Marietta City Schools

2023–2024 District Unit Planner

Algebra: Concepts & Connections

Unit title	Unit 6: Analyzing Exponential Functions	**MYP year**	4	**Unit duration (hrs)**	*19.5 hours*

Mastering Content and Skills through INQUIRY (Establishing the purpose of the Unit): ***What will students learn?***

GA DoE Standards

Standards

A.FGR.9: Construct and analyze the graph of an exponential function to explain a mathematically applicable situation for which the graph serves as a model; compare exponential with linear and quadratic functions.

A.FGR.9.1 Use function notation to build and evaluate exponential functions for inputs in their domains and interpret statements that use function notation in terms of a context.

Fundamentals

• Students should apply their understanding of function notation from their work with linear and quadratic functions to build, evaluate, and interpret exponential functions using function notation.

• Students should be able to interpret the domain given a function expressed numerically, algebraically, and graphically.

A.FGR.9.2 Graph and analyze the key characteristics of simple exponential functions based on mathematically applicable situations.

Examples

• If the function, h(n), gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.

• The function can be presented symbolically, as a graph, or as a table.

• Students should be able to estimate the rate of change from a graph.

• Students should be able to sketch a graph of an exponential function showing key features including domain, range, intercepts, average rate of change, intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; asymptotes; end behavior.

• Students should be given opportunities to show that linear functions grow by a constant rate and that exponential functions grow by equal factors over equal intervals. This can be shown by algebraic proof, with a table showing differences, or by calculating average rates of change over equal intervals.

• Students should be able to precisely use verbal descriptions, tables, and graphs created by hand and using technology.

• Students should be able to create graphs by hand and using graphing technology (i.e., graphing calculator or online interactive graphing technology)

• Students should be able to accurately express characteristics in interval notation and set-builder notation using inequalities.

A.FGR.9.3 Identify the effect on the graph generated by an exponential function when replacing $f(x)$ with $f(x) + k$, and $k\,f(x)$, for specific values of k (both positive and negative); find the value of k given the graphs.

Strategies and Methods

• Students should be given opportunities to experiment with cases and illustrate an explanation of the effects on the graph using interactive technology.

A.FGR.9.4 Use mathematically applicable situations algebraically and graphically to build and interpret geometric sequences as functions whose domain is a subset of the integers

Fundamentals

- Sequences can be defined recursively and explicitly.
- Connections should be made between exponential functions and geometric sequences.
- The focus of this learning objective is on building and interpreting geometric sequences.
- Students should be able to convert geometric sequences from explicit form to recursive and vice versa.
- Students should have ample opportunities to compare geometric sequences with arithmetic sequences presented in a variety of ways.

Example

- By graphing or calculating terms, students should be able to show how the geometric sequence in recursive form $a_1=8$, $a_n=2a_n-1$; the geometric sequence in explicit form $s_n = 8(2)^{n-1}$; and the function $f(x) = 4(2)^x$ (when x is a natural number) all define the same sequence.

A.FGR.9.5 Compare characteristics of two functions each represented in a different way.

Fundamentals

- Students should be able to present functions algebraically, graphically, and numerically in tables, or by verbal descriptions.
- Students should be able to compare an exponential function to a linear function, a quadratic function, or to another exponential function.
- Students should be able to compare key characteristics of exponential functions with the key characteristics of linear and quadratic functions.
- Students should be able to observe using graphs and tables that a quantity increasing quadratically will eventually exceed a portion of a quantity increasing linearly.
- Students should be able to observe using graphs and tables that a quantity increasing exponentially will eventually exceed a portion of a quantity increasing linearly or quadratically.

Example

- Given a graph of one function and an algebraic expression for another, determine which has the larger y-intercept.

A.MM.1: Apply mathematics to real-life situations; model real-life phenomena using mathematics

A.MM.1.1 Explain applicable, mathematical problems using a mathematical model.

Fundamentals

- Students should be provided with opportunities to learn mathematics in the framework of real-life problems.
- Mathematically applicable problems are those presented in which the given framework makes sense, realistically and mathematically, and allows for students to make decisions about how to solve the problem (model with mathematics).

A.MM.1.4 Use various mathematical representations and structures with this information to represent and solve real-life problems.

Strategies and Methods

- Students should be able to fluently navigate between mathematical representations that are presented numerically, algebraically, and graphically.
- For graphical representations, students should be given opportunities to analyze graphs using interactive graphing technologies.

