Name:______________________ Math _______, Period _________

Mr. Rogove Date: _________

LEARNING OBJECTIVE: We will understand the concept of exponential decay and solve problems involving exponential decay. (Alg1M3L6)

ACTIVATING PRIOR KNOWLEDGE

We can identify problems involving exponential growth.

$200 \times \_ = 300$

$300 \times \_ \; 450$

$450 \times \_ \; 675$

$f(x) = ab^x$

Ryan deposits $200 in his bank account. Due to a crazy bank error, each day his deposit grows. After 1 week, he has $300 in his account, After 2 weeks, he has $450. After three weeks, he checks his account and he has $675. What is the formula that models this problem? $R(t) = 200(1.5)^t$ How do you know this involves exponential $\boxed{\text{growth?}}$ $b > 1$ How much will he have after four weeks? $R(4) = 200(1.5)^4 = \$1012.50$	Malia ~~is at the~~ nursery picking up seedlings for summer. She buys a magic bean seed when it's 1 foot tall. After 1 month, she measures it and it's 2 feet 6 inches. After 2 months, it's 6 feet 3 inches, and after 3 months, it's 15 feet 7.5 inches. What is the formula that models this problem? $f(x) = 12(2.5)^x$ How do you know this involves exponential growth? $2.5 > 1$

12 in

30

75

187.5

CONCEPT DEVELOPMENT

When you buy a new car, the value drops considerably when the driver takes the car off the lot. Some cars will lose 15% of their value when you drive off the lot, and continue to lose 15% of their value each year. Below, we will complete a chart modeling this situation for a new car costing $15,000.

$V(t) =$

$15{,}000(.85)^{t+1}$

Number of years (*t*) passed since driving car off lot	Car value after *t* years	15% depreciation of current car value	Car value minus 15% depreciation
0	$12,750.00	$1,912.50	$10,837.50
1	10,837.50	1625.63	$9,211.87
2			
3			
4			$5,657.24

$(1 - .15) = .85$

Name:______________________ Math _______, Period _________

Mr. Rogove Date: _________

Exponential Decay is similar to exponential growth except the growth factor is between 0 and 1. Over time, the output of an exponential decay function will diminish .

Exponential decay functions will be in the form: $f(x) = ab^x$ where $0 < b < 1$.
Exponential growth functions will ALSO be in the form: $f(x) = ab^x$ but $b > 1$

Practice: Identify the initial value and state whether the formula is modeling exponential growth or decay, and justify your answer.

$f(t) = 2\left(\frac{2}{5}\right)^t$ $a=2$ Decay $b=\frac{2}{5}$, $\frac{2}{5}<1$	$f(t) = 2\left(\frac{5}{3}\right)^t$ $a=2$ growth $b=\frac{5}{3}$, $\frac{5}{3}>1$
$f(t) = \frac{2}{3}(3)^t$ $a=\frac{2}{3}$ Growth $b=3$ $3>1$	$f(t) = \frac{2}{3}\left(\frac{1}{3}\right)^t$ $a=\frac{2}{3}$ Decay $0<\frac{1}{3}<1$
$f(t) = \frac{3}{2}\left(\frac{2}{3}\right)^t$ $a=\frac{3}{2}$ Decay $b=\frac{2}{3}$, $\frac{2}{3}<1$	$f(t) = .95(1.01)^t$ $a=.95$ growth $b=1.01$ $1.01>1.00$

Name:______________________ Math _______, Period _________

Mr. Rogove Date: _________

GUIDED PRACTICE

Steps for Evaluating Exponential Decay Functions
1. Identify the growth factor and the initial value of the function.
2. Answer the questions posed.

If a person takes a dosage (d) of a particular medication then the formula $f(t) = d\,(0.8)^t$ represents the concentration of medication in the bloodstream t hours later. If Anna takes 200mg of the medication at 6:00AM, how much remains in her bloodstream at 10:00AM.

t = time d = dosage

$f(4) = 200\,(0.8)^4$

$200\,(.4096)$ 81.92 mg.

$f(t)$ = amt of medication in blood

How long does it take for the concentration to drop below 1mg?

$f(t) < 1$ $200 \cdot (0.8)^t < 1$

$\boxed{\text{24 hours}}$

As people approach retirement, they begin to spend their life savings (s). One model for a particular retiree is $f(t) = s\,(0.95)^t$ represents the money a person has after t years of retirement. If Cindy has \$6,000,000 saved up when she retires, how much money will remain after she's been retired for 7 years?

s = life savings at retirement.

t = years of retirement

f(t) = amount of \$ you have after t years of retirement.

$f(7) = 6{,}000{,}000\,(.95)^7 = \$4{,}190{,}023.78$

How many years will pass before she is no longer a millionaire?

35 years.   \$996,500.30

Ryan bought a new computer for \$2,100. The value decreases by 50% each year. Write the function that models this situation.

$$f(x) = 2100\,(.5)^x$$

When will the value drop below \$300?

$f(x) < 300$ 3 years

$$\frac{2100\,(.5)^x}{2100} < \frac{300}{2100}$$

$\boxed{x \leq 3}$

Akshat's dad takes 400mg of ibuprofen. Each hour, the amount of ibuprofen in a person's system decreases by 29%. Write the function that models this situation.

$\cancel{f(t) = d\,(.29)^t}$ (KAVI)

$f(t) = 400(.71)^t$

How much ibuprofen is left in his system after 3 hours?

$f(3) = 400\,(.71)^3$

143.16 mg.

Name:______________________ Math _______, Period _________

Mr. Rogove Date: _________

A rubber ball is dropped from a height of 30 feet. On the first bounce, it bounces up to 22.5 feet. Each successive bounce goes 75% as high as the bounce before it. Write a function that models this situation. After how many bounces will the ball bounce up under 1 foot?	An object attached to a bungee cord is released from a height of 60 feet. After the first bounce, the object goes back up to a height of 54 feet. After the second bounce, it reaches a height of 48.6 feet. After the third bounce, it reaches a height of 43.74 feet. What is the growth factor of the function? Write the function: How high will the object go back up after 6 bounces?

17

CLOSURE

A huge ping pong tournament is held in Beijing with 65,536 participants at the start of the tournament. Each round of the tournament eliminates half of the participants.

a. If $p(r)$ represents the number of participants after r rounds of play, write a formula to model number of participants remaining.

$$p(r) = 65536\left(\frac{1}{2}\right)^r$$

b. Use the model to determine how many participants remain after 10 round of play.

$$p(10) = 65536\left(\frac{1}{2}\right)^{10}$$

$$= 65536\left(\frac{1}{1024}\right) = 64$$

c. How many rounds will it take to crown a champion?

$p(r) = 1$ $\qquad 65536\left(\frac{1}{2}\right)^r = 1$

$\boxed{\text{16 rounds}}$

Name:______________________ Math _______, Period _________

Mr. Rogove Date: _________

INDEPENDENT PRACTICE

Complete problem set from Lesson 7.

NOTES

Maps to lesson 7, Alg 1 Mod 3