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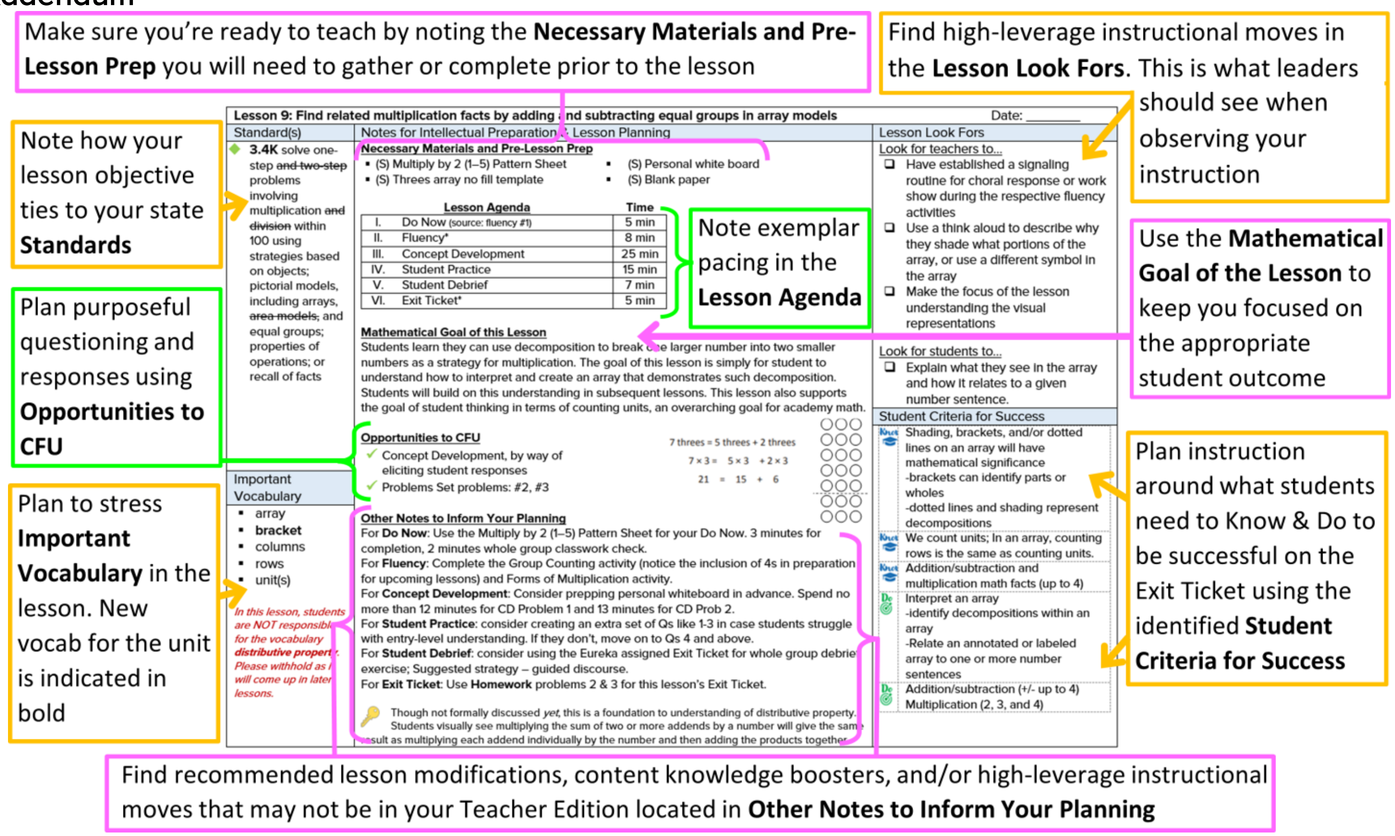


UNIT SYNOPSIS

Just as learning about arithmetic sequences set students up for understanding linear functions in Unit 5, this unit begins with geometric sequences to prime students for understanding exponential functions. Students apply their knowledge of geometric functions to make sense of $y = ab^x$ to express real world scenarios. While the first two lessons focus on growth patterns for exponential functions, the third, fourth, and fifth lessons focus on writing, graphing, and interpreting exponential growth and decay functions. The final lesson is on exponential regression. If you have flexible Success Days saved up from prior units, consider using one before Unit 10 to review how to work with radical expressions and expressions with rational exponents.

CONTENT STANDARDS

Below are the standards addressed in this unit.

