~~ Unit 5, Page 8 ~~

Bacteria Growth

If you don't brush your teeth regularly, it won't take long for large colonies of bacteria to grow in your mouth. Suppose that a single bacterium lands on one of your teeth and starts reproducing by a factor of four every hour. (multiplies by four every hour)

b = the number of bacteria
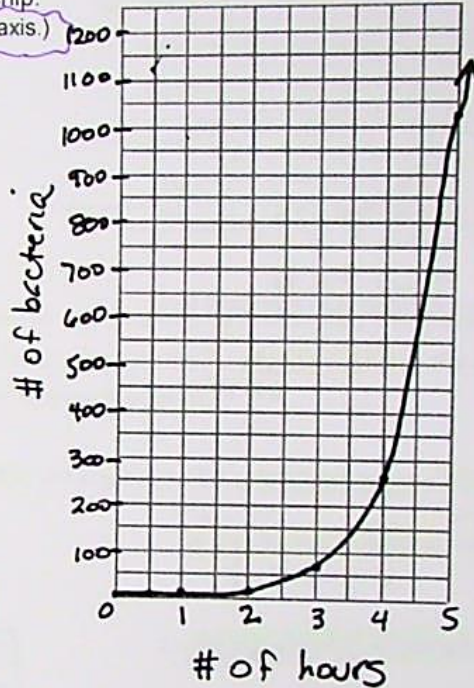n = the number of hours

Equation: $b = 4^n$

1. Complete the table and graph for the relationship.
   (Use an interval of 1/2 on the x axis and 50 on the y axis.)

Bacteria Growth

# of (n) hours	# of bacteria 4^n	(b)
0	4^0	1
1	4^1	4
2	4^2	16
3	4^3	64
4	4^4	256
5	4^5	1024
6	4^6	4096
7	4^7	16,384
8	4^8	65,536
9	4^9	262,144
10	4^{10}	1,048,576
(x)		(y)

×4 (between each row)

Won't fit on this graph

# of bacteria (y-axis: 100 to 1200 by 100)
# of hours (x-axis: 0 to 5)

2. Use the equation to find how many bacteria will be in the new colony after 12 hours?

Show your work. $n=12$ $b = 4^n = 4^{12} = 16,777,216$

3. How many bacteria will be in the new colony after 13 hours? $n=13$ 67,108,864
   Explain how you can use your answer from #2 instead of using your equation.

Multiply the previous number of bacteria (12hrs) by 4

4. After how many hours will there be at least 1 million bacteria in the colony? ