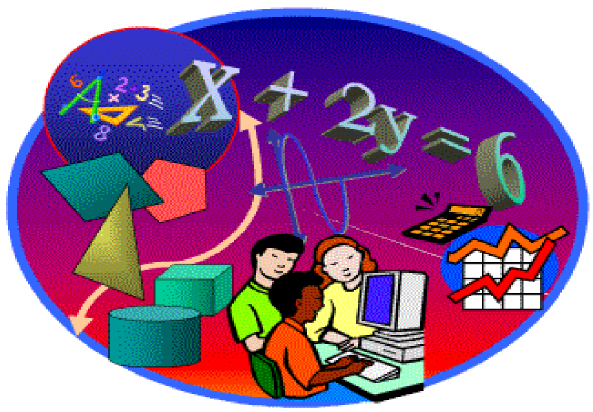
College- and Career-Readiness Standards for Mathematics



Exemplar Lesson Plan

"To Infinity and Beyond!"

F-LE.1a

F-LE.1b

F-LE.2

MISSISSIPPI DEPARTMENT OF EDUCATION

Ensuring a bright future for every child

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Mississippi College- and Career-Readiness Standards
Mathematics
Exemplar Lesson Plan

COURSE: Algebra I

Title: *To Infinity and Beyond!* **Estimated Duration: 3 to 4 Days**	**Real World Purpose:** While linear functions have shown many useful real world applications for relationships with a constant rate of change, not all functions fit this pattern. Exponential functions are also useful to model real world situations. The three most common are population growth, exponential decay, and compound interest.

I Can:

F-LE.1: Distinguish between situations that can be modeled with linear functions and with exponential functions.*

- **a.** Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
- **b.** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

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).*

Prerequisite Skills:

8.EE.1: Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example, 32 × 3–5 = 3–3 = 1/33 = 1/27.*

8.EE.5: Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*

8.F.2: Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.*

8.F.4: Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

Materials/Resources:

- XY Coordinate Geoboards
- www.regentsprep.org
- www.engageny.com
- www.illustrativemathematic.org
- www.khanacademy.org
- Big Ideas MATH Algebra I textbook
- Graphing calculator
- Graph paper
- Mini-white board
- Expo marker
- Eraser
- **Attachments (Total: 7)**

Key Vocabulary:

- Linear function
- Exponential function
- Polynomial function
- Quadratic function
- Constant of variation
- Properties of Exponents
- Exponential growth
- Constant rate
- Slope triangle
- Direct variation
- Successive quotients
- Exponential decay
- Unit rate
- Slope
- Compound interest

Lesson Introduction

Student Exploration Activity: Fill in the Missing Values and Determine the Change (15 minutes)

Directions:
The teacher will randomly place students into groups of three or four and distribute the activity ***Fill in the Missing Values and Determine the Change*** (*Attachment #1*). The teacher will review the directions at the top of the activity. The teacher will give the students 10 minutes to complete as many tables as possible. The teacher will spend 5 minutes as closure reviewing the students' discoveries and introducing the unit "To Infinity and Beyond!"

Activity Objective:
Students will work in groups and use shared understanding to fill in the missing values and determine the change in *x* (Δx) and change in y (Δy) for the tables given. Students should be able to identify the table of data that represents the linear function and possibly the table of data that represents the quadratic function (if the concept has been covered at this time). Students should notice that not all tables of data follow the linear function pattern for Δx and Δy (or a quadratic function). Students should be able to identify that Table 2 and Table 4 display the pattern for exponential growth and decay. They may not however be able to recognize the pattern by the high school formal name.

Lesson Activities

Guidelines for Group Work

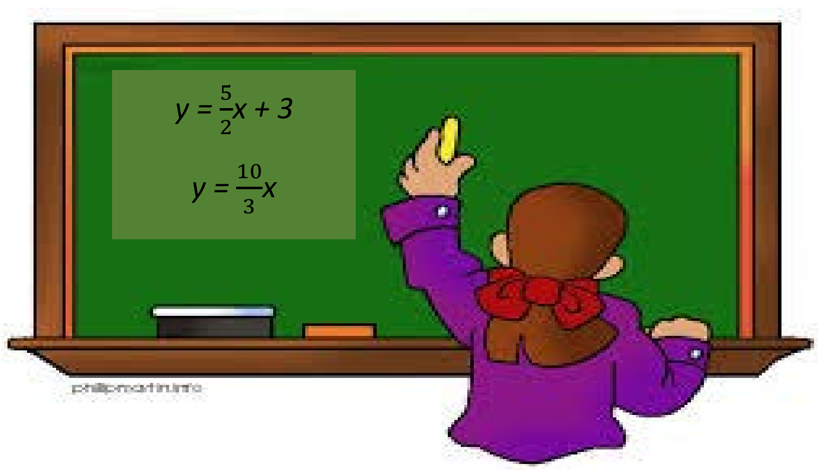
- The teacher will remind students during the Pair and Share activities that collaboration is required. Students will share equally in solving the task given. If one student finds the solution, the other student needs to check their work. Students will take turns until the task is complete. Students will use the "Flag It" technique to note any areas of difficulty during the activity using sticky notes.
- The teacher will remind students during the Group activities that collaboration is also required. This will be harder since four students will be groups. Students will need to take turns completing parts of the task until the task is complete. When a student is not actively engaged in finding solutions, he/she should be checking the work of another student or asking questions of the group. Students will use the "Flag It" technique to note any areas of difficulty during the activity using sticky notes.
- The teacher will circulate throughout the classroom to monitor student work and to guide them through the activity by using any form of questioning techniques. The teacher will also be looking for individual student understanding and general misconceptions.