Readiness Standards	Supporting Standards
A.9(C) write exponential functions in the form $f(x) = ab^x$ (where b is a rational number) to describe problems arising from mathematical and real-world situations, including growth and decay **A.9(D)** graph exponential functions that model growth and decay and identify key features, including y-intercept and asymptote, in mathematical and real-world problems	**A.9(A)** determine the domain and range of exponential functions of the form $f(x) = ab^x$ and represent the domain and range using inequalities **A.9(B)** interpret the meaning of the values of a and b in exponential functions of the form $f(x) = ab^x$ in real-world problems **A.9(E)** write, using technology, exponential functions that provide a reasonable fit to the data and make predictions for real-world problems **A.12(C)** identify terms of ~~arithmetic and~~ geometric sequences when the sequences are given in function form using recursive processes **A.12(D)** write a formula for the n^{th} term of ~~arithmetic and~~ geometric sequences, given the value of several of their terms

Focus on Disciplinary Literacy	Mathematical Process Standard (F) – analyze mathematical relationships to connect and communicate mathematical ideas
	Mathematical Process Standard (G) – display, explain, and justify mathematical ideas and arguments using precise mathematical language in written or oral communication

LEARNING SUPPORTS BY LESSON

There is a checkmark for the math support if the lesson	Lessons → / Math Supports	L1	L2	L3	L4	L5	L6
makes a connection to prior content or from a previous unit or academic year	Access Prior Knowledge		✓	✓	✓	✓	✓
uses familiar contexts or experiences to make the learning relevant to students	Real-World Connections	✓	✓		✓	✓	✓
makes use of graphic organizers	Graphic Organizers	✓		✓	✓	✓	
includes tools like rulers, protractors, patty paper, algebra tiles, etc.	Tools or Manipulatives						
incorporates tables, reference charts, displays, pictures, or models, or color-coding	Visual Aids	✓	✓	✓	✓	✓	✓
includes definitions, examples vs. nonexamples, cognates, etc.	Vocabulary Supports	✓	✓	✓	✓	✓	
includes strategies that support language development	Language Supports						
asks students to discuss with their partner to prepare for whole class discussion	- Turn and Talk	✓	✓	✓	✓	✓	
teacher facilitates a whole class discussion to debrief key learnings	- Guided Discussion	✓	✓	✓	✓	✓	
asks students to think independently, test their idea with a partner, and share whole group	- Think, Pair, Share						
includes sentence stems to support students with explanations	- Sentence Stems						
provides opportunities for students to work with a partner or a group	Peer Collaboration	✓	✓	✓	✓	✓	✓
uses mnemonics such as SohCahToa	Mnemonics						
includes websites or equipment that enhances the lesson	Technological Support						✓
content can be presented in different forms	Different Modalities						
uses hands-on tools or manipulatives to represent the math	- Concrete						
uses drawings to represent the math	- Pictorial			✓			
uses numbers and number sentences to represent the math	- Abstract	✓	✓	✓	✓	✓	✓

The EFFL Model

Experience First, Formalize Later (EFFL) Model

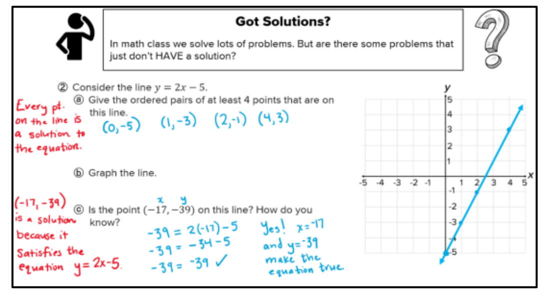
Opening

For every new lesson, the teacher begins by making the goals of the lesson crystal clear. The teacher does more than simply read the objective to the class. They make connections to previous learning, share how this learning fits into a bigger picture, or explain why this learning is important for future learning.

Activity / Interaction With New Material (INM)

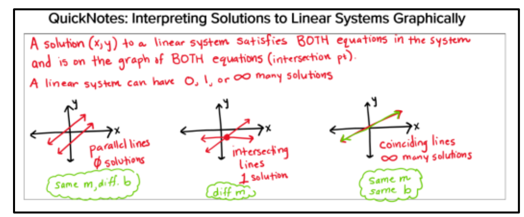
For this part of the lesson, students work in pairs or groups of four to experience new content through an activity. Students might be discussing a proposed scenario, working with other groups, or doing a simulation. The student activity is designed for students to be able to do without the help of the teacher. Of course, the teacher is watching and listening in to conversations in order to formatively assess student understanding. The teacher provides questions, cues, and prompts (not answers!) to help push groups forward when they are stuck or have made a mistake. As students begin to finish the activity, the teacher identifies students to write their work on the board. Most often, the teacher selects student work that will easily allow them to connect the experience to formal learning. Students write their work on the whiteboard in a single-color marker.

Debrief Activity



Once students have recorded their responses in their workbook (see blue writing to the right), the teacher calls the whole group back together for a debrief. It is in this discussion that the teacher will help students formalize the learning. The teacher connects the student activity experience to new vocabulary, definitions, formulas, and algorithms. The formal learning is attached specifically to the experiences of the activity so that students can enhance their constructed understanding of the new content. The teacher writes all of the formal learning in a different color in the margins of the activity (**see red writing to the right**). The students add these ideas in the margins on their activity page and often think of this as the formal "notes" of the lesson. In all of the answer keys we provide on Math Medic, the teacher formal learning points are provided in the margins in a **different color**.

QuickNotes



In this part of the lesson, the teacher uses the whole experience of the activity and the formalization in the debrief to summarize the learning from the lesson. Notice that we use the box to constrain the amount of formal "notes" that the teacher can provide.

Student Practice

Now that students have arrived at some new learning, they need to be able to apply it in new contexts. Most often we have students complete these questions in pairs and occasionally we select one question to use as an exit ticket. If we have time, we have students write solutions on the whiteboard.

Extra Practice

We typically give students around 3-5 "Extra Practice" problems for each lesson. We choose problems that are closely aligned with the Learning Objectives of the lesson. It is our belief that "less is more" here. We would rather students spend their Extra Practice time thinking deeply about just a few problems, rather than surface level thinking on many problems. When possible, we provide the answers at the bottom of the page, so they can immediately assess their understanding.

Slightly modified version of: https://www.calc-medic.com/post/experience-first-formalize-later#:~:text=%E2%80%9CExperience%20First%2C%20Formalize%20Later%E2%80%9D,at%20formal%20definitions%20and%20formulas.

Before You EFFL!

Here are helpful resources that you guide you in the right direction before your first EFFL lesson!

Why Should We EFFL?
The article advocates for the Experience First, Formalize Later (EFFL) teaching model, emphasizing its effectiveness in fostering deep understanding and flexible thinking in students. The author compares traditional teaching to a game of "Simon Says," where students merely mimic instructions without grasping underlying concepts. In contrast, EFFL encourages students to engage actively with problems, enhancing their ability to understand and apply calculus concepts creatively.

Tips for Lesson Planning
The article offers practical advice for effective lesson planning beyond the exhaustive and overly detailed approaches often emphasized during teacher training. It underscores the importance of thoughtful preparation but rejects the notion that teachers need to script every minute or detail of a class session.

Making the Most of Your EFFL Lesson Debrief
The article discusses the significance of the debriefing phase in the Experience First, Formalize Later (EFFL) lesson model, emphasizing its role in reinforcing learning and highlighting student contributions. The debrief session is seen as crucial for integrating academic vocabulary, emphasizing key lesson understandings, and valuing students' mathematical insights.

While You EFFL!

While each lesson may be unique in context and skills, all lessons benefit from the following practices:

Teacher Look Fors:
- ❑ Utilizing the Do Now to spark students’ interest in the Activity.
- ❑ Use questioning to promote small group discussion and exploration, guided by monitoring questions.
- ❑ Connects Experience First to formal concepts using a colored pencil/pen to take notes along the margin during the Debrief.
- ❑ Facilitates whole-class discussions for students to reflect, share insights, and provides feedback that reinforces key concepts.
- ❑ Tracks time to adapt lesson pacing and support based on student response and engagement.

Students Look Fors:
- ❑ In the Activity, students engage in group work and discourse.
- ❑ Exploring the activity, testing hypotheses and approaches (trial & error).
- ❑ Take notes on key ideas and concepts using different colored pencil/pen to take notes along the margin.
- ❑ Share thoughts and ideas that demonstrate their approach to their work.

Other considerations
- During the **Experience First** phase, if most of your students seem stuck or disengaged, take a moment to pause, reset, and provide clear instructions. Some problems of the Activity are more suitable to do a whole-class discussion as a means to save some instructional time for Student Practice or the Exit Ticket. You are encouraged to adapt the EFFL (Experience First, Formalize Later) process to meet your students' needs while maintaining a focus on student-centered instruction.

ROADMAP

AT A GLANCE: Unit 10 – Exponential Functions			
Day	Date	Lesson	Lesson Title
There are 2 flexible Success Days that you can use anywhere in the unit. • Consider using 1 day to review before the Unit 10 Exam. • If you don't need to use the other Success Day, you can/should incorporate it into your STAAR Success Unit.			
1		1	Geometric Sequences: Recursive to Explicit
2		2	Exponential Functions
3		3	Graphs of Parent Exponential Functions
4		4	Working With Exponential Functions
5		5	Interpreting Models for Exponential Growth and Decay
6		6	Exponential Regression
7			Success Day
8			Unit 10 Exam
9			Success Day

Lesson 1: Geometric Sequences: Recursive to Explicit Date: ________

Standard(s)

- **A.12(C)** identify terms of ~~arithmetic and~~ geometric sequences when the sequences are given in function form using recursive processes
- **A.12(D)** write a formula for the n^{th} term of ~~arithmetic and~~ geometric sequences, given the value of several of their terms

Important Vocabulary

- arithmetic sequence
- **common ratio, r**
- explicit rule
- **geometric sequence**
- sequence
- term
- term number

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 10.1 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (13 min)
- Debrief (10 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to write an explicit rule for a geometric sequence using the initial term and the common ratio. In a previous unit, students learned about arithmetic sequences. Students should be able to distinguish between arithmetic and geometric sequences. The rest of this unit on exponential functions builds on this foundational lesson.

Opportunities to CFU

- ✓ INM: 3, 5
- ✓ Student Practice: 1, 2, 3

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now cannot be skipped; it sets up the INM. Before moving onto the INM, ensure students understand the real-world context set up in #1 and how to do #2, since the rest of the lesson builds upon this idea.

For the **INM**: When debriefing INM#3, ensure students can articulate why this scenario is represented by a geometric (not arithmetic!) sequence. They should notice that there is NO common difference. For #5, know that some students will keep the table going up to the 10^{th} floor, while others might just use an exponent. When debriefing, discuss both methods, since they're both correct (although using the exponent is usually more efficient).

On **scaffolding:** When you notice students are struggling on the INM, use the questions in the green box on TE p7 to help spur their thinking.

Focus on Disciplinary Literacy

INM #3

Lesson Look Fors

Look for teachers to…

- ❑ allow students to use recursive patterns for finding monthly rent, even if it is not the most efficient. This material is new to students, and working through the recursive process will build their confidence in the explicit rule.
- ❑ while monitoring students, look for groups that are naturally using recursive and explicit methods to prepare for the debrief so the teacher can contrast their approaches

Look for students to…

- ❑ write out their expressions for calculating rent (in Q4), not just their final answer
- ❑ be able to explain how many times they've multiplied by 1.04 from the ground floor price

Student Know/Do Chart

- Do: Students can write a formula for the n^{th} term of a geometric sequence given a common ratio and an initial value.
- Do: Students can identify a specific term of a geometric sequence using either a recursive process or an explicit formula.
- Know: The common ratio is the ratio between two numbers in a geometric sequence.
- Know: Geometric sequences show repeated multiplication by the common ratio.
- Know: The explicit formula for a geometric sequence is $f(n) = f(0) \cdot r^n$, where $f(0)$ represents the initial term, r is the common ratio, n is the term number, and $f(n)$ is the term value.

Lesson 2: Exponential Functions Date: ________

Standard(s)

A.9(C) write exponential functions in the form $f(x) = ab^x$ (where b is a rational number) to describe problems arising from mathematical and real-world situations, including growth and decay

Important Vocabulary

- **decay factor**
- explicit rule
- **general form of an exponential function**
- **growth factor**
- **initial value**

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 10.2 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (14 min)
- Debrief (9 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to extend their understanding of geometric sequences to exponential functions, and evaluate exponential functions for positive, negative, and non-integer values of x. The focus of today's lesson is on interpreting the parameters of an exponential function in the form $y = ab^x$, whether the function represents a real-world context or not. In the next lesson, these parameters will be connected to their graphical representation.

Opportunities to CFU

- ✓ INM: 1, 2, 3
- ✓ Student Practice: 1, 2, 3

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now can be skipped or replaced; however, it spirals in previous content knowledge and juxtaposes arithmetic and geometric sequences, the contrast of which helps students make sense of the INM, especially #4.

For the **INM**: When you first release students to engage with the INM, encourage them to revisit the explicit rule they recorded in the previous day's QuickNotes. This may help them interpret the meaning of each value in the "Got Game?" equation.

A **common misconception** to look out for: When debriefing the term "decay factor," some students might think b should be negative, but that is not the case. Exponential decay is negative when $b < 1$.

Focus on Disciplinary Literacy

Debrief

Lesson Look Fors

Look for teachers to…

- ❑ release students to attempt the INM (as opposed to teacher working it out on board for students to copy) and circulate/monitor as students work
- ❑ use the monitoring questions provided in the green box on TE p19 when students get stuck.
- ❑ when debriefing, emphasize that when $b > 1$ it is a growth factor, and when $b < 1$, it is a decay factor.

Look for students to…

- ❑ be able to explain what each part of an exponential function represents in context.
- ❑ explain whether growth (in context of the INM real-world scenario) is linear and why or why not

Student Know/Do Chart

- Do: Students can write an exponential function given a real-world context and use it to calculate y given a, b, and x.
- Know: "Quadruple" means "times four."
- Know: An exponential function can be represented by $y = ab^x$, where a represents the initial term, b is the common ratio, x is the term number, and y is the term value.

Lesson 3: Graphs of Parent Exponential Functions

Date: _________

Standard(s)

- A.9(D) graph exponential functions that model growth and decay and identify key features, including y-intercept and asymptote, in mathematical and real-world problems
- A.9(A) determine the domain and range of exponential functions of the form $f(x) = ab^x$ and represent the domain and range using inequalities

Important Vocabulary

- **asymptote**
- **exponential decay**
- **exponential growth**
- exponential parent function

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 10.3 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (12 min)
- Debrief (10 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to graph equations of the form $y = b^x$ and identify the domain, range, y-intercept, and asymptote. After spending the previous two lessons thinking about growth patterns for exponential functions in contextual applications, we now turn to exponential growth (and decay) from a graphical perspective.

Opportunities to CFU

- ✓ INM: 3, 6, 7
- ✓ Student Practice: 1, 2

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now cannot be skipped or replaced; it sets up the INM. Ensure students get the chance to check their work against an exemplar before moving on, since the rest of the INM depends on correct Do Now responses.

For the **INM**: In Q3 – Q5, students explore the end behavior of exponential functions and how this is related to the function's range. When you debrief these questions after the INM, you will introduce the new term "horizontal asymptote."