<u>Concepts/Skills to support mastery of standards</u>

- Computation with whole numbers and decimals, including application of order of operations
- Graphing on a coordinate plane
- Calculating with exponents
- Applying rules of negative exponents

Vocabulary

Arithmetic Sequence	Asymptote	Asymptotic Behavior	Base	Characteristics of a Graph	Compound Interest
Compression	Domain	End Behavior	Exponent	Exponential	Exponential Decay
Exponential Growth	Function Notation	Graph	Half-life	Horizontal Translation	Intercept
Interval of Increase	Interval of decrease	Infinity	Negative Infinity	Parent Function	Positive Infinity
Range	Recursive Relationship	Simple Interest	Stretch	Strictly Decreasing	Strictly Increasing
Transformations	Vertical Translation	Zero			

Notation

Function Notation - $f(t)$ Interval Notation - [.] , (,) Set Notation - D: $\{x|x \in R\}$ (Set of all real numbers) , R: $\{y \mid y \in R\}$, $\{x|5 \leq x \leq 7\}$

Key concept	Related concept(s)	Global context
Form- The shape and underlying structure of an entity or piece of work, including its organization, essential nature and external appearance.	Change, Space, Quantity	Scientific and Technical Innovation- Mathematical puzzles, principals and discoveries

Statement of inquiry

Exploring the form of exponential functions and their relationship to scientific and technical innovation, including mathematical puzzles, principles, and discoveries, insights are given into the dynamic nature of change, space, and quantity within the global context of exponential growth and transformation.

Inquiry questions

Factual—

- What do “a” and ”b” represent within an exponential parent function?
- What causes an exponential graph to translate left or right?
- What causes an exponential graph to translate up or down?
- What does an exponential graph look like?

Conceptual—

- Explain what causes growth or decay.
- How can I use an equation to tell how the graph will look?

Debatable-

- Which one is faster growing a linear, quadratic or exponential function?

MYP Objectives	**Assessment Tasks**	
*What specific MYP **objectives** will be addressed during this unit?*	***Relationship** between summative assessment task(s) and statement of inquiry:*	*List of common formative and summative assessments.*
	Summative assessment will compare exponential growth functions and their transformation in relation to scientific and technical innovation.	**Formative Assessment(s):** Mid Unit Check **Summative Assessment(s):** Cumulative Assessment

Approaches to learning (ATL)

Category: Thinking Skills
Cluster: Transfer
Skill Indicator: Compare conceptual understanding across multiple subject groups and disciplines
Learning Experience: Comparing Linear, Quadratic, and Exponential Models Graphically

Learning Experiences

Add additional rows below as needed.

Objective or Content	Learning Experiences	Personalized Learning and Differentiation
A.FGR.9.1 Use function notation to build and evaluate exponential functions for inputs in their domains and interpret statements that use function notation in terms of a context. **A.FGR.9.2** Graph and analyze the key characteristics of simple exponential functions based on mathematically applicable situations. **A.FGR.9.5** Compare characteristics of two functions each represented in a different way.	**<u>Comparing Linear, Quadratic, and Exponential Models Graphically</u>** **Description:** In this learning plan, students will evaluate models of linear, quadratic, and exponential functions in a table. Using the information from the tables, students will graph the functions on the same coordinate plane. Ultimately, the objective of this learning plan is for students to be able to compare the functions and recognize the differences in the graphs. **Learning Goals:** ● I can compare and contrast linear, quadratic, and exponential functions. ● I can recognize the differences between the graphs of linear, quadratic, and exponential functions.	Supporting the Learning: The teacher will establish clear goals that articulate the mathematics that students are learning and the explicit connections to prior knowledge regarding rates of change, domain and range, and intervals of increase or decrease. Language Supports: The teacher may want to consider having an anchor chart available that ○ defines the vocabulary of this task (domain, range, rate of change, interval notation, end behavior, etc.) ○ provide an example of writing interval notations ○ the types of equations (linear, quadratic, and exponential) Extending the Learning: Once students have completed the task, allow time to discuss the findings. Focus on questioning that verifies and deepens students' understanding such as: ○ In your own words how would you describe a graph of an exponential function? ○ What kinds of features do you notice about a graph of an exponential function?

Content Resources

Textbook Correlation: enVision A|G|A - Algebra 1

A.FGR.9.1 - Lesson 6-2, 6-3, Topic 6 - Mathematical Modeling in 3 Acts
A.FGR.9.2 - Lessons 6-3, 8-5
A.FGR.9.3 - Lesson 6-5, 10-4
A.FGR.9.4 - Lessons 6-4
A.FGR.9.5 - Lessons 8-5