Name:____________________ Math ______, Period ________

Mr. Rogove Date: ________

LEARNING OBJECTIVE: We will understand the concept of exponential growth and solve problems involving exponential growth. (Alg1M3L5)

ACTIVATING PRIOR KNOWLEDGE

We can evaluate geometric sequences

Consider the sequence: Explicit $A(n) = 2 \cdot \left(\frac{3}{2}\right)^{n-1}, n \geq 1$	Consider the sequence: Explicit $A(n) = 3 \cdot 4^{n-1}, n \geq 1$
Find $A(5) = 2\cdot\left(\frac{3}{2}\right)^4 = \cancel{2}\cdot\frac{81}{\cancel{16}} = \boxed{\frac{81}{8}}$	Find $A(4) = 3\cdot 4^3 = 3\cdot 64 = \boxed{192}$
Find $A(7) = 2\cdot\left(\frac{3}{2}\right)^6 = 2\cdot\frac{729}{64} = \boxed{\frac{729}{32}}$	Find $A(5) = 3\cdot 4^4 = \boxed{768}$ $192\cdot 4 = 768$

CONCEPT DEVELOPMENT

Two equipment rental companies have different penalty policies for returning a piece of equipment late.

At Mountain View Heavy Equipment, the penalty for returning a backhoe 1 day late is \$5. On day 2, the penalty is \$10. On day 3, the penalty is \$15. On day 4, the penalty is \$20 and so on, increasing by \$5 each additional day late.

$M(n) = 5 + 5(n-1) = 5 + 5(14) = \$75$

At Los Altos Large Machines, the penalty for returning a backhoe one day late is \$0.01. On day 2, the penalty is \$0.02. On day 3 the penalty is \$0.04. On day 4, the penalty is \$0.08 and so on, doubling the amount each additional day late.

$\$163.84$

$L(n) = .01 \times 2^{n-1} = L(15) = .01 \times 2^{14}$ $.01 \times 16384$

Jim rented from Los Altos Large Machines because he thought they had the better late policy. But he ended up returning the backhoe 15 days late and was shocked at the price. What did he pay? What would he have paid if he went to MV Heavy Equipment?

Exponential Functions: Exponential functions are written in the form $y = ab^x$ *or* $f(x) = ab^x$, where a is a constant equal to $f(0)$, and b is the growth factor.

Examples:

- $f(x) = 1\cdot 4^x$
- $f(x) = 3 \cdot \left(\frac{3}{2}\right)^x$

$$\underset{a}{f(x) = 4}\cdot \underset{b}{2}^x$$

$$f(0) = 4\cdot 2^0$$

$$f(0) = 4$$

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GUIDED PRACTICE

Steps for Evaluating Exponential Growth Functions

1. If necessary, identify the growth factor and the value of the function at $f(0)$.
2. Answer the question(s) posed.

Consider the function:

$$f(x) = 4 \cdot 2^x$$

What is the growth factor?

2 → This function doubles

Evaluate the function at $f(0)$

$f(0) = 4 \cdot 2^0 = 4$

Evaluate the function at $f(5)$

$f(5) = 4 \cdot 2^5 = 4 \cdot 32 = 128$

Find the value of the variable when $f(x) = 4096$

$\frac{4 \cdot 2^x}{4} = \frac{4096}{4}$ $2^x = 1024$ $\boxed{x = 10}$

Consider the function:

$$f(x) = \frac{3}{4} \cdot 3^x$$

What is the growth factor?

3 → Function triples

Evaluate the function at $f(0)$

$f(0) = \frac{3}{4} \cdot 3^0 = \boxed{\frac{3}{4}}$

Evaluate the function at $f(2)$

$f(2) = \frac{3}{4} \cdot \frac{9}{1} = \boxed{\frac{27}{4}}$

Find the value of the variable when $f(x) = 182.25$

$f(5) = 182.25$

Toilet paper is about 0.001 inches thick. That seems pretty thin. What happens when we fold it? How thick is a stack of toilet paper after 1 fold? .002 in.

After 2 folds? .004 in.

Write an explicit formula for the sequence that models the thickness of the folded toilet paper after *n* folds.

$f(n) = .001(2^n)$

How many folds will it take for the toilet paper to be a foot thick?

14, $f(14) = .001(2^{14}) = 16.384$ in.

The moon is about 240,000 miles from earth. Compare that to the thickness of the toilet paper folded 50 times.

17,769,885 miles!

A rare coin appreciates at the rate of 5.2% each year. If the initial value of the coin is \$500, after how many years will it take to cross the \$3,000 mark?

After 36 years

Show the formula that will model the value of the coin after *t* years.

$f(t) = 500 \cdot (1.052^t)$

You could go to moon 74x!

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INDEPENDENT PRACTICE

Complete problem set for lesson 5—what is not completed is done for homework.

CLOSURE

Chain email are emails with a message suggesting you will have good luck if you forward the email on to others. Suppose a student started a chain email by sending the message to 3 friends and asking those friends to each send the same email to 3 more friends exactly one day after they receive it.

a. Write an explicit formula for the sequence that models the number of people who will receive the email on the nth day. (let the first day be the day the original email was sent). Assume everyone who receives the email follows the directions.

b. Which day will be the first day that the people receiving the email exceeds 100.

NOTES

Maps to lesson 5, Alg 1 Mod 3