## Functions (F)

| Kindergarten | Grade 1 | Grade 2 | Grade 3 | Grade 4 | Grade 5 | Grade 6 | Grade 7 | Grade 8 | | Grades 9-12 | |
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| | | | | | | | | **MA.8.F.1** Define, evaluate and compare functions. | MA.8.F.1.1 Given a set of ordered pairs, a table, a graph or mapping diagram, determine whether the relationship is a function. Identify the domain and range of the relation.<br>MA.8.F.1.2 Given a function defined by a graph or an equation, determine whether the function is a linear function. Given an input-output table, determine whether it could represent a linear function.<br>MA.8.F.1.3 Analyze a real-world written description or graphical representation of a functional relationship between two quantities and identify where the function is increasing, decreasing or constant. | **MA.912.F.1** Understand, compare and analyze properties of functions. | MA.912.F.1.1 Given an equation or graph that defines a function, determine the function type. Given an input-output table, determine a function type that could represent it.<br>MA.912.F.1.2 Given a function represented in function notation, evaluate the function for an input in its domain. For a real-world context, interpret the output.<br>MA.912.F.1.3 Calculate and interpret the average rate of change of a real-world situation represented graphically, algebraically or in a table over a specified interval.<br>MA.912.F.1.4 Write an algebraic expression that represents the difference quotient of a function. Calculate the numerical value of the difference quotient at a given pair of points.<br>MA.912.F.1.5 Compare key features of linear functions each represented algebraically, graphically, in tables or written descriptions.<br>MA.912.F.1.6 Compare key features of linear and nonlinear functions each represented algebraically, graphically, in tables or written descriptions.<br>MA.912.F.1.7 Compare key features of two functions each represented algebraically, graphically, in tables or written descriptions.<br>MA.912.F.1.8 Determine whether a linear, quadratic or exponential function best models a given real-world situation.<br>MA.912.F.1.9 Determine whether a function is even, odd or neither when represented algebraically, graphically or in a table. |
| | | | | | | | | | | **MA.912.F.2** Identify and describe the effects of transformations on functions. Create new functions given transformations. | MA.912.F.2.1 Identify the effect on the graph or table of a given function after replacing f(x) by f(x)+k, kf(x), f(kx) and f(x+k) for specific values of k.<br>MA.912.F.2.2 Identify the effect on the graph of a given function of two or more transformations defined by adding a real number to the x- or y-values or multiplying the x- or y-values by a real number.<br>MA.912.F.2.3 Given the graph or table of f(x) and the graph or table of f(x) + k, kf(x), f(kx) and f(x+k), state the type of transformation and find the value of the real number k.<br>MA.912.F.2.4 Given the graph or table of values of two or more transformations of a function, state the type of transformation and find the values of the real number that defines the transformation.<br>MA.912.F.2.5 Given a table, equation or graph that represents a function, create a corresponding table, equation or graph of the transformed function defined by adding a real number to the x- or y-values or multiplying the x- or y-values by a real number. |

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| | **MA.912.F.3** Create new functions from existing functions. | MA.912.F.3.1<br>Given a mathematical or real-world context, combine two functions, limited to linear and quadratic, using arithmetic operations. When appropriate, include domain restrictions for the new function.<br>MA.912.F.3.2<br>Given a mathematical or real-world context, combine two or more functions, limited to linear, quadratic, exponential and polynomial, using arithmetic operations. When appropriate, include domain restrictions for the new function.<br>MA.912.F.3.3<br>Solve mathematical and real-world problems involving functions that have been combined using arithmetic operations.<br>MA.912.F.3.4<br>Represent the composition of two functions algebraically or in a table. Determine the domain and range of the composite function.<br>MA.912.F.3.5<br>Solve mathematical and real-world problems involving composite functions.<br>MA.912.F.3.6<br>Determine whether an inverse function exists by analyzing tables, graphs and equations.<br>MA.912.F.3.7<br>Represent the inverse of a function algebraically, graphically or in a table. Use composition of functions to verify that one function is the inverse of the other.<br>MA.912.F.3.8<br>Produce an invertible function from a non-invertible function by restricting the domain.<br>MA.912.F.3.9<br>Solve mathematical and real-world problems involving inverse functions. |