Table of Contents with Student Outcomes

F1 Introduction to Functions and Function Notation

- Be able to identify whether a given representation is the representation of a function or not based on whether each input corresponds to a unique output
- Identify input and output in the notation $(x, f(x))$
- Identify domain and range of a given function and be able to write it using interval notation

F2 Graphing of Functions

- Be able to connect function notation with the graph, for example, identify that a specific point, for example $(3, f(3))$ is on the graph, or be able to tell if a point (x, y) is on the graph.
- Given a graph of a function, be able to identify domain and range
- Given a graph, be able to identify x and y intercepts
- Given a graph, be able to identify whether it's the graph of a function

F3 Combinations of Functions

- Given the formulas for two functions, find the formula for addition/subtraction of the functions, or multiplication or division of the functions
- Given the graphs of two functions, find the graph of the sum or difference of the two functions.
- Given the graphs or equations of two functions, identify the domain of the addition/subtraction/multiplication/division of the two functions.

F4A Vertical and Horizontal Shifts

- Given a graph of $y = f(x)$, sketch the graph of transformed functions, $y = f(x) + a$, and $y = f(x + a)$
- Given a family of graphs that represent vertical or horizontal shifts of a given function, identify which graph corresponds to which shift.
- Sketch the graph of a function that results from a combination of vertical and horizontal shifts of the graph of a given function $y = f(x)$.

F4B – Stretching Reflecting

- Given a graph of $y = f(x)$, sketch the graph of transformed functions, $y = -f(x)$, $y = f(-x)$, $y = -f(-x)$, $y = f(a \cdot x)$ and $y = a \cdot f(x)$.
- Given a family of graphs that represent vertical and horizontal stretches of a given function, identify which graph corresponds to which transformation.
- Sketch the graph of a function that results from a combination of transformations of the graph of a given function $y = f(x)$.

F5 Compositions of Functions

- Compute the composition of two functions given a formula, graph, or verbal description
- Given representations of two functions, find and interpret the domain of the composition
- Decompose a composite function of the form $f(g(x))$ into two functions $f(x)$ and $g(x)$

F6 Inverse Functions

- Determine if a function is invertible (i.e., one-to-one) based on whether each output corresponds to exactly one input or by using the horizontal line test
- Given the formula of a one-to-one function, find the formula for its inverse
- Given the graph of a function, be able to sketch the graph of the inverse function and explain the relationship between those graphs

P1 Linear Functions

- Specify the defining property of linear functions, in other words, that the slope or rate of change is constant
- Given a function that represents a real-world situation, interpret the slope and intercepts in the context.
- Given two points, calculate the average rate of change
- Identify the slope and y-intercept of a linear equation

P2A Exploring Linear Functions

- Given a description, identify whether a function is linear.
- Graph a line given a verbal description.
- Given a graph or an equation of a linear function, be able to identify whether it is increasing or decreasing
- Find equations of vertical and horizontal lines

P2B Finding Equations of Lines

- Find the equation of a line given two points, or a point and a slope.
- Given a table of values, identify whether a function is linear

P2C: Parallel and Perpendicular Lines

- Determine if two lines are perpendicular, parallel, or neither.
- Given the equation of a line and a point, find a line that passes through the point and is perpendicular to the line.
- Given the equation of a line and a point, find a line that passes through the point and is parallel to the line.