By the end of the **Debrief**: Students should notice that the y-intercept for any parent exponential function is always $(0, 1)$ because any non-zero b to the zero power is 1.

Focus on Disciplinary Literacy

Debrief #4

Lesson Look Fors

Look for teachers to...

- ❑ release students to attempt the INM (as opposed to teacher working it out on board for students to copy) and circulate/monitor as students work
- ❑ use the monitoring questions provided in the green box on TE p24 when students get stuck.

Look for students to...

- ❑ explain what "growth" and "decay" look like graphically (and algebraically)
- ❑ use the equation they're given to generate a table BEFORE attempting to graph the equation.
- ❑ connect graphed points with a smooth curve

Student Know/Do Chart

- Do: Students can graph an exponential function.
- Do: Students can identify key attributes of an exponential function, including its y-intercept, domain, range, and whether the graph is increasing or decreasing.
- Know: When $b > 1$, an exponential function is increasing.
- Know: Before graphing an exponential function, it often helps to generate a table of values.

Lesson 4: Working With Exponential Functions Date: ________

Standard(s)

- **A.9(C)** write exponential functions in the form $f(x) = ab^x$ (where b is a rational number) to describe problems arising from mathematical and real-world situations, including growth and decay
- **A.9(B)** interpret the meaning of the values of a and b in exponential functions of the form $f(x) = ab^x$ in real-world problems

Important Vocabulary

- **cube root**
- exponential function
- **fourth root**
- linear function
- **square root**

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 10.4 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (10 min)
- Debrief (13 min)
- Student Practice (15 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to solve for the common ratio when given values of a geometric sequence or exponential function, find missing values of a geometric sequence or exponential function, and construct exponential functions given a description, table or graph.

Opportunities to CFU

✓ INM: 3, 5

✓ Student Practice: 1, 2, 3

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now sets up the INM; it cannot be skipped or replaced. It is included to contrast linear and exponential scenarios. Ensure you debrief the Do Now before moving on so students can refer to the correct responses for #1 and #2 when reflecting on the lesson as a whole.

For the **INM**: Know that in Q4, most (if not all) students are going to get stuck. That is okay; this is an important step in the learning process. In this lesson, students aren't yet "demonstrating" knowledge, but **developing** it (see TE p30 for more details). Please see the yellow box on TE p31 about 4b, which requires students to recall and apply radical expressions with rational exponents, something they haven't done since Lesson 7.5. Once you've given students enough time to struggle through #4, It is OK to help them perform the calculations for 4b, since performing this specific type of calculation is not the focus of this lesson as much as understanding what is going on in 4c and 4d.

Focus on Disciplinary Literacy

Debrief #4

Lesson Look Fors

Look for teachers to…

- ❑ use the monitoring questions provided in the green box on TE 31 when students inevitably get stuck.
- ❑ give students an opportunity to productively struggle (at least 5 minutes but no more than 10) with #4 before debriefing or giving correct answers.

Look for students to…

- ❑ use tables to organize their thinking and/or identify patterns when appropriate
- ❑ distinguish between a constant rate of change and a constant percent change (see INM Q3)

Student Know/Do Chart

Do: Students can write an exponential function given a table.

Know: An exponential function can be represented by $y = ab^x$, where a represents the initial term, b is the common ratio, x is the term number, and y is the term value.

Lesson 5: Interpreting Models for Exponential Growth and Decay | Date: ________

Standard(s)

◆ **A.9(C)** write exponential functions in the form $f(x) = ab^x$ (where b is a rational number) to describe problems arising from mathematical and real-world situations, including growth and decay

Important Vocabulary

- exponential decay
- exponential growth

Notes for Intellectual Preparation & Lesson Planning

__Necessary Materials and Pre-Lesson Prep__

- Unit 10.5 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (10 min)
- Debrief (15 min)
- Student Practice (13 min)
- Exit Ticket (10 min)

__Mathematical Goal of this Lesson__

By the end of this lesson, students should be able to interpret the parameters of an exponential function in context and use exponential functions to make predictions. In this lesson, students use exponential modeling to represent scenarios with percent change. (Students were first introduced to percent change in 7th grade.)

__Opportunities to CFU__

✓ INM: 3, 6, 7

✓ Student Practice: 1, 2, 3

__Other Notes to Inform Your Planning__

For the **Do Now**: The Do Now sets up the INM and cannot be skipped or replaced. Ensure you debrief the Do Now before moving on so students can refer to the correct responses for #1 and #2 to they can be successful with the INM.

In **General:** If you have a class period longer than 60 minutes, consider preceding the Do Now by looking at an article about the fastest growing cities. You can ask students why cities with the greatest increase in population are not necessarily the fastest growing cities. The goal is to get students to articulate that very large cities may have a population increase, but this is a small percentage of their previous year's population. If you DON'T have time for this, jump directly into the Do Now.

Focus on Disciplinary Literacy

Debrief of Q4

Lesson Look Fors

__Look for teachers to…__

- ❑ circulate while students are working in groups during the INM, listening in to see which groups are *multiplying by 0.065 and adding on* and *which groups are multiplying by 1.065*. Connecting these two approaches will be a critical part of the debrief.
- ❑ use the monitoring questions provided in the green box on TE 39 when students inevitably get stuck.

