Got Math?

A Newsletter from the Secondary Mathematics Team www.rpdp.net

Southern Nevada Regional Professional Development Program

NACS MINI-SERIES HS #4B

NEVADA ACADEMIC CONTENT STANDARDS

Functions - Nevada Academic Content Standards (High School)*

The High School Nevada Academic Content Standards for Mathematics are listed in six conceptual categories. In the conceptual category - **Functions,** we consider ***Interpreting Functions***, ***Building Functions***, ***Linear, quadratic and Exponential models***, and ***Trigonometric Functions***.

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Math Resources

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Interpreting Functions: F-IF

Understand the concept of a function and use function notation

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 $y = f(x)$.
2. Use function notation, **evaluate functions for inputs in their domains**, and interpret statements that use function notation in terms of a context.
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* $n \geq 1$.

Interpret functions that arise in applications in terms of the context

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.*
5. **Relate the domain of a 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.*
6. **Calculate and interpret the average rate of change of a function** (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Analyze functions using different representations

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
   a. **Graph linear and quadratic functions** and show intercepts, maxima, and minima.
   b. **Graph square root, cube root, and piecewise-defined functions**, including step functions and absolute value functions.
   c. **Graph polynomial functions**, identifying zeros when suitable factorizations are available, and showing end behavior.
   d. (+) **Graph rational functions**, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
   e. **Graph exponential and logarithmic functions**, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
8. **Write a function** defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
   a. Use the process of factoring and completing the square in a quadratic function to **show zeros, extreme values, and symmetry of the graph**, and interpret these in terms of a context.
   b. Use the properties of exponents to **interpret expressions for exponential functions**. *For example, identify percent rate of change in functions such as* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, *and classify them as representing exponential growth or decay.*
9. **Compare Properties** of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

Building Functions: F-BF

Build a function that models a relationship between two quantities

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.
   b. **Combine standard function types using arithmetic operations**. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*
   c. (+) **Compose functions**. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.*

Functions - Nevada Academic Content Standards (HS)* (Continued)

2. **Write arithmetic and geometric sequences** both recursively and with an explicit formula, use them to model situations, and translate between the two forms.

Build new functions from existing functions

3. **Identify the effect** on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*
4. **Find inverse functions**.
   a. **Solve an equation** of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. *For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x–1)$ for $x \neq 1$.*
   b. (+) **Verify** by composition **that one function is the inverse of another**.
   c. (+) **Read** values of an inverse function **from a graph or a table**, given that the function has an inverse.
   d. (+) **Produce an invertible function** from a non-invertible function by restricting the domain.
5. (+) **Understand the inverse relationship between exponents and logarithms** and use this relationship to solve problems involving logarithms and exponents.

Linear, Quadratic, and Exponential Models: F -LE

Construct and compare linear, quadratic, and exponential models and solve problems

1. **Distinguish** between situations that can be modeled with linear functions and with exponential functions.
   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.
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).
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.
4. For exponential models, **express as a logarithm** the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; **evaluate the logarithm** using technology.

Interpret expressions for functions in terms of the situation they model

5. **Interpret the parameters** in a linear or exponential function in terms of a context.

Trigonometric Functions: F-TF

Extend the domain of trigonometric functions using the unit circle

1. **Understand radian measure** of an angle as the length of the arc on the unit circle subtended by the angle.
2. **Explain how the unit circle** in the coordinate plane **enables the extension of trigonometric functions** to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
3. (+) Use special triangles to **determine geometrically the values of sine, cosine, tangent** for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for $\pi–x$, $\pi+x$, and $2\pi–x$ in terms of their values for x, where x is any real number.
4. (+) Use the unit circle to **explain** symmetry (odd and even) and periodicity of trigonometric functions.

Model periodic phenomena with trigonometric functions

5. **Choose trigonometric functions to model periodic phenomena** with specified amplitude, frequency, and midline.
6. (+) **Understand** that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
7. (+) Use inverse functions to **solve trigonometric equations** that arise in modeling contexts; **evaluate the solutions** using technology, and interpret them in terms of the context.

Prove and apply trigonometric identities

8. **Prove the Pythagorean identity** $sin2(\theta) + cos2(\theta) = 1$ and use it to find $sin(\theta)$, $cos(\theta)$, or $tan(\theta)$ given $sin(\theta)$, $cos(\theta)$, or $tan(\theta)$ and the quadrant of the angle.
9. (+) **Prove the addition and subtraction formulas** for sine, cosine, and tangent and use them to solve problems.

Mathematics Standards for High School specify the mathematics that all students should study in order to be college and career ready. All standards without a (+) symbol should be in the common mathematics curriculum for all college and career ready students. Standards with a (+) symbol may also appear in courses intended for all students. Modeling Standards are indicated by the star symbol ( ).