Day 1

1. **Activity #1: Mini-Review Linear Functions**
   All students using XY-Coordinate Geoboards (10 minutes estimated)
   The teacher will review the following suggested topics: slope (positive, negative, zero, and undefined), domain and range, how to identify a function, slope form, how to write a linear equation, and how to graph the equation of a line. Suggested equations: $y = 2x$; $y = -\frac{1}{3}x + 2$; $x = 1$; and $y = 3$.

Activity Objective:
Students have already been introduced to linear functions earlier in this course. The objective of this activity is to reinforce students' prior knowledge about linear functions (A-REI.10, A-CED.2, F-IF.6, F-IF.4, etc.). After this review activity, students should have a solid foundation for success on Activity #2. If the teacher feels further review is needed, intervention activities should be aligned to Standard 8.F.4 and the following website may be used to supplement classroom instruction, https://www.engageny.org/ccls-math/8f4.

2. **Activity #2: F-LE.1a,b**
Slope and Direct Variation - Teacher Guided Instruction, Individual, Pair and Share (45 minutes estimated)



The students will individually do the following for each function: graph at least 5 points in quadrant I, write a table of data showing the *Δx* and *Δy*, and create four slope triangles. The teacher will explain that students have proven that linear functions grow by equal differences over equal intervals. The teacher will ask students to compare the two functions and describe $y = \frac{10}{3}x$ as having a y-intercept of zero. The teacher will remind students of prior knowledge from 8.EE.5 that describes $\frac{10}{3}$ as the unit rate since the function graphs through the origin. The teacher can use the progressions documents from http://ime.math.arizona.edu/progressions/ as an intervention resource for 8.EE.5. The teacher will ask 2 to 3 students to give real-world scenarios where $\frac{10}{3}$ could be the unit rate and describe a situation for the function given. The teacher will show students the direct variation equation and explain the similarities to linear functions with unit rates as slopes. Students will know to determine direct variation situations because the ratio y/x from the direct variation equation, $y = kx$, must be constant. The teacher will ask thought provoking questions during the guided instruction to determine level of conceptual understanding and student mastery. The teacher will distribute the ***Slope and Direct Variation*** (*Attachment #2*) activity, review the directions, and explain the objective of the activity. At the end of the activity, the teacher will review some of the "Flag Its" and student misconceptions.

Activity Objective:
Students will make a connection between the concepts *constant rate of change* and *growth by equal differences over equal intervals* (F-LE.1a: Prove that linear functions grow by equal differences over equal intervals). Students will also extend their prior knowledge of unit rate from the standard 8.EE.5 to direct variation (F-LE.1b: Recognize situations in which one quantity changes at a constant rate per unit interval relative to another).

Transition – The teacher will explain that linear functions and special linear functions that exhibit direct variations (mention quadratic functions if they have been taught) are not the only functions that model real-world situations. Exponential functions are another type of function that students will explore in Algebra I. Exponential functions model population growth, exponential decay, and compound interest. The teacher will remind the students that these functions were seen during the Student Exploration Activity and review the students' discoveries from that activity. This activity prepares students for their work with exponential functions by reviewing the properties of exponents.

3. **Activity #3: 8.EE.1**
Review Properties of Exponents - Pair and Share (35 minutes estimated)
The students will stay with the same partners as Activity #2 to review the properties of exponents. The teacher will distribute the activity ***Review Properties of Exponents*** (*Attachment #3*). The teacher will review the directions at the top of the activity and explain the objective of the activity. At the end of the activity, the teacher will allow two students to present their strategies to the class as closure.

Teacher: "Use MP. 7: Look for and make use of structure and MP. 8: Look for and express regularity in repeated reasoning to write general rules for Properties of Exponents. Remember to work with your partner. Follow the specific directions for each property. Be clear and concise in all your work."

Activity Objective:
Students will review the Properties of Exponents in preparation for their work with exponential functions. Students will develop expertise with two of the Mathematical Practices.

Day 2

1. **Activity #1: Opening**
   Student Presentations (10 minutes estimated)
   The teacher will have the following set of points written on the board {(0, 6), (1, 12), (2, 24), (3, 48), (4, 96), (5, 192)}. The teacher will instruct the students to write the points in a vertical table and prove the data represents a function that is not linear by determining the Δx and Δy. The teacher will remind students that today begins their work with exponential functions. The teacher will allow two students to present their proofs to the class.

   Activity Objective:
   Students will remember how to prove that linear functions grow by equal differences over equal intervals. The teacher will remind students that exponential functions do not follow that pattern.

