Rigorous Curriculum Design

Unit Planning Organizer

Subject:	Integrated Mathematics 1			Grade:	9
Unit Number:	4	Unit Name:	Exponential Functions		
Unit Length	Days: 25 days		Mins / Day: 50-55 mins		
Unit Synopsis	Compare exponential functions with linear functions.				

Priority Standards	**Math CCSS**
	M1.F.IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. ***For example, the Fibonacci sequence is defined recursively by f(0)=f(1)=1, f(n+1) =f(n) +f(n – 1) for n ≥ 1.*** **M1.F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.** **M1.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)**
SMP	**Standards for Mathematical Practice**
	✓ Make sense of problems and persevere in solving them ✓ Reason abstractly and quantitatively ✓ Construct viable arguments and critique the reasoning of others ✓ Model with mathematics ✓ Use appropriate tools strategically ✓ Attend to precision ✓ Look for and make use of structure ✓ Look for and express regularity in repeated reasoning
Supporting Standards	**Math CCSS**
	M1.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. **M1.F.IF.1** – Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and x is an element of its domain, then *F(x)* denotes the output of *f* corresponding to the input x. The graph of *f* is the graph of the equation *y = f(x)*. **M1.F.IF.2** – Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. **M1.F.LE.1a** – Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. **M1.F.LE1b** – Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. **M1.F.LE1c** – Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. **M1.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. **M1.F.LE.5** – Interpret the parameters in a linear of exponential function in terms of a context. **M1.A.CED.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales **M1.F.BF.1** Write a function that describes a relationship between two quantities **M1.S.ID.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. **M1.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

Interdisciplinary Connections	Literacy/Science/ History/Other	NG ELD Standards
		ELD.9.1.B.6 Reading closely literary and informational texts and viewing multimedia to determine how meaning is conveyed explicitly and implicitly through language. ELD.9.1.B.8 Analyzing how writers and speakers use vocabulary and other language resources for specific purposes (to explain, persuade, entertain, etc.) depending on modality, text type, purpose, audience, topic, and content area. ELD.9.1.C.10 Writing literary and informational texts to present, describe and explain ideas and information, using appropriate technology.

Unwrapped Priority Standards

Standard:	M1.F.IF.3			
Skills	Concepts	Bloom's	DOK	Language Demand
Recognize	That sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.	Analyze	2	Interpretive

Essential Question(s)	Big Idea(s)
How are sequences and functions related?	The position value, *n* (domain) in a sequence is associated with exactly one output value, *f(n)* (range).

Standard:	M1.F.LE.1			
Skills	Concepts	Bloom's	DOK	Language Demand
Distinguish between	Situations that can be modeled with linear functions and with exponential functions.	Analyze	3	Interpretive

Essential Question(s)	Big Idea(s)
Why is a linear function modeled by a straight line while an exponential function is modeled by a curve? When is it appropriate to use a linear function versus an exponential function?	Linear functions progress with a constant rate of change while exponential functions grow by a multiplier.

Standard:	M1.F.LE.2			
Skills	Concepts	Bloom's	DOK	Language Demand
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)	Create	3	Productive

Essential Question(s)	Big Idea(s)
Given a set of data, how can we represent it such that someone else can duplicate the same data set?	Graphs, tables, diagrams and written scenarios can be represented through the creation of linear and exponential functions.

Learning Progressions

Standard:	M1.F.IF.3				
Previous Grade		Current Grade		Next Grade	
Skills	Concepts	Skills	Concepts	Skills	Concepts
Understand	That a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. (8.F.1)	Recognize	That sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.	Interpret	Functions that arise in applications in terms of the context. [Quadratic]
				Relate	The domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

Standard:	M1.F.LE.1				
Previous Grade		Current Grade		Next Grade	
Skills	Concepts	Skills	Concepts	Skills	Concepts
Describe	Qualitatively the functional relationship between two quantities by analyzing a graph (8.F.5)	Distinguish between	Situations that can be modeled with linear functions and with exponential functions.	Construct Compare	Linear, quadratic, and exponential models
		Solve	Problems	Solve	Problems

