

Math III UNIT 5 OVERVIEW: Modeling with Advanced Functions

Unit Outcomes At the end of this unit, your student should be able to:	Key Vocabulary Terms to deepen the student's understanding
<ul style="list-style-type: none"> ✓ Use technology to evaluate logarithms. ✓ Use the properties of logs to simplify or expand logarithmic expressions. ✓ Solve exponential and logarithmic equations approximately by using technology, making tables of values, or finding successive approximations. ✓ Solve exponential equations algebraically using logs. <ul style="list-style-type: none"> ○ 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. ○ Express as a logarithm the solution to $ab^{ct} = d$, where a, c, and d are numbers and the base $b > 0$. ✓ Solve logarithmic equations algebraically using the properties of logs. ✓ Solve a system of equations that include exponential and/or logarithmic functions using technology. ✓ Graph exponential and logarithmic functions showing the intercepts and end behavior. ✓ Compare rates of growth for different functions (linear, quadratic, exponential, and polynomial) using tables and graphs. ✓ Determine whether a function has an inverse using the horizontal line test. ✓ Find the inverse of a simple function algebraically, if it exists. ✓ Read values of an inverse function from a graph or table. ✓ Produce a function that has an inverse from one that does not by restricting the domain. ✓ Determine whether a sequence is arithmetic, geometric or neither. ✓ Determine the common ratio for a geometric sequence. ✓ Write a geometric sequence using formal recursive function notation. ✓ Convert between recursive and explicit forms of a geometric sequence. ✓ Derive the formula for the sum of a finite geometric series (when the common ratio is not 1). ✓ Use the formula for the sum of a finite geometric series to solve problems (e.g. calculate mortgage payments). ✓ Find a partial sum for a geometric series. ✓ Find an infinite sum for a geometric series. 	<ul style="list-style-type: none"> ✓ Logarithm ✓ Common Log ✓ Natural log ✓ Inverse Function ✓ Horizontal Line Test ✓ Geometric Sequence ✓ Common ratio ✓ Recursive Function Notation ✓ Explicit Form ✓ Finite Geometric Series ✓ Converge ✓ Diverge ✓ Partial sum ✓ Infinite Sum ✓ Sigma Notation

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✓ Use sigma notation to represent a geometric series.
 Note: Topics highlighted in red are covered in Honors Math III only.

<p align="center">Key Standards Addressed</p> <p align="center">Connections to Common Core/NC Essential Standards</p>	<p align="center">Where This Unit Fits</p> <p align="center">Connections to prior and future learning</p>
<p>Note: Many standards appear in multiple units and courses. The concepts in bold are the focus for this unit. Notes in italics provide clarification for some standards.</p> <p>A-SSE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. <i>For example, calculate mortgage payments.</i></p> <p>A-CED.1 Create equations and inequalities in one variable and use them to solve problems. <i>Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</i></p> <p>A-REI.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.</p> <p>F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.</p> <ul style="list-style-type: none"> ○ Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. 	<p>Coming into this unit, students should have a strong foundation in:</p> <ul style="list-style-type: none"> ✓ Geometric sequences using NOW-NEXT form ✓ Converting between recursive and explicit form of an exponential function ✓ Solving exponential equations by graphing and using common logs ✓ Creating exponential equations from a contextual situation ✓ Graphing exponential and logarithmic functions, identifying key features <p>This unit builds to the following future skills and concepts:</p> <p><u>Pre-Calculus</u></p> <p>2.01 Use functions (polynomial, power, rational, exponential, logarithmic, logistic, piecewise-defined & greatest integer to model and solve problems; justify results.</p> <p>2.03 For sets of data, create and use calculator-generated models of linear, polynomial, exponential, trigonometric, power, logistic, and logarithmic functions.</p>

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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. *Bring in formal recursive function notation.*

F-BF.4 Find inverse functions.

- 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 $x \neq 1$.*

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.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.

Additional Resources

Materials to support understanding and enrichment

- ✓ [Expanding Logarithms \(Honors Only\)](#)
- ✓ [Condensing Logarithms \(Honors Only\)](#)
- ✓ [Solving Exponential Equations using Logs](#)
- ✓ [Solving Logarithmic Equations \(Honors Only\)](#)
- ✓ [Converting an explicit function to a recursive function](#)
- ✓ [Graphing Exponential Functions](#)
- ✓ [Graphing Logarithmic Functions](#)
- ✓ [The Vertical and Horizontal Line Tests](#)
- ✓ [Finding the Inverse of a Function Algebraically](#)
- ✓ [Is the sequence arithmetic, geometric or neither?](#)
- ✓ [What is a series?](#)

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- ✓ [How to find the sum of a geometric series](#)
- ✓ [Finding the sum of a Finite Geometric Series](#)
- ✓ [Video: Find the partial sum of a geometric series \(Honors Only\)](#)
- ✓ [Partial Sum of a Geometric Series \(Honors Only\)](#)
- ✓ [Infinite Geometric Series \(Honors Only\)](#)
- ✓ [Video: Sum of an Infinite Geometric Series \(Honors Only\)](#)
- ✓ [Sigma Notation](#)

* **Please note**, the unit guides are a work in progress. If you have feedback or suggestions on improvement, please feel free to contact sdupree@wcpss.net.