluate and select technological tools that can be used to collaborate on a project.
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.
TECH.9.4.2.CT.3	Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
TECH.9.4.2.TL.4	Navigate a virtual space to build context and describe the visual content.
TECH.9.4.2.TL.5	Describe the difference between real and virtual experiences.
TECH.9.4.2.GCA	Global and Cultural Awareness

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- Functions can be represented graphically, precisely (with technology) or in sketch (by hand).
- Function notation denotes independent and dependent variables (input/output).
- Precision of language and terminology (function, domain/range, odd/even, etc.) aids fluency in concept attainment.
- Operations can be performed within the set of functions.
- A function from one set to another set assigns to each element of the domain exactly one element of the range

Procedural Knowledge

Students will be able to:

- Determine if a graph/equation represents a function
- Determine domain/range, maximums/minimum, even/odd/neither, and increasing/decreasing intervals
- Perform operations with functions
- Prove functions are inverses
- Apply transformations (vertical/horizontal shifts, compression/stretches) to graph functions
- Combine standard function types using arithmetic operations
- Graph linear and quadratic functions expressed symbolically
- Graph polynomial functions expressed symbolically
- Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions expressed symbolically
- Identify the effect on the graph of replacing f(x) by f(x) + k, kf(x), f(kx), and f(x + k) for specific values of k (both positive and negative
- Recognize even and odd functions from their graphs and algebraic expressions for them
- Relate the domain of a function to its graph and to the quantitative relationship it describes
- Calculate and interpret average rate of change of a function
- Find inverse functions
- Interpret key features of graphs and tables of a function that models a relationship

between two quantities
- Sketch graphs showing key features given a verbal description of the relationship
- Use function notation, evaluate function notation in terms of a context

EVIDENCE OF LEARNING

Benchmark Assessments

Benchmark Assessments conducted three times per year, using Pear Assessment (Standards Based Assessments)

Alternate Assessments

- Portfolios
- Verbal Assessment (instead of written)
- Multiple choice
- Modified Rubrics
- Performance Based Assessments

Formative Assessments

- Class Discussion
- Teacher Observation
- Exit/Entrance Tickets
- Classwork
- Homework

Summative Assessments

- Quizzes
- Tests
- Projects

RESOURCES (Instructional, Supplemental, Intervention Materials)

Core Instructional Resources

- Sullivan Algebra and Trigonometry Textbook (chapter 3)

Supplemental Resources

- Khan Academy
- Illustrative Math
- Illustrative Mathematics Task by Standard
- New Jersey Center for Teaching & Learning
- Desmos
    - https://teacher.desmos.com/functions
    - https://teacher.desmos.com/collection/5ff0ee0c289a1a0d5c68023b

INTERDISCIPLINARY CONNECTIONS

Interdisciplinary connections are frequently addressed through modeling and application problems whereby students solve and analyze situations such as predicting natural disasters, converting from binary to decimal, hourly wage, volume, and cost analysis. Examples can be found in topic specific textbook problems and digital resources.

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.