Standard:	M1.F.LE.2				
Previous Grade		Current Grade		Next Grade	
Skills	Concepts	Skills	Concepts	Skills	Concepts
Construct	A Function to model a linear relationship between two quantities. (8.F.4)	Construct	Linear and exponential functions, including arithmetic and geometric sequences, given a	Use Observe	Graphs and tables That a quantity increasing exponentially eventually exceeds a quantity

			graph, a description of a relationship, or two input-output pairs (include reading these from a table)		increasing linearly, quadratically, or (more generally) as a polynomial function.

Unit Vocabulary Words	
Academic Cross-Curricular Vocabulary (Tier 2)	Content/Domain Specific Vocabulary (Tier 3)
Investment, Principal, Rate, Interest, Depreciation (decay), Appreciation (growth), Data, Table, Deposit, Withdrawal.	Function, Linear Function, Exponential Function, Exponent, Growth, Decay, Depreciation, Value, Equation, Common Ratio, Rate, Investment, Evaluate, Table, Input, Output, Domain, Range, Principal, Interest, Recursive, Geometric Sequence, Arithmetic Sequence, Graph, Relationship, Data, Constant Rate of Change (slope), Curve, Sets, Subsets, Integers, Increase, Decrease, Growth Factor, Term, Finite Sequence, Infinite Sequence, Rule (function/equation), Deposit, Withdrawal, Constant Function.
Resources for Vocabulary Development (Strategies, Routines and Activities) Unit graphic organizers, Word walls, Vocabulary Quizzes, Crosswords, Foldable, Cornell Notes, Flashcards, Quizlet. https://quizlet.com/login	

21st Century Skills	
☐Creativity and Innovation	☐Initiative and Self-Direction
☐Critical Thinking and Problem Solving	☐Social and Cross-Cultural Skills
☐Communication and Collaboration	☐Productivity and Accountability
☐Flexibility and Adaptability	☐Leadership and Responsibility
☐Globally and Financially Literate	☐_____
☐Communicating and Collaborating	☐_____
Connections between 21st Century Skills, CCCSS, and Unit Overview: Investing money, appreciation and depreciation of items/objects, how sickness spreads over time.	

Costa & Kallick, 2008

Unit Assessments	
Pre-Assessment	Post-Assessment
For the CFA test ID go to: http://www.alvordschools.org/Page/2700	For the CFA test ID go to: http://www.alvordschools.org/Page/2700
Scoring Guides and Answer Keys	
For the CFA test ID go to: http://www.alvordschools.org/Page/2700	For the CFA test ID go to: http://www.alvordschools.org/Page/2700
Assessment Differentiation	

Students with Disabilities	***Accommodations*** Reference IEP to ensure appropriate testing environment ***Modifications***	English Language Learners	Emerging Expanding

Engaging Scenario Overview (Situation, challenge, role, audience, product or performance)	
Description: S: *current situation:* Life Lessons! You are working 40 hours per week at Target, making $9 per hour. Throughout your journey you experience a variety of situations. The first life lesson is learning about investing money earned. Later, you want to purchase the newest iPhone. You know that the iPhones can be costly so you determine if it is a good investment by comparing different depreciation methods. A third lesson is finding out how fact the flu can spread if you are sick and go to school. C: *student challenge:* Managing money by choosing an investment method (appreciation). Purchasing expensive items and deciding if the cost is worth the value (depreciation). How to manage going to school, working, and being sick along with how that affects other people (exponential growth). R: *student role:* Learn to compare possible outcomes and make well informed decisions with good reasoning. A: *intended audience:* Student peers and parents. P: *product or performance:* You will create tables and graphs of the given information in each task to compare which method is the better life decision.	Suggested Length of Time Days: Mins/Day:

Engaging Learning Experiences Synopsis of Authentic Performance Tasks		
Authentic Performance Tasks	Description	Suggested Length of Time
Task 1: Basics of graphing linear and exponential functions.	Students should be able to complete a table and graph the data when given a function/rule. A table consists of using term numbers for the domain and the sequence for the range. Determine which function is representative of the given graph. Reinforce vocab throughout (Domain, Range, Sequence, Recursive, Geometric Sequence, Arithmetic Sequence, Data, Rule (equation), Table, Constant Function, and Exponential Functions).	Days: 1 Mins/Day: 50
Task 2: Investment plans for money earned while working during summer.	For this task, you will be given 2 different investment plans for which you will calculate the data (tables). From the data, calculate the average rate of change for each plan then graph. From the graph compare which method is better over a period of 10 years.	Days: 1 Mins/Day: 50
Task 3: Determine if purchasing a new iPhone is worth its value, using depreciation.	Using a previous purchase price of a cell phone and what it sold for 5 years later on EBay. Complete the given tables, graph, and compare the depreciation graphs to each other. Determine future values of the iPhone using the given rates (linear function vs. growth function).	Days: 1 Mins/Day: 50
Task 4: How does the flu virus spread if you go to school sick?	Geometric sequences help represent many things including the influenza virus. After working with geometric sequences and calculating common ratios of the sequences, write a rule for the influenza virus based on the function given. Determine how many people are infected over a period of time (exponential growth).	Days: 1 Mins/Day: 50

Authentic Performance Task 1

<table>
<tr><td>Name:</td><td>Life Lessons: Functions and Tables</td><td>Suggested Length</td><td>Days: 1
Mins/Day: 55</td></tr>
<tr><td rowspan="8">Standards Addressed</td><td colspan="3">Priority Standards</td></tr>
<tr><td colspan="3">CCCSS Math</td></tr>
<tr><td colspan="3">M1.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)
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☐Construct viable arguments and critique the reasoning of others
✓ Model with mathematics
☐Use appropriate tools strategically
✓ Attend to precision
✓ Look for and make use of structure
✓ Look for and express regularity in repeated reasoning</td></tr>
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M1.F.IF.2 – Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
M1.F.LE1b – Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
M1.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.</td></tr>
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ELD.9.1.B.8 Analyzing how writers and speakers use vocabulary and other language resources for specific purposes (to explain, persuade, entertain, etc.) depending on modality, text type, purpose, audience, topic, and content area.</td></tr>
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<tr><td>Understand</td><td>2</td></tr>
<tr><td>Analyze</td><td>2</td></tr>
</table>

		Scoring Rubric

Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations	Emerging	
		Expanding	
	Modifications	Bridging	

Authentic Performance Task 2

Name:	Life Lessons: Investments	Suggested Length	Days: 1 Mins/Day: 55

Standards Addressed

Priority Standards

CCCSS Math

M1.F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.
M1.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)

Standards for Mathematical Practice

- ✓ Make sense of problems and persevere in solving them
- ☐ Reason abstractly and quantitatively
- ☐ Construct viable arguments and critique the reasoning of others
- ✓ Model with mathematics
- ☐ Use appropriate tools strategically
- ✓ Attend to precision
- ✓ Look for and make use of structure
- ✓ Look for and express regularity in repeated reasoning

Supporting Standards

CCCSS Math

M1.F.IF.1 – Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and x is an element of its domain, then *F(x)* denotes the output of *f* corresponding to the input x. The graph of *f* is the graph of the equation *y = f(x)*.
M1.F.IF.1 – Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and x is an element of its domain, then *F(x)* denotes the output of *f* corresponding to the input x. The graph of *f* is the graph of the equation *y = f(x)*.
M1.F.LE.1a – Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
M1.F.LE1c – Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
M1.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.
M1.F.LE.5 – Interpret the parameters in a linear or exponential function in terms of a context.
M1.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Interdisciplinary Connections

Literacy/Science/ History/Other	NG ELD Standards
	ELD.9.1.B.6 Reading closely literary and informational texts and viewing multimedia to determine how meaning is conveyed explicitly and implicitly through language. ELD.9.1.B.8 Analyzing how writers and speakers use vocabulary and other language resources for specific purposes (to explain, persuade, entertain, etc.) depending on modality, text type, purpose, audience, topic, and content area.

