Marietta City Schools

2023–2024 District Unit Planner

Honors Algebra: Concepts & Connections

Unit title	Unit 6: Analyzing Exponential Functions	**MYP year**	4	**Unit duration (hrs)**	15 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 covert 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.*
MYP A - Unit Quiz MYP C - Penny A Day	Summative assessment will compare exponential growth functions and their transformation in relation to scientific and technical innovation.	**Formative Assessment(s):** MYP A - Unit Quiz MYP C - Penny A Day **Summative Assessment(s):** Unit Assessment

Approaches to learning (ATL)

Category: Communication Skills
Cluster: Communication
Skill Indicator: Make effective summary notes for studying
Learning Experience: Reasoning about Exponential Graphs

Category: Self-Management Skills
Cluster: Affective
Skill Indicator: Practice “bouncing back” after adversity, mistakes and failures
Learning Experience: 3-Act-Task A Penny a Day

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.9.4** Use mathematically applicable situations algebraically and graphically to build and interpret geometric sequences as functions whose domain is a subset of the integers. **A.FGR.9.5** Compare characteristics of two functions each represented in a different way.	**Having Kittens (FAL)** **Description:** In this learning plan, students will use their knowledge of working with exponential functions to determine what happens if you do not have your cat spayed. According to a cat charity, spaying cats will help control the population. Students will be responsible for using the provided data to prove if the statement that one female cat would produce 2000 descendants in 18 months is realistic. Learning Goals: ● I can interpret a situation and represent the constraints and variables mathematically. ● I can select appropriate mathematical methods to use. ● I can make sensible estimates and assumptions. ● I can investigate an exponentially increasing sequence. ● I can communicate their reasoning clearly.	**Supporting the Learning:** As the teacher is circulating the room observing and listening as groups are moving through the FAL, the teacher can ask guiding questions of those who seem to be struggling to begin. These questions will be ones that will get them to think about what information they have and what more is needed to solve the problem. ○ What do you know? ○ What do you need to find out? ○ Can you describe in words what happens during the first five months?
A.FGR.9.2 - Graph and analyze the key characteristics of simple exponential functions based on mathematically applicable situations. **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.	**3-Act-Task A Penny a Day** **Description:** In this learning plan, students will participate in a 3-ACT set of tasks by watching videos, then tell what they noticed. They will then be able to discuss what they wonder or are curious about. These questions will be recorded on a class chart or on the board. Students will then use mathematics to answer their own questions. Students will be given information to solve the problem based on need. When they realize they don't have the information they need, and ask for it, it will be given to them. **Learning Goals:** ● I can identify patterns in exponential functions. ● I can recognize that exponential functions increase very rapidly.	**Supporting the Learning:** The teacher will want to have the various groups share their strategies either orally or on the board. This will allow the students to analyze each strategy for accuracy and simplest of methods. **Supporting the Learning:** The teacher will want to guide students through the specific directions for each phase and how it applies to what they are doing. The teacher will want to be careful not to tell the students if they are right or wrong; instead, help them to self-talk and ask questions of each other using their prior knowledge.
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

YouTube
ATL Skills - TEDEd
A.PAR.8 - Erin's Essential Questions Playlist: Introduction to Exponential Functions

Ed Puzzle

Khan Academy