

Pre-Calculus: Exponential & Logarithmic Functions

Stage 1 Desired Results		
ESTABLISHED GOALS: <u>Competencies:</u> - Students will demonstrate perseverance and strategic thinking by identifying the underlying meaning of a problem, planning a logical solution pathway, working through challenges, and verifying the reasonableness of their answers. - Students will demonstrate the ability to decontextualize (represent symbols) and contextualize (understand the meaning of quantities) by converting real-world situations into mathematical symbols for manipulation, and interpreting symbolic results back into practical contexts. - Students will demonstrate logical thinking and communication skills by building justified mathematical arguments, comprehending the justification of others, and critiquing their reasoning. - Students will demonstrate application skills by using mathematical concepts and symbols to represent, analyze, and solve problems arising in everyday life, society, and the workplace. - Students will demonstrate accuracy and clarity using correct mathematical terminology, specifying units of measure, and calculating with the degree of precision appropriate for the problem context. - 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. <u>Content Standards:</u> - 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 $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^t/10$, and classify them as representing	Transfer	
	<i>Students will be able to independently use their learning to make informed decisions based on their understanding of exponential growth and decay.</i>	
	Meaning	
	ENDURING UNDERSTANDINGS <i>Students will understand that...</i> - 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.	ESSENTIAL QUESTIONS How do different factors alter an outcome?
	Acquisition	
	<i>Students will know...</i> - 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	<i>Students will be skilled at...</i> - 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.	<i>equation.</i> • <i>properties of inequalities involving exponential and logarithmic functions.</i> • <i>logarithm function require positive inputs, and this may affect the solution set for a function involving log functions.</i> <u><i>vocabulary:</i></u> <i>iterate, inverse function, one-to-one, exponential, asymptote, e, logarithmic, natural log</i>	<i>exponential, logarithmic, and natural logarithmic functions.</i> • <i>simplifying and expanding expressions using log properties.</i> • <i>converting between two bases.</i>
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 <i>grades 11-12 texts and topics</i>. • 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.		• <i>reason effectively</i> • <i>use systems thinking</i> • <i>make judgments and decisions</i> • <i>solve problems</i> • <i>assess and evaluate information</i> • <i>access technology effectively</i> • <i>communicate clearly</i>

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

	OTHER EVIDENCE:

Stage 3 – Learning Plan <i>Summary of Key Learning Events and Instruction</i>	
<i>Language Arts Integration</i>	<i>Mathematics Integration</i>
1.OA.1 Use	1.OA.1 Use
<i>Technology Integration</i>	<i>District Materials</i>
1.OA.1 Use	