Tea		Bloom's	DOK

		Analyze	2
		Evaluate	2
		Scoring Rubric	

Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations	Emerging	
		Expanding	
	Modifications		
		Bridging	

Authentic Performance Task 3

Name:	Life Lessons: Depreciation	Suggested Length	Days: 1 Mins/Day: 55

Standards Addressed

Priority Standards

CCCSS Math

M1.F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.
M1.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)

Standards for Mathematical Practice

- ✓ Make sense of problems and persevere in solving them
- ✓ Reason abstractly and quantitatively
- ✓ Construct viable arguments and critique the reasoning of others
- ✓ Model with mathematics
- ✓ Use appropriate tools strategically
- ✓ Attend to precision
- ✓ Look for and make use of structure
- ✓ Look for and express regularity in repeated reasoning

Supporting Standards

CCCSS Math

M1.F.IF.1 – Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and x is an element of its domain, then *F(x)* denotes the output of *f* corresponding to the input x. The graph of *f* is the graph of the equation *y = f(x)*.
M1.F.IF.2 – Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
M1.F.LE.1a – Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
M1.F.LE1b – Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
M1.F.LE1c – Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
M1.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.
M1.F.LE.5 – Interpret the parameters in a linear or exponential function in terms of a context.
M1.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
M1.F.BF.1 - Write a function that describes a relationship between two quantities
M1.S.ID.7 - Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
M1.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

Interdisciplinary Connections

Literacy/Science/ History/Other	NG ELD Standards
	ELD.9.1.B.6 Reading closely literary and informational texts and viewing multimedia to determine how meaning is conveyed explicitly and implicitly through language. ELD.9.1.B.8 Analyzing how writers and speakers use vocabulary and other language resources for specific purposes (to explain, persuade, entertain, etc.) depending on modality, text type, purpose, audience, topic, and content area.

Teaching and Learning Progression		Bloom's	DOK
		Analyze	2
		Evaluate	2
		Scoring Rubric	

Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations	Emerging	
	Modifications	Expanding	
		Bridging	

Authentic Performance Task 4

Name:	Life Lessons: Flu	Suggested Length	Days: 1 Mins/Day: 55

Standards Addressed

Priority Standards

CCCSS Math

M1.F.IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. ***For example, the Fibonacci sequence is defined recursively by f(0)=f(1)=1, f(n+1) =f(n) +f(n – 1) for n ≥ 1.***
M1.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)

Standards for Mathematical Practice

- ✓ Make sense of problems and persevere in solving them
- ☐ Reason abstractly and quantitatively
- ☐ Construct viable arguments and critique the reasoning of others
- ✓ Model with mathematics
- ☐ Use appropriate tools strategically
- ✓ Attend to precision
- ✓ Look for and make use of structure
- ✓ Look for and express regularity in repeated reasoning

Supporting Standards

CCCSS Math

M1.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.
M1.F.LE.1a – Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
M1.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.
M1.F.BF.1
Write a function that describes a relationship between two quantities

Interdisciplinary Connections

Literacy/Science/ History/Other	NG ELD Standards
	ELD.9.1.B.6 Reading closely literary and informational texts and viewing multimedia to determine how meaning is conveyed explicitly and implicitly through language. ELD.9.1.B.8 Analyzing how writers and speakers use vocabulary and other language resources for specific purposes (to explain, persuade, entertain, etc.) depending on modality, text type, purpose, audience, topic, and content area.

Teaching and

	Bloom's	DOK
	Understand	2

		Evaluate	2
		Scoring Rubric	

Instructional Strategies			
All Students	SWD	ELs	Enrichment
	Accommodations	Emerging	
	Modifications	Expanding	
		Bridging	