Pre-Calculus: Exponential & Logarithmic Functions

Stage 1 Desired Results

ESTABLISHED GOALS:

Competencies:
- *Students will demonstrate the ability to solve equations, inequalities, and systems by analyzing structure and applying the properties of equality and rational expressions.*
- *Students will demonstrate the ability to apply functions to solve problems by interpreting and analyzing multiple representations of functions.*
- *Students will demonstrate the ability to graph equations, functions, and figures by using tables and analyzing equations.*
- *Students will demonstrate the ability to model real world problems by building and analyzing the appropriate expression, equation, or function.*
- *Students will demonstrate the ability to analyze and summarize text and integrate knowledge to make meaning of discipline-specific materials.*
- *Students will demonstrate the ability to produce coherent and supported writing in order to communicate effectively for a range of discipline-specific tasks, purposes, and audiences.*
- *Students will demonstrate the ability to speak purposefully and effectively by strategically making decisions about content, language use, and discourse style.*

Content Standards:
- HSA.REI.D.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
- IF.B.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.
- HSF.IF.C.7.E Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
- HSF.IF.C.8.B Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12^t$, $y = (1.2)^t/10$, and classify them as representing

Transfer

Students will be able to independently use their learning to **make informed decisions based on their understanding of exponential growth and decay.**

Meaning

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Students will understand that… - a constant percent increase or decrease at regular intervals always results in an exponential relationship - an inverse function reverses the effect of the original function.	- How do different factors alter an outcome?

Acquisition

Students will know…	Students will be skilled at…
- *that the domain of a function is the range of its inverse, and the range of a function is the domain of its inverse.* - *that composing a function with its inverse results in x.* - *that a graph and its inverse are symmetric about the line* y=x. - *that a function has an inverse if and only if that function is one-to-one.* - *that the horizontal line test can be used to determine if a function is one-to-one.* - *the domain, range, and graph of $y=2^x$.* - *the domain, range, and graph of $y=e^x$.* - *that log function and exponential functions are inverses.* - *the domain, range, and graph of $y=\log_b x$.* - *properties of logarithms.* - *that using the properties of logarithms to solve logarithmic equations may introduce extraneous solutions that do not check in the original*	- *adding composing functions and determining the resulting domain.* - *computing iterates of a function.* - *finding the inverse of a function.* - *determining if two functions are inverses of each other.* - *using symmetry to sketch the graph of an inverse function.* - *simplifying expressions containing irrational exponents.* - *solving equations with the unknown as an exponent* - *sketching the graph of $y=a^x$.* - *sketching transformations of $y=a^x$.* - *sketching the graph of $y=e^x$.* - *sketching transformations of $y=e^x$.* - *using both the logarithmic and exponential forms of equations .* - *sketching transformations of $y=\log_b x$.* - *sketching transformations of $y=\ln x$.* - *solving equations and inequalities involving*

exponential growth or decay.
- HSF.BF.A.1.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.
- HSF.BF.B.4.B (+) Verify by composition that one function is the inverse of another.
- .HSF.BF.B.4.C (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.
- HSF.BF.B.4.D (+) Produce an invertible function from a non-invertible function by restricting the domain.
- HSF.BF.B.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
- HSF.LE.A.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.
- HSF.LE.A.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.
- MP2 Reason abstractly and quantitatively.
- MP4 Model with mathematics.
- MP7 Look for and make use of structure.
- MP8 Look for and express regularity in repeated reasoning.

equation.
- *properties of inequalities involving exponential and logarithmic functions.*
- *logarithm function require positive inputs, and this may affect the solution set for a function involving log functions.*

vocabulary: *iterate, inverse function, one-to-one, exponential, asymptote, e, logarithmic, natural log*

exponential, logarithmic, and natural logarithmic functions.
- *simplifying and expanding expressions using log properties.*
- *converting between two bases.*

Content Area Literacy Standards	21st Century Skills
- RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. - RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. - RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. - RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. - RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. - RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.	- *reason effectively* - *use systems thinking* - *make judgments and decisions* - *solve problems* - *assess and evaluate information* - *access technology effectively* - *communicate clearly*

Stage 2 - Evidence	
Evaluative Criteria	*Assessment Evidence*
	PERFORMANCE TASK(S):

	OTHER EVIDENCE:

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Language Arts Integration	***Mathematics Integration***
• 1.OA.1 Use	• 1.OA.1 Use
Technology Integration	***District Materials***
• 1.OA.1 Use	