2. **Activity #2: F-LE.1a**
   Successive Quotient - Teacher Guided Instruction and Student Group Work (20 minutes estimated)
   The teacher will direct students to add a third column to their table of data from the above work and label it Successive Quotients. The teacher will direct students to find *f(1)/f(0)* and add that value to the first row under the new heading Successive Quotients. The students will continue filling in the column, following the pattern, with the quotients *f(2)/f(1)* and so on. The teacher will then direct the students to generate a new table of data with three columns for the following function $f(x) = 1600 \cdot (1/2)^x$. Data will be generated for f(0), f(2), f(4), f(6), and f(8). The teacher will direct the students to find Δx and the successive quotients for this new table. The teacher will discuss the students' findings and explain the significance of the successive quotient as a way of proving the data fits an

exponential model. The teacher will explain that the criteria for an exponential model is *Δx* and the successive quotients must be constant. The teacher will put the students into groups of four and pass out the activity ***Successive Quotient*** (*Attachment #4)*. The teacher will review the directions at the top of the activity and explain the objective of the activity. At the end of the activity, the teacher will review some of the "Flag Its" and student misconceptions.

Activity Objective:
Students will finalize their work with the standard F-LE.1a. Students will now have a way to distinguish a given data set or a set of data generated from an equation as either linear or exponential. The students will explore possible situations that model the given data sets. This will help with the next activity in the lesson, determining whether a given situation should be modeled with a linear or exponential function.

*The teacher will assign homework that reinforces the skill in this activity if students are struggling with the "procedural skill and fluency" that is needed to successfully identify an exponential function.

3. **Activity #3: Types of Exponential Functions**
Teacher Guided Instruction and Student Questioning (40 minutes estimated)
The teacher will explain key concepts of the following:
Exponential Function, $y = ab^x$, explaining *b* is the successive quotient when Δx is one and *a* is the initial value.
Exponential Growth, $y = a(1 + r)^t$, explaining *r* is the rate of growth as a decimal and *t* is time.
Exponential Decay, $y = a(1 - r)^t$, explaining *r* is the rate of decay as a decimal.
Compound Interest, $y = P\left(1+\frac{r}{n}\right)^{nt}$, explaining *P* is the principal, *r* is the annual interest rate as a decimal, and *n* is the number of times interest is compounded per year.

The teacher will ask thought-provoking questions that relate students' previous work with unit rate (8.EE.5) and current work with direct variation (F.LE.1b) and successive quotients (F-LE.1a) to their conceptual understanding of the above functions. The teacher will allow for some productive struggle during the questioning instead of immediately providing the answers. The teacher will ask 3 or 4 students to provide examples with personal interest for each exponential function. The teacher will ask students to explain the significance of the (*1*) in the Exponential Growth and Decay Functions and why Exponential Growth is ($1 + r$) and Exponential Decay is ($1 – r$). The teacher will work several sample problems of each type with students to wrap up the activity. The use of a graphing calculator may assist students in seeing the difference between linear and exponential functions and the difference between exponential growth and decay functions.

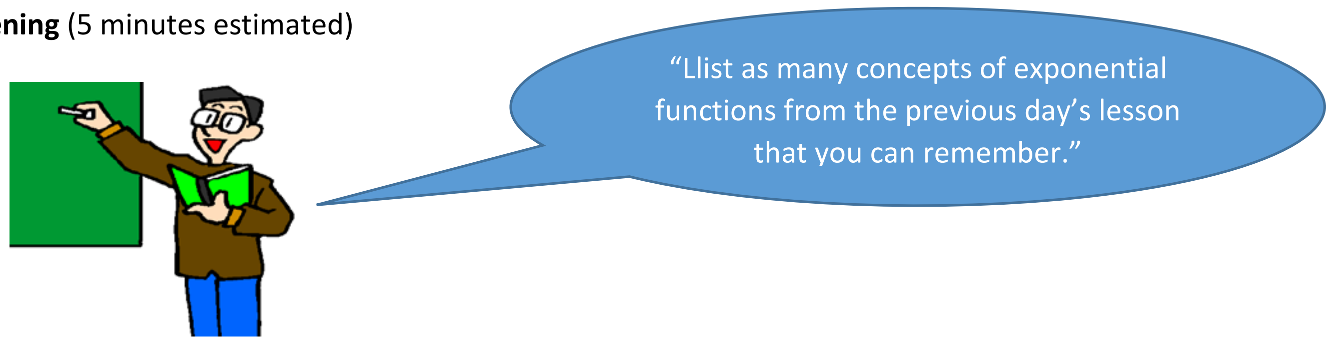
Activity Objective:
Students will have an understanding of each type of exponential function above and its key points. Students will relate their previous work with successive quotients to the values *b* and *r* in the exponential equations above.

