



Unit 1 - Function Relationships

Algebra I



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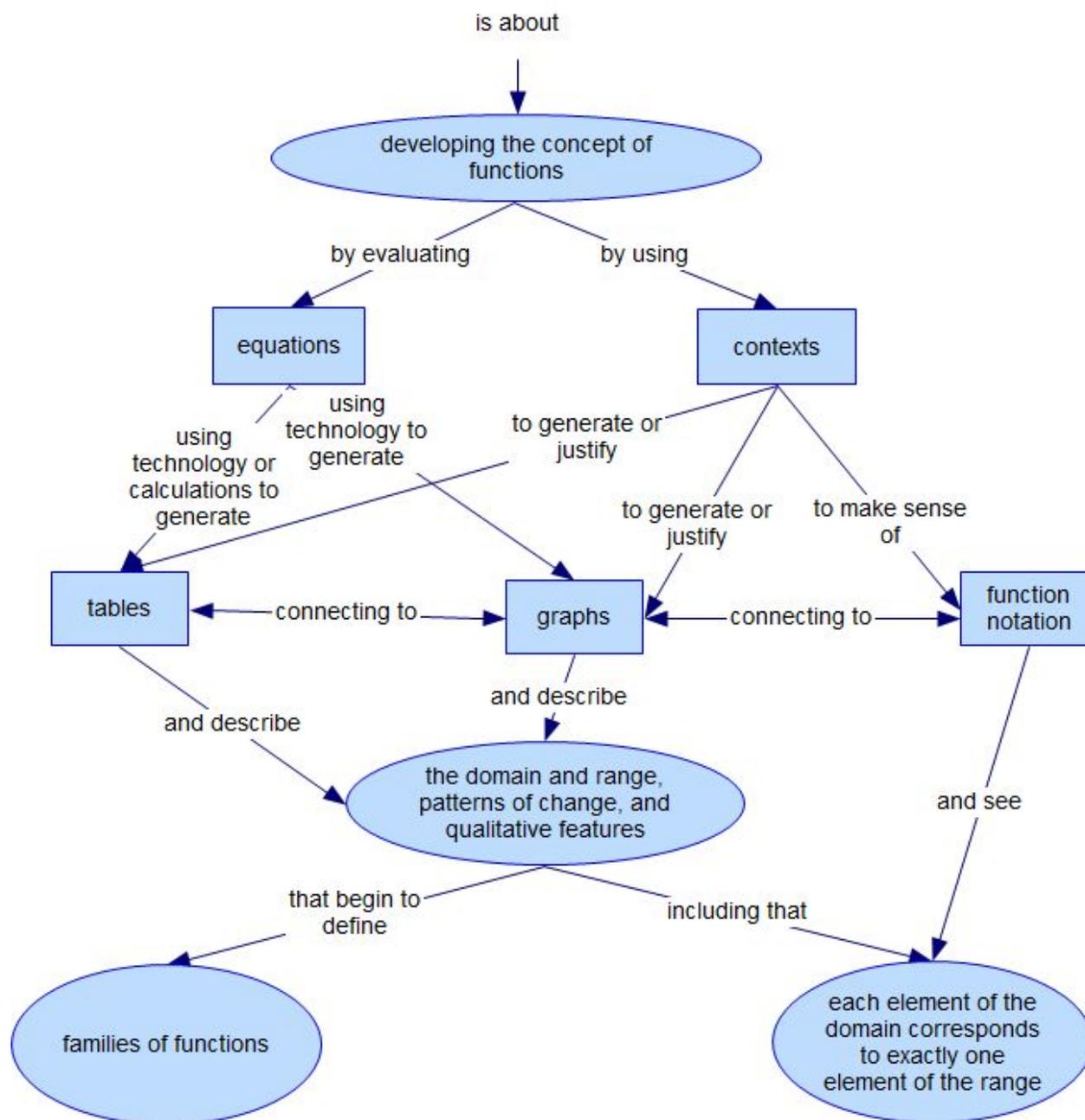
Common Core > 2015-2016 > Grade 9 > Mathematics > Algebra I
(CC) > Week 1 - Week 4

Common Core Initiative

Overarching Questions and Enduring Understandings

In what ways can relationships between variables be represented and studied?

Graphic Organizer



Unit Abstract

In this unit, students build the foundational understandings that functions model relationships between quantities. In addition, students build an arsenal of tools to study functions throughout the course including the routine of examining functions with multiple representations. “Students should develop ways of thinking that are general and allow them to approach any type of function, work with it, and understand how it behaves, rather than see each function as a completely different animal in the bestiary” (*Grade 8, High School Functions* progression document, page 7). Specific features of linear, exponential, quadratic, and polynomial functions are each studied extensively in their own units in Algebra 1.

