

Unit 2 Exponential and Logarithmic Functions

Content Area: **Mathematics**
Course(s):
Time Period: **November**
Length: **9 weeks**
Status: **Published**

Unit Overview:

In Unit 2, students build an understanding of exponential and logarithmic functions. Exponential and logarithmic function models are widespread in the natural and social sciences. When an aspect of a phenomenon changes proportionally to the existing amount, exponential and logarithmic models are employed to harness the information. Exponential functions are key to modeling population growth, radioactive decay, interest rates, and the amount of medication in a patient. Logarithmic functions are useful in modeling sound intensity and frequency, the magnitude of earthquakes, the pH scale in chemistry, and the working memory in humans. The study of these two function types touches careers in business, medicine, chemistry, physics, education, and human geography, among others.

Enduring Understandings:

- Exponential and logarithmic functions model real-world phenomena.
- Inverse functions allow us to solve equations algebraically
- Logarithmic functions are the inverse of exponential functions

Career Education Connection

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.

Essential Questions:

- How can I make a single model that merges the interest I earn from my bank with the taxes that are due so I can know how much I will have in the end?
- How can we adjust the scale of distance for a model of planets in the solar system so the relationships among the planets are easier to see?
- If different functions can be used to model data, how do we pick which one is best?

Standards/Indicators/Student Learning Objectives (SLOs):

MA.F-IF.A.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
MA.F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
MA.F-IF.B.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.
MA.F-IF.C	Analyze functions using different representations
MA.F-IF.C.7e	Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
MA.F-IF.C.8b	Use the properties of exponents to interpret expressions for exponential functions.
MA.F-BF.A.1	Write a function that describes a relationship between two quantities.
MA.F-BF.A.1a	Determine an explicit expression, a recursive process, or steps for calculation from a context.
MA.F-BF.A.1b	Combine standard function types using arithmetic operations.
MA.F-BF.A.1c	Compose functions.
MA.F-BF.A.2	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
MA.F-BF.B.4	Find inverse functions.
MA.F-BF.B.4b	Verify by composition that one function is the inverse of another.
MA.F-BF.B.4c	Read values of an inverse function from a graph or a table, given that the function has an inverse.
MA.F-BF.B.4d	Produce an invertible function from a non-invertible function by restricting the domain.
MA.F-BF.B.5	Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.
MA.F-LE.A	Construct and compare linear and exponential models and solve problems
MA.F-LE.A.1	Distinguish between situations that can be modeled with linear functions and with exponential functions.
MA.F-LE.A.1a	Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
MA.F-LE.A.1b	Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
MA.F-LE.A.1c	Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
MA.F-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.
MA.F-LE.A.4	Understand the inverse relationship between exponents and logarithms. For exponential models, express as a logarithm the solution to ab to the ct power $= d$ where a , c , and d are numbers and the base b is 2, 10, or e ; evaluate the logarithm using technology.

Lesson Titles:

- 2.1 Change in Arithmetic and Geometric Sequences
- 2.10 Inverses of Exponential Functions
- 2.11 Logarithmic Functions
- 2.12 Logarithmic Function Manipulation
- 2.13 Exponential and Logarithmic Equations and Inequalities
- 2.14 Logarithmic Function Context and Data Modeling
- 2.15 Semi-Log Plots
- 2.2 Change in Linear and Exponential Functions
- 2.3 Exponential Functions
- 2.4 Exponential Function Manipulation
- 2.5 Exponential Function Context and Data Modeling
- 2.6 Competing Function Model Validation
- 2.7 Composition of Functions
- 2.8 Inverse Functions
- 2.9 Logarithmic Expressions

Diversity, Equity, and Inclusion

Amistad Mandate

Topic:

Materials Used:

Addresses the Following Component of the Mandate:

- African Slave Trade
- Amistad
- Contributions of African Americans to our Society
- Slavery in America
- Vestiges of Slavery in this Country

Holocaust Mandate

Topic:

Materials Used:

Addresses the Following Component of the Mandate:

- Bias
- Bigotry
- Bullying
- Holocaust Studies
- Prejudice

LGBTQ and Disabilities Mandate

Topic (Person and Contribution Addresses):

Materials Used:

Addresses the Following Component of the Mandate:

- Economic
- Political
- Social

Climate Change

Asian American Pacific Islander Mandate

Topic (Person and Contribution Addresses):

Materials Used:

Addresses the Following Component of the Mandate:

- Economic
- Political

- Social

Inter-Disciplinary Connections:

9-12.HS-ETS1-4.5.1	Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems.
9-12.HS-ETS1-3.6.1	Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Career Readiness, Life Literacies, & Key Skills:

WRK.9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
WRK.9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.