4. **Activity #4: F-LE.2**
Construct an Exponential Function - Teacher Guided Instruction, Mini-white board, Pair and Share (20 minutes estimated)
The teacher will explain how to construct a basic exponential function from a table of data, a graph, and 2 points. The teacher will emphasize the importance of the Δx being 1 and how to adjust the successive quotient if the Δx is not 1. The teacher will ask thought-provoking questions to gauge students' conceptual understanding. The teacher will use the mini-white board to assess student's mastery of skills during the guided instruction. The teacher will explain that some situations can be modeled by an exponential function rather than a linear function. The teacher can use students' prior understanding of linear regression and line-of-best fit to explore exponential regression on the calculator. (See Enrichment Standard S-ID.6). The teacher will place students in pairs to complete the activity ***Construct an Exponential Function*** (*Attachment #5)*. The teacher will distribute the activity, review the directions, and explain the objective of the activity. At the end of the activity, the teacher will review some of the "Flag Its" and student misconceptions.

Activity Objective:
Students will begin constructing exponential functions without a modeling or application component. Students will see how to transfer their understanding of the y-intercept from linear functions to initial amount in exponential functions. This will be the foundation for their work on the next day's lesson where application/modeling is critical to constructing exponential growth, exponential decay, and compound interest functions.

Day 3

1. **Activity #1: Opening** (5 minutes estimated)



After five minutes, the teacher will review with the students by writing the exponential growth, exponential decay, and compound interest functions on the board.

Activity Objective:
Students will review the key features of the major exponential functions to prepare for today's lesson involving application/modeling.

2. **Activity #2: F-LE.2**
Constructing Exponential Functions through Application - Teacher Guided Instruction (15 minutes estimated)
The teacher will provide guidance on when to apply different functions to different situations by telling the students to highlight clue words in the text and explaining to students how to break down the context given - without relying on a formula. The teacher will guide the students through examples of each type of function using the following situations:

Exponential Growth:
A sales report shows that 3500 gas grills were purchased from a national home improvement store last year. The store expects grill sales to increase 8% each year.
Exponential Decay:
A city has a population of 150,000. The population is expected to decrease by 2.5% annually for the next decade. Write a function that represents this situation.

Compound Interest:
A person deposits $9000 in a savings account that earns 3.6% annual interest compounded monthly. Write a function rule for this situation.

The teacher will used thought-provoking questions to ensure students' conceptual understanding. The teacher will allow the students to ask questions and pose scenarios to work during the guided instruction.

Activity Objective:
Students will explore the three types of exponential functions through real world situation posed by the teacher that are applicable to each function. Students will gain confidence about when to apply the function to different situations and use this knowledge to model real world problems in the next activity.

3. **Activity #3: F-LE.1 and F-LE.2**
Modeling with Exponential Functions - Student Group Work and Independent Work (60 minutes estimated)
This activity will have two parts requiring group work for Part A and independent work for Part B. The teacher will put the students into groups of four and pass out the activity ***Modeling with Exponential Functions*** (*Attachment #6)*. The teacher will review the directions at the top of the activity and explain the objective of the activity. The teacher will remind students that Part B will be done independently when the group finishes Part A. *(Modeling with Exponential Functions, Attachment #6, can be modified as an activity using Activity Cards in **Attachment #7**).*

Activity Objective:
Students will be able to determine whether a given situation models a linear function, an exponential function, or neither. Students will also construct a linear or exponential function for the given situation. Since students have not solved exponential functions using logarithmic concepts, students will use tables of data, knowledge of geometric sequences, or graphing technology to extrapolate and draw conclusions about the given situation. Teachers can make the connection between roots and exponents to solve some exponential equations if the teacher wants to expand students' understanding. (See Enrichment Standard F-LE.4)

4. **Activity #4: Teacher Review**
Modeling with Exponential Functions – Teacher Guided Instruction (10 minutes estimated)
The teacher will review the students' findings from the activity ***Modeling with Exponential Functions*** (*Attachment #6*). The teacher will review some of the "Flag Its" and student misconceptions from the activity. The teacher will review key concepts from the activity to prepare the students for the Performance based assessment task.

Activity Objective:
Students will receive feedback on Activity #3 in order to prepare for the Performance based assessment task.

<u>Day 4</u>

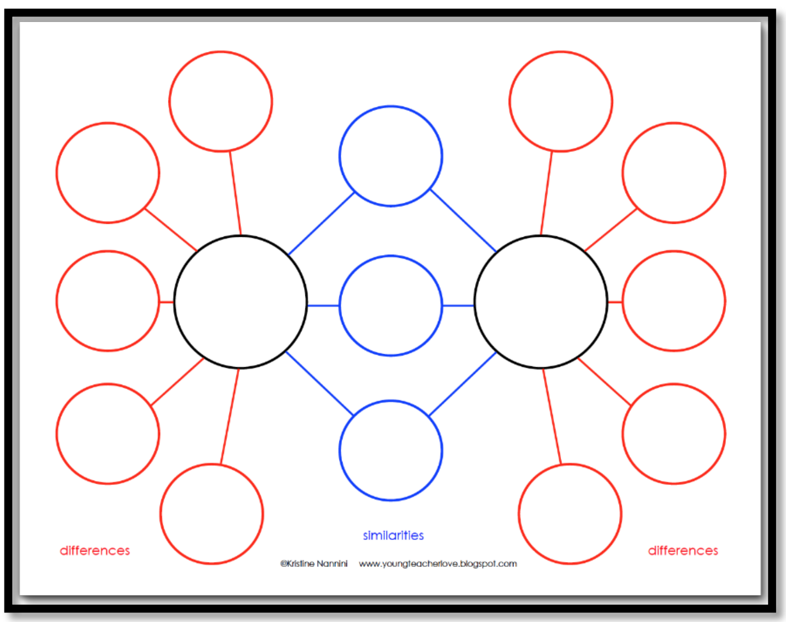
1. **Activity #1: Review**
Exponential Functions Lesson Plan Review - Teacher Guided Instruction (55 minutes if needed)
The teacher will use this day as a review day as needed for students. If students need additional time for procedural skill and fluency, this day can be used for independent student work or pair and share as appropriate.