__Look for students to…__

- ❑ explain how and why growth rates are expressed in an exponential equation (e.g. in Q6, a growth rate of 6.5% is expressed as 1.065 because 100% + 6.5% = 106.5%).
- ❑ explain how and why decay rates are expressed in an exponential equation (e.g. in Q7, a decay rate of 2% is expressed as 0.98 because 100% - 2% = 98%)

Student Know/Do Chart

- Do: Students can determine if a situation calls for a growth or decay function.
- Do: Students can write an exponential function given a real-world situation and use it to make a prediction.
- Know: An exponential function is a growth function if $b > 1$.
- Know: An exponential function can be represented by $y = ab^x$, where a represents the initial term, b is the common ratio, x is the term number, and y is the term value.

Lesson 6: Exponential Regression Date: ________

Standard(s)

- ◆ **A.9(E)** write, using technology, exponential functions that provide a reasonable fit to the data and make predictions for real-world problems
- ◆ **A.9(A)** determine the domain and range of exponential functions of the form $f(x) = ab^x$ and represent the domain and range using inequalities
- ◆ **A.9(B)** interpret the meaning of the values of a and b in exponential functions of the form $f(x) = ab^x$ in real-world problems

Important Vocabulary

- curve of best fit
- **exponential regression**

Notes for Intellectual Preparation & Lesson Planning

Necessary Materials and Pre-Lesson Prep

- Unit 10.6 Student Workbook pages
- Class set of red pens

Lesson Structure:

- Do Now (7 min)
- INM (12 min)
- Debrief (2 min)
- Student Practice (24 min)
- Exit Ticket (10 min)

Mathematical Goal of this Lesson

By the end of this lesson, students should be able to use their calculator to generate a line of best fit for data that can be modeled by an exponential function. This lesson also spirals in concepts from previous lessons in this unit by having students explain the meaning of a and b in context, along with using inequality notation to express the real-world domain and range.

Opportunities to CFU

- ✓ INM: 1, 3, 4
- ✓ Student Practice: 1, 2

Other Notes to Inform Your Planning

For the **Do Now**: The Do Now spirals in previous concept and can be skipped or replaced.

In **General:** Students saw a lesson like this one when they learned how to generate a line of best fit modeled by a **linear** function (Lesson 5.5) and again when they learned how to generate a curve of best fit modeled by a **quadratic** function (Lesson 9.14). The steps are very similar; still, you need to decide if you want to model under the doc cam and have students follow along, or if you want to release them to walk through the steps with their partner.

Focus on Disciplinary Literacy

INM #1

Lesson Look Fors

Look for teachers to…

- ❑ model how to use the calculator to find the curve of best fit, step by step.
- ❑ maintain the expectation that students coach their partners when they're stuck (as opposed to pressing the buttons for them).

Look for students to…

- ❑ follow along in their workbook (SW pp 190 - 191) as their teacher models the steps.
- ❑ take advantage of the four problems in the SP to further internalize these steps, which they'll need for STAAR.

Student Know/Do Chart

Do: Students can use their calculator to write an exponential function that provides a reasonable fit to data and make a prediction.

Know: Students know the steps to generating a curve of best fit on their calculator (see TE p48).

Recommended Success Day Materials and Resources

A.9(C) & A.9(D): write and graph exponential functions ☐ Imagine Math: Graphing Exponential Functions (SE | TE) ☐ Kahoot: Graphs of Exponential Functions Part 1 ☐ Kahoot: Graphs of Exponential Functions Part 2 ☐ Kahoot: Exponential Functions ☐ Kahoot: Growth and Decay ☐ Carnegie: Write an Exponential Function	**A.9(E): exponential regression** ☐ Carnegie Math: Exponential Regression Practice
A.12(C) & A.12(D): Geometric Sequences ☐ Kahoot: Geometric Sequences ☐ Kahoot: Comparing Arithmetic and Geometric Sequences ☐ Carnegie: Geometric Sequences	**A.9(B): interpret *a* and *b*** ☐ Carnegie Math: Interpreting a and b practice
Unit 10 Tech Enhanced Question Practice This problem set gives students opportunities to work with drop down and equation editor questions EdCite. Students determine whether situations can be classified as “growth” or “decay,” generate a function for the situation, and use it to make predictions. This assignment is not mandatory, and it can be retaken as many times as the student wishes to take it. You’ll need to click “copy assignment” to be able to assign it to your students.	**General Review** ☐ General Review packet: pick and choose problems based on your needs. This packet contains a variety of problems that blend Lessons 3-5 together. (Regression and geometric sequences are not included.) ☐ Carnegie Assessments: Topic Quiz 1, Topic Quiz 2, Topic Quiz 3, Topic Quiz 4