Contexts are important for developing conceptual understanding. Drawing from contexts, students justify that one quantity depends on another and that each element of the domain corresponds to exactly one element of the range. They can qualitatively describe aspects of functions (e.g., increasing, decreasing) and reason about a function’s domain and range leading to conjectures about additional representations. In addition, students use contexts to make sense of function notation. For example, if the function h represents the height in centimeters of a bean sprout at specified days, t , then students should be able to talk about and/or identify each of the following: $h(3)$, $5=h(t)$, $h(6.5)=13.2$, and $h(t)=n$.

When functions are expressed symbolically, students input values into the equations to generate a table of output values and use these corresponding values to graph the function. After manually generating numeric and then graphic representations, students will use technologies such as a graphing calculator to generate both tables of values and graphs of functions. In doing so, they should pause to reflect upon the functional relationship between variables exhibited in these representations and why the representations make sense. By generating and comparing multiple cases, students recognize that functions can be organized by similar and different features like patterns of change, restrictions in the domain/range, and general shape. This organization of functions both serves as an introduction to the families of functions that they will study throughout the course and equips students with strategies to study and represent functions.

Students should not be expected to generate symbolic representations until later units. Likewise, symbolic manipulation of equations to reveal key features of functions (e.g., intercepts, maximum, horizontal asymptote) is included later in specific function units.

 [Unit Overview \(Word\)](#)

 [Unit Overview \(PDF\)](#)

Content Expectations/Standards

High School: Number/Quantity

Quantities

HSN-Q.A. Reason quantitatively and use units to solve problems.

- HSN-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling.
- HSN-Q.A.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

High School: Algebra

Reasoning with Equations & Inequalities

HSA-REI.D. Represent and solve equations and inequalities graphically.

- HSA-REI.D.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).

Unit Level Standards

Please Note: The standards listed in this section have been modified to be appropriate for this unit. Text in gray font is part of the CCSS-M standard but does not apply to this unit. Text in brackets denotes a modification that has been made to the standard.

Mathematics: HS: Algebra, Creating Equations

HSA-CED.A. Create equations that describe numbers or relationships.

- HSA-CED.A.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Mathematics: HS: Functions, Interpreting Functions

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

- HSF-IF.B.6. Calculate and [Describe qualitatively and] interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate [Describe qualitatively] the rate of change from

MI: HS: Functions

Interpreting Functions

HSF-IF.A. Understand the concept of a function and use function notation.

- HSF-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 $y = f(x)$.
- HSF-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.

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

- HSF-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. HSF-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

Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. ★

- HSF-IF.B.5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
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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. ★

HSF-IF.C. Analyze functions using different representations.

- HSF-IF.C.7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
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a graph.

HSF-IF.C. Analyze functions using different representations.

- HSF-IF.C.9. Compare [informally] 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 [that can be represented numerically or graphically], say which has the larger maximum.*

Mathematics: HS: Functions, Building Functions

HSF-BF.A. Build a function that models a relationship between two quantities.

- HSF-BF.A.1a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

Essential/Focus Questions

1. What is a function and how can tables, graphs, algebraic rules, and verbal descriptions be used to study them?
2. Given two variables, how do you decide which is the independent variable and which is the dependent variable?
3. How do the shapes of graphs, the patterns in tables, the parts of algebraic rules, or verbal descriptions give clues about the ways the variables are related to one another?
4. What are the advantages and disadvantages of using graphs, tables, verbal descriptions, and algebraic rules to demonstrate the relationship between two variables?

Key Concepts

function
families of functions
domain and range
function notation
patterns of change/recursion
relationships between variables
independent/dependent variable

Assessment Tasks

-  [Assessment Overview](#)
-  [Student Handout](#)
-  [Professional Learning Task - Student Misconceptions](#)
-  [Professional Learning Task - Teacher Video Attend to Precision](#)

Intellectual Processes

Standards for Mathematical Practice

Students will have opportunities to:

- **construct viable arguments and critique the reasoning of others** when using contexts to make connections between multiple representations of functions and including function notation;
- **make sense of problems and persevere in solving them** developing routines for representing, examining, and interpreting functions with multiple representations; and
- **model with mathematics** by attending to contexts and making connections between different representations of functions.

Lesson Sequence

-  [Lesson Overview](#)
-  [Student Handout Page One](#)
-  [Student Handout page two](#)
-  [Student Handout page three](#)
-  [Professional Learning Task – Extending the Lesson: Students Construct Viable Arguments](#)
-  [Professional Learning Task –Student Work Sample: Using Student Work to Attend to Precision](#)
-  [Professional Learning Tasks-Teacher Video-Attending to Precision](#)

Resources

-  [Unit Resources](#)