Algebra I: Exponents and Exponential Functions

Stage 1 Desired Results

ESTABLISHED GOALS: *Competencies:*

- *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 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 structural awareness by discerning patterns and functional relationships within complex mathematical concepts to simplify and solve problems.*
- *Students will demonstrate the ability to notice repetitive calculations or patterns, evaluate the reasonableness of results, and formulate general methods, formulas, or shortcuts while maintaining oversight of the process.*
- *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:

- N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents.
- N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.
- F-IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- F-IF.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.
- F-IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- F-IF.7 Graph functions expressed symbolically and show key features

Transfer

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

Meaning

ENDURING UNDERSTANDINGS

Students will understand that…

- iIn order to use a short cut appropriately and with confidence, one must have a firm understanding of the longer process.
- a constant percent increase or decrease applied at regular intervals always results in an exponential relationship between two quantities.

ESSENTIAL QUESTIONS

- How do different factors alter an outcome?

Acquisition

Students will know…

- *that population growth can be modeled using an exponential expression.*
- *the rules of exponents can be applied to problems with scientific notation.*
- *that $b^m = a$ means that b multiplied as a factor m times equals a.*
- *that, if the x-values in a table have a common difference and the y-values have a common ratio, the table represents an exponential function.*
- *the graph and equation for the parent exponential function ($y = 2^x$).*
- *the similarities and differences between linear and exponential functions.*
- *that an exponential function can be used to model both exponential growth or decay and compound interest.*

vocabulary: *exponent, power, base, rational, radical, growth factor, exponential growth, compound interest, exponential decay, decay factor, principal, geometric sequence, common ratio, scientific notation*

Students will be skilled at…

- *simplifying expressions with exponents, including exponents of zero and negative numbers.*
- *evaluating exponential expressions.*
- *multiplying and dividing powers with like bases.*
- *simplifying expressions with rational exponents.*
- *simplify a power raised to a power.*
- *raising a quotient to a power.*
- *using rational exponents to simplify radical expressions.*
- *converting between scientific notation and standard form.*
- *evaluating exponential functions.*
- *graphing and transforming exponential functions*
- *interpreting key features of an exponential function's graph, including intercepts and end behavior.*
- *graphing and transforming exponential functions*
- *writing recursive and explicit formulas for geometric sequences.*

of the graph, by hand in simple cases and using technology for more complicated cases. • F-IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). • F-BF.1 Write a function that describes a relationship between two quantities. Determine an explicit expression, a recursive process, or steps for calculation from a context. • F-BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. • F-BF.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. • F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. o Prove that linear functions grow by equal differences over equal intervals; and that exponential functions grow by equal factors over equal intervals. o Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. • F.LE.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). • F.LE.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. • F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context. • A.SSE.1 Interpret expressions that represent a quantity in terms of its context. o Interpret parts of an expression, such as terms, factors, and coefficients. o Interpret complicated expressions by viewing one or more of their parts as a single entity. • A.SSE.2 Use the structure of an expression to identify ways to rewrite it. • A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. o Use the properties of exponents to transform expressions forexponential functions. For example the expression 1.15t can be rewritten as (1.151/12)12t ≈ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%. • 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.		

Content Area Literacy Standards	***21st Century Skills***
• RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. • RST.9-10.4 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 9-10 texts and topics*. • RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*). • RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.	• *reason effectively* • *solve problems* • *make judgments and decisions*

Stage 2 - Evidence

Evaluative Criteria	***Assessment Evidence***
	PERFORMANCE TASK(S):
	OTHER EVIDENCE:

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Science Integration	***College, Career, and Civic Life Integration***	***Technology Integration***
District Materials	***Distance Learning/Field Trips***	***Technology Resources***