2. **Activity #2: Performance Based Assessment Task - Individual** (35 minutes estimated)
The teacher will review with the students one last time before giving the Performance based assessment task. This review will be at the discretion of the teacher and will cover items/topics/content specific to the students. The teacher will ask questions as needed to determine student understanding. Upon completion of the review, the teacher will distribute the Performance based assessment task.

Lesson Closure

1. Lesson Closure will occur either at the end of Day 3 as homework or Day 4 during the Lesson Plan review.
2. Students will individually create a Double Bubble Thinking Map comparing a Linear Function to an Exponential Function.
3. Students will add a real-world example for each function to the double bubble map, create the function, write the table of data, and graph the function.
4. The teacher will display the double bubble maps in the classroom.

http://youngteacherlove.blogspot.com/



Essential Questions:

- What characterizes exponential growth and decay and compound interest functions?
- What are real-world models of exponential growth and decay functions?
- How can an exponential model be differentiated from a linear model given a real-world set of data?
- How does the successive quotient for an exponential function relate to slope of a linear function?
- What clue words can assist you in determining the type of function that can be modeled by a real-world problem?

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.

Supplemental Activities

Intervention

- **8.EE.5**: Graph the following proportional relationships and determine the unit rates. Which fruit is the best deal:
  a. 3.2 lbs of bananas cost $2.75
  b. a 5lb bag of apples cost $4
  c. 2 oranges that weighted 11 oz cost $0.90
  http://ime.math.arizona.edu/progressions/

- **8.F.4**: An equipment rental company charges Samuel $325 to rent the back hoe for the day plus an additional $3.50 for each hour the machine is used. Construct a linear function that models the situation. Graph the function. What is the rate of change and the initial value? How much will Samuel pay to rent the back for one day and use it for 10 hours? https://www.engageny.org/ccls-math/8f4

Enrichment

- **S-ID.6**: Fit a function (linear, quadratic, or exponential) to the following data. Justify your conclusion.
  The following data represents the number of fruit flies recorded at experimental station #1 over a 10 day period.

Day	# of Fruit Flies
1	4
2	20
3	50
4	31
5	90
6	75
7	150
8	300
9	320
10	350

- **<u>F-LE.4</u>**: Solve problems 13, 14 and 15 from ***Modeling with Exponential Functions*** (*Attachment #6*) as logarithms instead of exponentials.

Performance Based Assessment Task

The "One Stone" Band

Two band members have only 7 days to spread the word about their next performance. Jack thinks they can each pass out 100 fliers a day for 7 days and they will have done a good job in getting the news out. Meg has a different strategy. She wants to tell a friend about the performance on the first day. On the second day that person can tell 2 of her friends about the performance. On the third day each of those people will tell 2 of their friends and so on, for 7 days. Assume that once a student has been told they cannot be told again.

a. Who's strategy is the most effective (Jack's or Meg's)? Justify your conclusion.

b. If they had been given more than 7 days, would there be a day on which Meg's strategy would begin to inform more people than Jack's strategy? If not, explain why not. If so, which day would this occur on? Justify your conclusion.

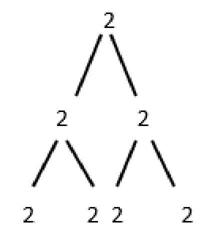
c. Knowing that she has only 7 days, how can Meg alter her strategy to reach more people than Jack does?

Rubric/Plausible Student Responses

a. Jack's strategy is the most effective for the first seven days. **(1pt)**

Jack: $\frac{100 \text{ flyers}}{\text{day}} \times 7 \text{ days} = 700 \text{ flyers} \approx 700 \text{ people}$ **(1pt)**

Meg: $2^7 = 128$ people **(1pt)**



Pattern: 2, 4, 8, 16, …. Pattern: $2^1, 2^2, 2^3, 2^4, \ldots$

(1pt: Pattern recognition)

d. What function type best represents the situation described by Jack's strategy? Write the function that models the situation where *d* represents the number of days the flyers are passed out.

e. What function type best represents the situation described by Meg's strategy? Write the function that models the situation where *d* represents the number of days the flyers are passed out.

f. Graph the functions you created in parts (d) and (e).

b. Yes, more days would help Meg's strategy inform more people. **(1pt)** On the 10^{th} day Meg's strategy would reach more people than Jack's strategy. **(1pt)**