Unit 10 Exam [OPTIONAL]	Date: ________
Standard(s)	Notes for Intellectual Preparation & Lesson Planning
◆ **A.9(C)** write exponential functions in the form $f(x) = ab^x$ (where b is a rational number) to describe problems arising from mathematical and real-world situations, including growth and decay ◆ **A.9(D)** graph exponential functions that model growth and decay and identify key features, including y-intercept and asymptote, in mathematical and real-world problems ◆ **A.9(A)** determine the domain and range of exponential functions of the form $f(x) = ab^x$ and represent the domain and range using inequalities ◆ **A.9(B)** interpret the meaning of the values of a and b in exponential functions of the form $f(x) = ab^x$ in real-world problems ◆ **A.9(E)** write, using technology, exponential functions that provide a reasonable fit to the data and make predictions for real-world problems ◆ **A.12(C)** identify terms of ~~arithmetic~~ and geometric sequences when the sequences are given in function form using recursive processes ◆ **A.12(D)** write a formula for the n^{th} term of ~~arithmetic and~~ geometric sequences, given the value of several of their terms	<u>**Necessary Materials and Pre-Lesson Prep**</u> ▪ Ensure you can access UE10 on EdCite. <u>**Notes to Inform Your Planning**</u> Review the Unit 10 Exam on Curriculum Corner. Internalize and create an exemplar for the assessment prior to teaching the unit as part of unpacking the unit. Use your exemplar to spar with the solutions provided in the Assessment Companion on Curriculum Corner. The scanning deadline for the Unit 10 Exam is April 2^{nd}, 2026. For any test items that are not multiple choice, verify that student responses marked incorrect by Edcite truly are incorrect. (Edcite occasionally does not recognize all possible equivalent correct responses.)

UNPACKED STANDARDS

Focus standards for this unit.

Standard Breakdown

Standard	Specificity	STAAR Alignment
A.9(C) write exponential functions in the form $f(x) = ab^x$ where b is a rational number to describe problems arising from mathematical and real-world situations, including growth and decay	**Concepts** - exponential functions - $f(x) = ab^x$ -rational number -growth -decay **Skills** - write -describe	See below

2025 – Q18 & Q47

A bank customer opened a money market account with \$2,500. Each year the bank will add interest to the account, which will increase the account's value by 0.5%.

Which function can be used to determine the amount, A, in the account after t years?

Ⓐ $A(t) = 2{,}500(0.50)^t$

Ⓑ $A(t) = 2{,}500(1.005)^t$

Ⓒ $A(t) = 2{,}500 + 0.50t$

Ⓓ $A(t) = 2{,}500(1.005)t$

The table represents some points on the graph of an exponential function.

x	$P(x)$
−1	270
0	90
1	30
2	10

Which function represents the relation shown in the table?

Ⓐ $P(x) = 30\left(\frac{1}{3}\right)^x$

Ⓑ $P(x) = 90(3)^x$

Ⓒ $P(x) = 90\left(\frac{1}{3}\right)^x$

Ⓓ $P(x) = 30(3)^x$

2024 – Q19 & Q43

The table represents some points on the graph of an exponential function.

x	$g(x)$
1	48
2	72
3	108
4	162

Which function represents the relation shown in the table?

Ⓐ $g(x) = 32\left(\frac{2}{3}\right)^x$

Ⓑ $g(x) = 48\left(\frac{2}{3}\right)^x$

Ⓒ $g(x) = 32\left(\frac{3}{2}\right)^x$

Ⓓ $g(x) = 48\left(\frac{3}{2}\right)^x$

A company currently has 500 employees. The number of employees is expected to grow at a rate of 2% each year.

Write an exponential function to model the number of employees in the company, y, after x years.

Enter your answer in the box provided.

$y =$

A.9(D) graph exponential functions that model growth and decay and identify key features, including *y*-intercept and asymptote, in mathematical and real-world problems

Concepts

- exponential functions
- growth
- decay
- key features
- *y*-intercept
- asymptote
- real-world problems

Skills

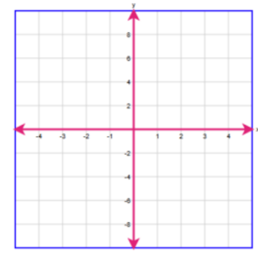
- graph
- model
- identify

2025 – Q33 & Q2

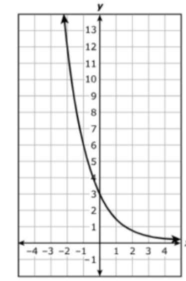
Graph the function $f(x) = 6\left(\frac{1}{3}\right)^x$.

Select the type of graph. Drag the two points and the asymptote, if applicable, to their correct positions.

Linear
Quadratic
Exponential



The graph of an exponential function is shown on the grid.



Which statement is best represented by the graph of the function?

Ⓐ The equation of the asymptote of the graph is $x = 4$.

Ⓑ The function is increasing on the interval $x > 0$ and decreasing on the interval $x < 0$.

Ⓒ The x-intercept of the graph of the function is $(8, 0)$.

Ⓓ The y-intercept of the graph of the function is $(0, 3)$.

2024 – Q11 & Q27

Which statement about the graph of $y = 16(0.5)^x$ is **NOT** true?