Computer Science and Design Thinking Standards

CS.9-12.8.1.12.AP.5	Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
CS.9-12.8.1.12.CS.2	Model interactions between application software, system software, and hardware.

Assessments

Summative Assessment:

- Alternate Assessment
- AP Practice Test
- Benchmark
- Marking Period Assessment

Benchmark Assessments

Writing Prompt

Skills Based Assessment

Reading Response

Alternative Assessment

Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Reflective pieces

Concept maps

Case-based scenarios

Portfolios

Formative Assessment:

- Anticipatory Set
- Closure
- Warm-Up

Materials:

Core Instructional Materials

- AP Classroom
- Course and Exam Description Book

Supplemental Materials

- Bryan Passwater Materials
- Calc Medic
- Collegeboard
- Flamingo Math

- Flipped Math

Texts at Various Levels

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

- AP Classroom progress checks
- Demonstrate how to manipulate Exponential functions
- Demonstrate how to manipulate logarithmic functions
- Demonstrate parent functions and transformations of Exponential and logarithmic functions
- Interpret and construct Exponential functions with and without calculator
- Interpret and construct logarithmic functions with and without calculator
- Intro Arithmetic Sequences
- Intro Composition of Functions
- Intro Geometric Sequences
- Intro inverse functions
- Intro Semi-log plots
- Practice expressing functions in analytically equivalent forms
- Practice problems
- provide group activity
- provide individual activity
- Provide Real world examples
- review homework
- Review properties of logarithmic functions
- Thin slicing activity on vertical White boards
- vertical White board work in groups

Modifications

MLL Modifications:

- Choice of test format (multiple-choice, essay, true-false)
- Continue practicing vocabulary
- Provide study guides prior to tests
- Read directions to the student

- Read test passages aloud (for comprehension assessment)
- Vary test formats

G&T Modifications:

- Alternate assignments/enrichment assignments
- Enrichment projects
- Extension activities
- Higher-level cooperative learning activities
- Pairing direct instruction with coaching to promote self-directed learning
- Provide higher-order questioning and discussion opportunities
- Provide texts at a higher reading level
- Tiered assignments
- Tiered centers

At Risk Modifications

The possible list of modifications/accommodations identified for Special Education students can be utilized for At-Risk students. Teachers should utilize ongoing methods to provide instruction, assess student needs, and utilize modifications specific to the needs of individual students. In addition, the following may be considered:

- Additional time for assignments
- Adjusted assignment timelines
- Agenda book and checklists
- Answers to be dictated
- Assistance in maintaining uncluttered space
- Books on tape
- Concrete examples
- Extra visual and verbal cues and prompts
- Follow a routine/schedule
- Graphic organizers
- Have students restate information
- No penalty for spelling errors or sloppy handwriting
- Peer or scribe note-taking
- Personalized examples
- Preferential seating
- Provision of notes or outlines
- Reduction of distractions
- Review of directions

- Review sessions
- Space for movement or breaks
- Support auditory presentations with visuals
- Teach time management skills
- Use of a study carrel
- Use of mnemonics
- Varied reinforcement procedures
- Work in progress check

IEP & 504 Modifications:

*All teachers of students with special needs must review each student's IEP. Teachers must then select the appropriate modifications and/or accommodations necessary to enable the student to appropriately progress in the general curriculum.

Possible Modifications/Accommodations: (See listed items below):

- Allow for redos/retakes
- Assign fewer problems at one time (e.g., assign only odds or evens)
- Differentiated center-based small group instruction
- Extra time on assessments
- Highlight key directions
- If a manipulative is used during instruction, allow its use on a test
- Opportunities for cooperative partner work
- Provide reteach pages if necessary
- Provide several ways to solve a problem if possible
- Provide visual aids and anchor charts
- Test in alternative site
- Tiered lessons and assignments
- Use of a graphic organizer
- Use of concrete materials and objects (manipulatives)
- Use of word processor

Technology Materials and Standards

- AP Classroom
- Calc Medic Videos
- Flipped Math Videos
- Google Classroom
- Google Slides
- Graphing Calculator

- IXL

TECH.8.1.12.A.3	Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
TECH.8.1.12.F.CS1	Identify and define authentic problems and significant questions for investigation.
TECH.8.1.12.F.CS2	Plan and manage activities to develop a solution or complete a project.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.
TECH.8.1.12.F.CS4	Use multiple processes and diverse perspectives to explore alternative solutions.