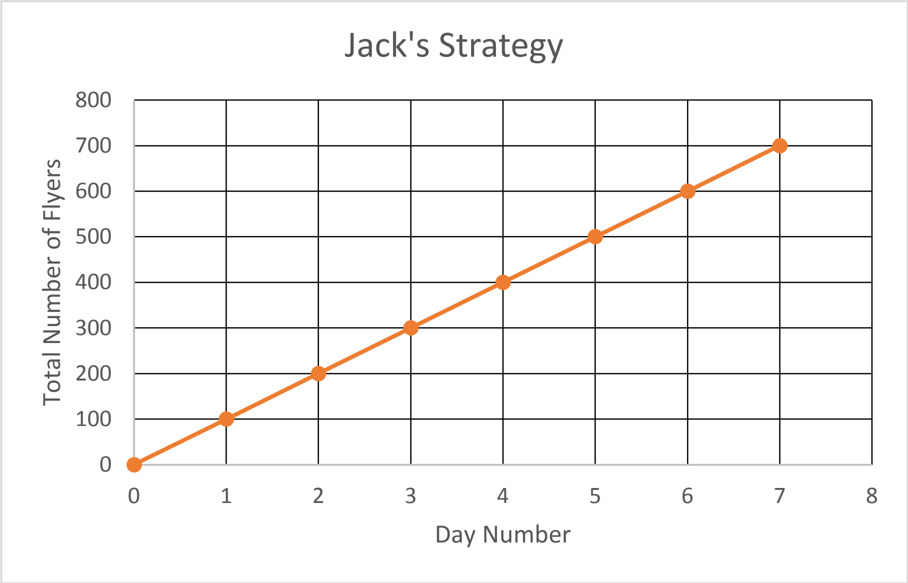
d (days)	8	9	10	11
Jack	800	900	1000	1100
Meg	256	512	1024	2048

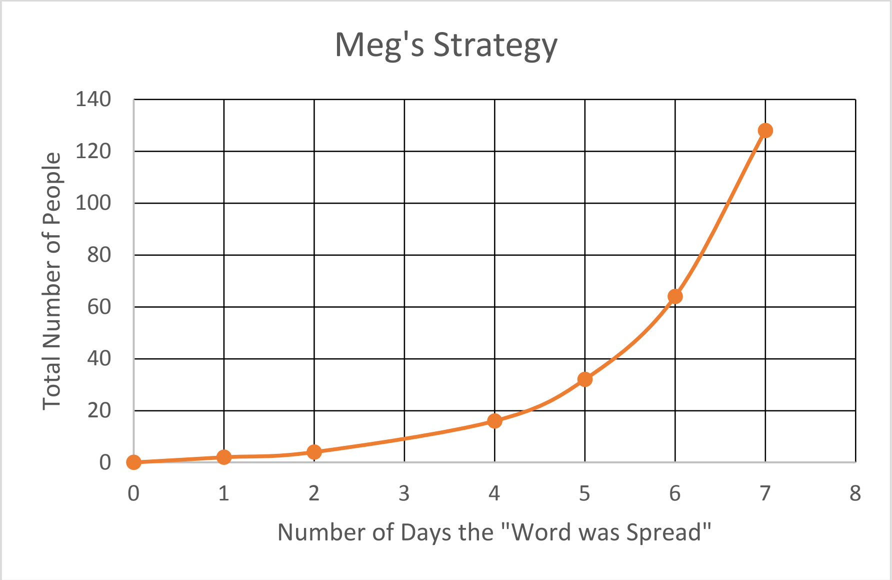
(2pts: Table/Justify)

c. Meg can alter the initial pattern so that on Day 1 three people know about the performance.**(1pt)** Then each person can tell three additional people. The new pattern would be **(1pt)**
Pattern: 3, 9, 37, 81, … Pattern: $3^1, 3^2, 3^3, 3^4$, ….

d. Linear function, $y = 700d$, where *d* is the number of days the flyers are passes out.
(1pt Identify Linear Function)
(1pt Construct function and label variable)

e. Exponential function, $y = 2^d$, where *d* is the numbers of days the "word of the performance was spread".
(1pt Identify Exponential Function)
(1pt Construct function and label variable)

	f.  **1pt for axis labels** **1pt for data points** **1pt for linear construction** **1pt for overall graph presentation**

	 **1pt for axis labels** **1pt for data points** **1pt for exponential construction** **1pt for overall graph presentation** **Performance Based Assessment Task** **Total Points: 22**

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Lesson Plan Attachments

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Mississippi College- and Career-Readiness Standards
Mathematics

Find the Missing Values and Determine the Change

Directions:
1. Fill in any missing values in the tables of data.
2. Identify the Δ*x* and Δ*y* beside each table.

1.

x	y
-0.435	2
	4
-0.235	
-0.135	8
0.065	12

3.

x	y
-2	5
0	-1
	2
2	9
	20

2.

x	y
-2	
	½
0	1
1	
	4
3	8

4.

x	y
0	270
	30
3	10
4	

Mississippi College- and Career-Readiness Standards
Mathematics

Slope and Direct Variation

Class Directions:
Students will have 10 minutes to individually complete as much of the activity as possible. Students will work with a partner for 10 minutes to complete the activity and answer their partner's scenario question.