Ⓐ The y-intercept is (0, 16).

Ⓑ The graph is decreasing for all values of x.

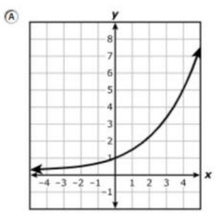
Ⓒ The x-intercept is (0.5, 0).

Ⓓ The graph has a horizontal asymptote at $y = 0$.

An exponential function has these characteristics:

- The y-intercept is 2.
- The function increases at a rate of 50%.

Which graph best represents this function?

Ⓐ


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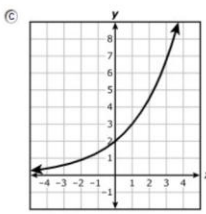

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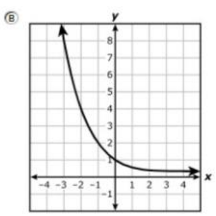

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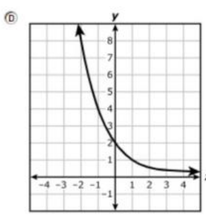

A.12(C) identify terms of arithmetic and geometric sequences when the sequences are given in function form using recursive processes	**Concepts (Know)** -arithmetic sequences -geometric sequences -recursive processes **Skills (Do)** - identify	2025 – Q40 A sequence can be generated by using the equation shown, where $a_1 = 100$ and n is a whole number greater than 1. $$a_n = 1.1a_{(n-1)}$$ What are the first four terms in the sequence? Ⓐ 100 210 441 926.1 Ⓑ 100 109 118.9 129.79 Ⓒ 100 101.1 102.2 103.3 Ⓓ 100 110 121 133.1
◆ **A.12(D)** write a formula for the n^{th} term of arithmetic and geometric sequences, given the value of several of their terms	**Concepts (Know)** -arithmetic sequences -geometric sequences -terms -n^{th} term **Skills (Do)** - write	2022 – Q41 **(only time A.12D has been assessed for geometric sequences post-COVID)** **41** The first six terms in a geometric sequence are shown, where $a_1 = -4$. $-4 \quad -16 \quad -64 \quad -256 \quad -1{,}024 \quad -4{,}096 \ldots$ Based on this information, which equation can be used to find the n^{th} term in the sequence, a_n? **A** $a_n = -4n$ **B** $a_n = -(4)^n$ **C** $a_n = -n^2$ **D** $a_n = (-4)^n$

VERTICAL STANDARDS

This section details the **progression** of key student expectations/standards** in the courses **before** and **after** this course. This will help you understand what **prior knowledge skills to build upon** and guide you in knowing what **skills you are preparing your students** for in the subsequent course.

6th / 7th Grade	Algebra I	Algebra II
6.2(E) extend representations for division to include fraction notation such as $\frac{a}{b}$ represents the same number as $a \div b$ where $b \neq 0$ 6.3(A) recognize that dividing by a rational number and multiplying by its reciprocal result in equivalent values 6.3(D) add, subtract, multiply, and divide integers fluently 6.3(E) multiply and divide positive rational numbers fluently 7.7(A) represent linear relationships using verbal descriptions, tables, graphs, and equations that simplify to the form y = mx + b	A.12(C) identify terms of arithmetic and geometric sequences when the sequences are given in function form using recursive processes A.12(D) write a formula for the nth term of arithmetic and geometric sequences, given the value of several of their terms A.9(C) write exponential functions in the form $f(x) = ab^x$ (where b is a rational number) to describe problems arising from mathematical and real-world situations, including growth and decay A.9(D) graph exponential functions that model growth and decay and identify key features, including y-intercept and asymptote, in mathematical and real-world problems A.9(A) determine the domain and range of exponential functions of the form $f(x) = ab^x$ and represent the domain and range using inequalities A.9(B) interpret the meaning of the values of a and b in exponential functions of the form $f(x) = ab^x$ in real-world problems	A2.2(A) graph the functions $f(x) = b^x$ and $f(x) = log_b(x)$ where b is 2, 10, and e, and, when applicable, analyze the key attributes such as domain, range, intercepts, symmetries, asymptotic behavior, and maximum and minimum given an interval A2.2(C) describe and analyze the relationship between a function and its inverse (logarithmic and exponential), including the restriction(s) on domain, which will restrict its range A2.5(A) determine the effects on the key attributes on the graphs of $f(x) = b^x$ and $f(x) = log_b(x)$ where b is 2, 10, and e when $f(x)$ is replaced by $af(x)$, $f(x) + d$, and $f(x - c)$ for specific positive and negative values of a, c, d A2.5(B) formulate exponential and logarithmic equations that model real-world situations, including exponential relationships written in recursive notation. A2.6(H) formulate rational equations that model real-world situations A2.5(C) rewrite exponential equations as corresponding logarithmic equations and logarithmic equations as corresponding exponential equations A2.5(D) solve exponential equations of the form $y = ab^x$ where a is a nonzero real number and b is greater than zero and not equal to one and single logarithmic equations having real solutions