8th CCSS D3 Functions Conceptual Foundation (6-8 weeks)

Domain 3: Functions 8.F

D3 Cluster 1: Define, evaluate, and compare functions.

1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions)..
   For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change
3. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.
   For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.

3.1.1 I can explain what a function is.

3.1.2 I can determine if a table, graph, or set of ordered pairs is or is not a function and justify my conclusion.

3.1.3 I can distinguish between linear and nonlinear functions given a table, graph, or equation and justify my conclusion.

3.1.4 Given two functions (represented algebraically, graphically, numerically in tables, or by verbal descriptions), I can determine which function has a greater rate of change.

D3 Cluster 2: Use functions to model relationships between quantities.

4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

3.2.1 I can write the equation of a line (in the form $y = mx + b$, point-slope, or standard form) given a point and a slope, two points, a table, or the graph of the line. (In Honors, also write the equation of a line in point-slope and standard form.)

3.2.2 I can explain a real world situation from an equation, table, or graph (explain the rate of change/slope and the y intercept in the context).(linear only)

3.2.3 I can create the equation, table or graph for a real-life situation. (linear only)

3.2.4 I can describe a relationship as increasing or decreasing, linear or nonlinear, from an equation, table or graph.

* Please note: The following conceptual foundation highlights important concepts and instructional support, but is not all inclusive. Please refer to the associated assessments for a more complete picture of content.

What is a function?

Three main parts of a function:

Input, **Relationship**, **Output**:

Example: $y = 3x$

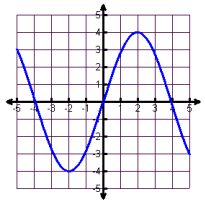
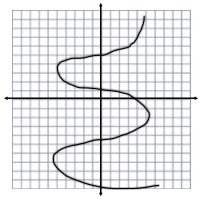
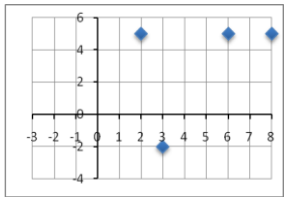
Input (x)	Relationship	Output (y)
1	times 3	3
4	times 3	12
10	times 3	30

Function Names: Functions can be named anything. In books, we most frequently see "***f***" or "***g***" as names. Examples:

- $f(x) = 3x$ means "**a function** f with **input** (x)" and "you **multiply the input by 3**" for the **output**
- $g(x) = 2x + 1$ means "a **function** g with **input** (x)" and "you **multiply the input by 2 and add 1**" for the **output**
- $h(x) = x^2$ means "a **function** h with **input** (x)" and "you **square the input**" to get the **output**
- Sometimes there is no function name and you will see $y = 3x$, as in the table above. There is still input, output, and a relationship that assigns a unique output for each input. Remember x is just the variable-name for the input—it could be q or r or m etc.

Formal Definition of a Function: **A function relates each element of an input set with exactly one element of an output set.**

- "…each element…" means that every element in *x* (input) is related to a unique element in *y* (output)
- "…exactly one…" means that the function will not output more than 1 result for a given input. You can have ONLY ONE Y VALUE for each X VALUE

This is NOT a function (two points with y values for the same x value)	This is a function— (only one y value for each x value) USE VERTICAL LINE TEST*	This is NOT a function (two points with y values for the same x value) USE VERTICAL LINE TEST*	This is a function— (only one y value for each x value) (functions can also be discrete—not continuous)
{(7, 12), (6, 9), (7, 8), (4,11)} {(-2, 5), (-2, 6), (-2, 7)}			

*The vertical line test is only useful when graphing on a Cartesian plane. In other words graphing parametrically, in polar form etc. the vertical line test does not hold for determining function.

(Definition of Function: www.mathisfun.com/sets/function.html)

Function Representations: Stories, Tables, Graphs, Equations

NOTE: In the study of Functions, students must represent the functions using different representations (tables, graphs, equations) and be able to work interchangeably among those representations. They will need to…

- Describe increasing/decreasing patterns
- Compare rates of change from the same or different representations
- Write equations from real life situations, from data, from graphs
- Create functions from real life examples—use all forms of representations

The definitive assessment item for Functions in 8th grade math: "Describe a situation from real life which involves a mathematical function. Then create the table, graph, equation and prediction."

1. Inform students from the beginning about this final assessment item.
2. Students should have extensive experience with real life problem situations (please refer to suggested lessons or assessment tasks on the wordpress site http://middlemathccss.wordpress.com/8th-grade-math/).

Other Instructional examples:

1. Write an equation describing the following situations:
   - Jane has $20. She saves $1.50 each week. How much money does she have in any given week?
   - Kris has edited 200 pages so far in his career. He can edit 8 pages per day. How many pages will he have edited in the future?
   - Leah is at her neighbor's house 2 miles from her house. She runs toward her house at a rate of 1/10 of a mile each minute. How far is she from her house at any given time? When will she reach her house?
2. Describe the following situations as increasing or decreasing, and linear or nonlinear.
   - Mike has $25. He saves $11 each week.
   - Nettie has $2. She doubles her money each week.
   - Paul has $100. He spends $5 each day.

A mathematical look at increasing and decreasing functions: http://apcentral.collegeboard.com/apc/members/repository/ap03_adaptation_calca_29895.pdf (Honors as written, adaptable for regular.)