P3 Quadratic Functions

- Identify the graph of a quadratic function as a parabola
- Given a table of values, identify whether a function is quadratic or not using second differences
- Given a quadratic function that represents a real-world situation, interpret the x and y coordinates of the vertex

P4A Standard and Vertex Form of a Quadratic Function

- Given a quadratic equation in standard or vertex form, or given the graph of a quadratic function, identify the vertex and axis of symmetry
- Given the equation of a quadratic function given in standard form be able to draw the graph

P4B Completing the Square

- Given a quadratic expression, complete the square
- Be able to use the quadratic formula to solve a quadratic equation

P4C Roots of Quadratic Functions

- Given a quadratic function that represents a real-world situation, interpret the x- intercepts in the context
- Given a quadratic equation, be able to identify whether it has two real roots, one repeated real root, or two complex roots

P5 Monomial Functions

- Describe the differences in the graphs of two monomial functions with even degree, or both with odd degree
- Describe the end behavior of the graph of a monomial function based on whether the degree of the monomial is even or odd
- Identify a monomial function as being either an even or an odd function

P6 Polynomial Functions

- Discuss rate of growth of polynomial functions for differences of monomials and relationship between the leading term and the rate of growth (for example, a polynomial of degree 7 grows faster than a polynomial of degree 6).
- Distinguish between polynomials and non-polynomials by the equation; Defining the degree of a polynomial
- Rate of growth dependent on leading term

P7 Graphing Polynomial Functions

- Be able to identify the relationship between the zeros, intercepts, and factors of a polynomial function
- Be able to identify the multiplicity of a zero of a polynomial function
- Given a polynomial function, be able to identify its maximum number of roots

R1 Rational Functions 1

- State that a rational function is a quotient of polynomials and state the domain
- Find vertical asymptotes from the graph or equation of a rational function, if they exist
- Interpret the meaning of a vertical or horizontal asymptote in real world applications
- Distinguish between vertical asymptotes and removable discontinuities of a rational function

R2 Rational Functions 2

- Find horizontal or slant asymptotes from the graph or equation of a rational function, if they exist
- Interpret the meaning of a horizontal asymptote in real world applications
- Sketch a rational function given the equations of its asymptotes

E1 Introduction to Exponential Functions

- Be able to identify the base and multiplicative constant of an exponential function
- Given a table of data, be able to identify whether the data might correspond to an exponential function
- Given some data (e.g., two points) about an exponential function, construct the equation of the function.
- Distinguish exponential functions from polynomial functions.

E2 Exponential Functions 2

- Be able to identify an exponential function as one whose rate of growth is proportional to the function (i.e., a constant percent).
- Given a real-world situation that can be modeled with an exponential function, construct the model equation, and use it to answer questions about the model.
- Be able to define e informally as the limit of (1 + 1/n)^n as n gets large.
- Distinguish between interest compounded a finite number of times a year versus compounded continuously, or related application.

E3 Graphing Exponential Functions

- Given the equation of an exponential function, sketch the graph of the function.
- Describe the relationship between the growth or decay of an exponential function and the base.
- Given the equation of an exponential function, describe end behavior (at +/- infinity) of exponential functions.
- Given the equation of an exponential function, identify its domain and range.

L1 Logarithmic Functions 1

- Describe the relationship between a logarithmic function and an exponential function
- Given a real-world phenomenon modeled by a logarithmic function, interpret the logarithmic scale in the context of the problem
- Use the relationship between the logarithmic function and the exponential function to sketch the graph of logarithmic functions with different bases

L2 Logarithmic Functions 2

- Be able to state and use the laws of logarithms to rewrite algebraic expressions.
- Be able to use logarithms to solve equations.

S1 Linear Systems

- Identify the solution(s) to a system of two linear equations from a graph, or state that the system has no solution.
- Find solution(s) to a system of two linear equations using substitution, or state that the system has no solution.
- Find solution(s) to a system of two linear equations using elimination, or state that the system has no solution.

S2 Nonlinear Systems of Equations

- Identify the solution(s) to a system of two equations from a graph, or state that the system has no solution.
- Find solution(s) to a system of two equations using substitution, or state that the system has no solution.
- Interpret the meaning of a solution to a system of two equations in real world applications.

I1 Inequalities

- Set up a linear inequality to model a real-world scenario
- Solve a system of linear inequalities.
- Graph lines corresponding to linear inequalities and shade appropriate solution regions for single near inequalities and system of linear inequalities