Functions

Understand and interpret functions (3.1)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Understand functions (F.IF.1)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Determine and explain if a relation, graph **and** table are functions Use the different terminology that describes the x values (domain, input) and the y values (output, f(x)) to find the domain and range from a table, relation, **and** graph.	Determine **and explain** if a relation, graph or table are functions **(2 of the 3)** **Use** the different terminology that describes the x values (domain, input) and the y values (output, f(x)) to find the domain and range **from a table, relation, or graph.**	Determine if a relation, graph **or** table are functions **(2 of the 3)** Identify the different terminology that describes the x values (domain, input) and the y values (output, f(x))	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Use function notation (F.IF.2)		Use function notation and the values in the domain to calculate the values in the range from a table, graph, and equation **and interpret statements using function notation in context of a given situation**	Use function notation and the values in the domain to calculate the values in the range from a table, graph, **and** equation	Use function notation and the values in the domain to calculate the values in the range from a table, graph, **or** equation	

F.IF.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).

F.IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

Functions

Analyze sequences and functions (3.2/3.3)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Construct linear and exponential functions (F.BF.1a, F.BF.2*, F.IF.3, F.LE.1, F.LE.2)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Distinguish between linear and exponential functions from arithmetic and geometric sequences, tables, graphs, and **real world situations** Write the recursive function and the function rule for linear and exponential functions **to model real world situations.**	Distinguish between linear and exponential functions from arithmetic and geometric sequences, tables, and graphs. **Write the recursive function and the function rule** for linear and exponential functions from arithmetic and geometric sequences and tables.	**Distinguish** between linear and exponential functions from arithmetic and geometric sequences, tables, and graphs. **Identify the common difference/common ratio** for linear and exponential functions from arithmetic and geometric sequences and from tables.	Little evidence of reasoning or application to solve the problem Does not meet the criteria in a level 1
Calculate and interpret rate of change (F.IF.6*, F.LE.3)		Calculate the average rate of change over a given interval and explain the meaning in context for linear and exponential functions presented symbolically, in a table, **and** in a graph **Describe that an increasing exponential function will eventually exceed a linear function**	Calculate the average rate of change over a given interval **and explain the meaning in context** for linear and exponential functions presented symbolically, in a table, or in a graph	Calculate the average rate of change over a given interval for linear and exponential functions presented symbolically, in a table, or in a graph	

F.BF.1 Write a function that describes a relationship between two quantities.
~~a. Determine an explicit expression~~, a recursive process or steps for calculation from a context.

F.BF.2* Write arithmetic and geometric sequences both recursively ~~and with an explicit formula~~, use them to model situations, and translate between the two forms. *(Modeling Standard)

F.IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.

F.LE.2* Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). *(Modeling Standard)

F.LE.1* Distinguish between situations that can be modeled with linear functions and with exponential functions. *(Modeling Standard)
a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another

F.IF.6* Calculate and interpret the average rate of change of a linear, exponential, ~~or quadratic~~ function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph of a function over a specified interval. *

F.LE.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.~~ *(Modeling Standard)

Functions

Analyze and compare graphs of linear and exponential functions (4.1/4.2)

CCSS	4 – Mastery	3 – Proficient	2 - Basic	1 – Below Basic	0 – No Evidence
Identify and compare key features (F.IF.4, F.LE.5, F.IF.5, F.IF.9*, F.LE.3)	Can extend thinking beyond the standard, including tasks that may involve one of the following: • Designing • Connecting • Synthesizing • Applying • Justifying • Critiquing • Analyzing • Creating • Proving	Identify and compare key features of two functions represented in **all** of the following ways • algebraically • graphically • tables • in context	Identify and compare key features of two functions represented in **three** of the following ways • algebraically • graphically • tables • in context	Identify and compare key features of two functions represented in **two** of the following ways • algebraically • graphically • tables • in context	
Calculate and interpret rate of change (F.IF.6*)		Calculate the average rate of change over a given interval and explain the meaning in context for linear and exponential functions presented as an equation, table, **and** graph	Calculate the average rate of change over a given interval **and explain the meaning in context** for linear and exponential functions presented as an equation, table, or graph	Calculate the average rate of change over a given interval for linear and exponential functions presented as an equation, table, **or** graph	
Understand solutions (A.REI.10)		**Explain** that all solutions to an equation in two variables are contained on the graph of that equation	Verifies that **multiple solutions** to an equation in two variables are contained on the graph of that equation.	**Verifies** that **one solution** to an equation in two variables is contained on the graph of that equation.	

F.IF.4 For a linear, exponential, ~~or quadratic 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; and end behavior. *

F.LE.5* Interpret the parameters in a linear or exponential function in terms of a context. *(Modeling Standard)

F.IF.5 Relate the domain of a linear, exponential, or quadratic 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. *

F.IF.9* Compare 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, say which has the larger maximum.

F.IF.6* Calculate and interpret the average rate of change of a linear, exponential, ~~or quadratic~~ function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph of a function over a specified interval. *

A.REI.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).

F.LE.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.