Part A Directions:
Show that even though both tables represent linear functions only one shows direct variation. Justify your response. Write the direct variation equation for that table of data, graph the equation, create a scenario for the equation, and label the graph for the scenario created. Write an extension question for your scenario.

A.

x	1	2	3	4
y	5	10	15	20

B.

x	1	2	3	4
y	4	7	10	13

Scenario:

Mississippi College- and Career-Readiness Standards
Mathematics

Slope and Direct Variation

Part B Directions:
Determine which situation(s), if any, represents direct variation and write the direct variation function. Explain your work and justify your conclusion.

a. A person buys several music CDs for $12.50.

b. The cost of a $400 party room rental is shared equally by a group of college friends.

c. A person earns $5.50 an hour for each lawn they mow on the weekend as an extra job.

Part C Directions:
Following the examples above, write two situations: one that represents direct variation and another one that does not. Explain your work.

a.

b.

Attachment #3

Mississippi College- and Career-Readiness Standards

Mathematics

Review Properties of Exponents

Directions: Use MP.7 and MP.8 to write each general rule below.

Products of Powers. Write the product of the two powers as a single power. Write a general rule for finding the product of two powers with the same base.

a. $(5^1)(5^4)$ =

b. $(x^4)(x^3)$ =

Quotients of Powers. Write the quotient of the two powers as a single power. Write a general rule for finding the quotient of two powers with the same base.

c. $\frac{4^6}{4^4}$ =

d. $\frac{x^{12}}{x^5}$ =

Powers of Powers. Write the expression as a single power. Write a general rule for finding a power of a power.

e. $(9^3)^2$ =

f. $(y^4)^3$ =

Powers of Products. Write the expression as the product of two powers. Write a general rule for finding a power of a product.

g. $(3 \cdot 4)^3$ =

h. $(4a)^6$ =

Powers of Quotients. Write the expression as the quotient of two powers. Write a general rule for finding a power of a quotient.

i. $\left(\frac{3}{2}\right)^4$ =

j. $\left(\frac{a}{b}\right)^3$ =

Attachment #4

Mississippi College- and Career-Readiness Standards

Mathematics

Successive Quotients

Directions:

Each student in the group will pick one of the tables of data (A) – (D) below and determine if the table of data represents a linear function, an exponential function, or neither. Each student will write a justification for their decision and present their findings to their team. The team must reach a consensus as to the type of function for each table given. After each table is given a label, the group will review the four scenarios at the bottom and try to match a scenario to a table of data.

A		**B**		**C**		**D**	
x	**Y**	**x**	**y**	**x**	**y**	**x**	**y**
0	5000	0	20	0	50	0	15
1	4150	1	20.3	1	49	1	45
2	3444.50	2	20.6	2	46	2	135
3	2858.90	3	20.9	3	41	3	405

Scenarios

1. A population of rabbits in a national forest triple every year.

2. Each day, after the initial day, a charge of $0.30 is added to the bill.

3. The value of an All-Terrain Vehicle depreciates 17% each year after the initial purchase.

4. A diver jumps off a 50ft cliff and lands in the water after 7.1 seconds.

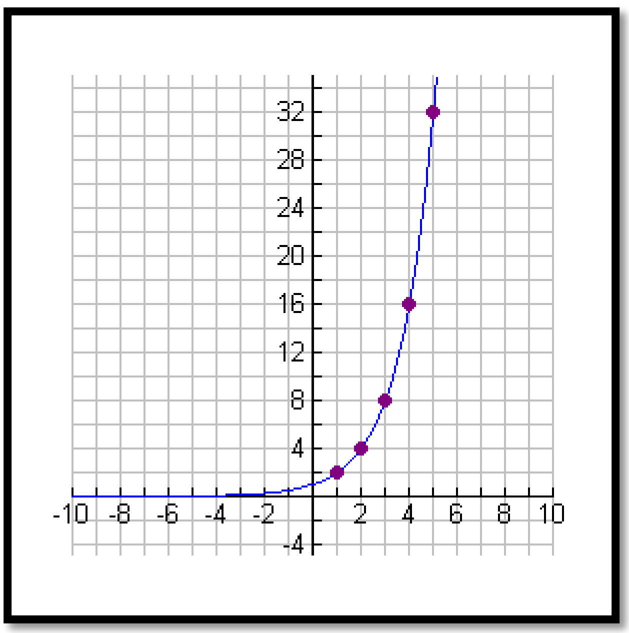
Attachment #5

Mississippi College- and Career-Readiness Standards
Mathematics
<u>Construct an Exponential Function</u>

<u>Directions</u>:
Write the exponential function for each table (A) – (C) below.

A		B		C	
x	**Y**	**x**	**y**	**x**	**y**
0	128	1	6	0	1
2	32	2	12	1	1.4
4	8	3	24	2	2.0
6	2	4	48	3	2.7
8	1/2	5	96	4	3.8

D.



E. (2, 90) and (3, 135)

F. (1, 12) and (0, 3)

Mississippi College- and Career-Readiness Standards
Mathematics

Modeling with Exponential Functions

Part A Directions:
In groups of four designated by the teacher, decide whether the given situation models a linear function, an exponential function, or neither. Write the linear or exponential function as appropriate.

1. A mutual fund account containing $10,000 and earning no interest receives a deposit of $252 per month.

2. A $120,000 John Deere Combine Tractor depreciates 16.5% per year.

3. The circumference of a circle as a function of the radius.

4. Every week 2/5 of a radioactive substance remains from an initial amount of 150 mg.

5. Students made 96 tee-shirts for Cinco de Mayo and gave away 12 tee-shirts every hour.

6. Joseph takes 1000mg of heart medicine at 7:00 am. Every hour 1/2 of the drug dosage remains in his body.

7. From 1910 until 2010, the growth rate of Mexico averaged about 1.6% per year. The population of Mexico in 1910 was 20,000,000.

8. A floor tile pattern needs one blue triangle for the 1st tile, two blue triangles for the 2nd tile, four blue triangles for the 3rd tile, eight blue triangles for the 4th tile, and so on.

9. The area of a circle as a function of the radius.

10. The flow of liquid through a pipe every day is a constant 12 ft/sec.

Mississippi College- and Career-Readiness Standards
Mathematics
Modeling with Exponential Functions

Part B Directions:
Independently, construct an exponential model for the situation and extrapolate the data as needed.

11. Your sister "tells" you a secret. You and she get into a fight and you decide to "tell" her secret to your two best friends. Now four people know the secret. Each of your friends "tell" two new people, after the third "telling" of the secret eight people know the secret. How many people know the secret after ten "tellings"? Approximate how many "tellings" will it take for 100 people to know?

12. Bora, Serbia has a population of 35,000. The town population declines 5% every year. What will the population be in seven years? Estimate when its population will be half of its original amount.

13. Cesium-137 is a radioactive tracer element used to study soil erosion. It has a half-life of approximately 30 days. Assume the amount of becquerels of Cesium-137 in a given soil sample is $A = c \cdot r^t$, where t is the number of days since the release of Cesium-137 into the soil and c and r are unknown constants. Assume the initial amount of Cesium-137 is eight becquerels. Write the function.

14. Aaliyah got a $36.00 ticket for parking in a reserved spot in her apartment building. If she pays the fine now there will be no penalty. If she delays her payment, then a penalty will be assessed for the number of months (t) that she delays paying her fine. The amount she will have to pay triples each month that she does not pay the ticket. She believes the ticket was unfair since the spot was not clearly marked and refuses to pay the ticket. Her apartment rent is $875 a month. Approximately how many months will it take for her fine to exceed her apartment rent?

Mississippi College- and Career-Readiness Standards
Mathematics
Activity Cards

$y = 3\ (84x + 333\ 1/3)$	$y = 150\ (0.4)^t$
$y = 252x + 10{,}000$	$y = 150\ (1 – 3/5)^t$
$y = 120{,}000\ (0.835\ )^t$	$y = -12x + 96$
$y = 120{,}000\ (1 – 0.165)^t$	$12x + y = 96$
$C = 2\pi r$	$y = 1000\ (1/2)^t$

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Mississippi College- and Career-Readiness Standards
Mathematics
Activity Cards

$y = 1000\ (0.5)^t$	$A = \pi r^2$
$y = 20{,}000{,}000\ (1.016)^t$	$y = 12$
$y = 20{,}000{,}000\ (1 + 0.016)^t$	$y = 2^2 \cdot 3$
$y = 2^x$	$y = 10{,}000\ (252)^t$
$2^0, 2^1, 2^2, 2^3, \ldots$	$y = 120{,}000\ (16.5)^t$

Mississippi College- and Career-Readiness Standards
Mathematics
Activity Cards

$y = 12x + 96$	$y = 150\ (0.6)^t$
$y = 1000\ (x)^{1/2}$	$y = (20{,}000{,}000)^{1.6t}$
$y = x^2$	$y = 3^x$
$y = 16.5x - 120{,}000$	$x = 12$
$C = \pi d$	$A = 2\pi(2d)^2$

A mutual fund account containing \$10,000 and earning no interest receives a deposit of \$252 per month.	Joseph takes 1000mg of heart medicine at 7:00 am. Every hour 1/2 of the drug dosage remains in his body.
A \$120,000 John Deere Combine Tractor depreciates 16.5% per year.	From 1910 until 2010, the growth rate of Mexico averaged about 1.6% per year. The population of Mexico in 1910 was 20,000,000.
The circumference of a circle as a function of the radius.	A floor tile pattern needs one blue triangle for the 1st tile, two blue triangles for the 2nd tile, four blue triangles for the 3rd tile, eight blue triangles for the 4th tile, and so on.
Every week 2/5 of a radioactive substance remains from an initial amount of 150 mg.	The area of a circle as a function of the radius.

Mississippi College- and Career-Readiness Standards
Mathematics
Activity Cards

Students made 96 tee-shirts for Cinco de Mayo and gave away 12 tee-shirts every hour.	The flow of liquid through a pipe every day is a constant 12 ft/sec.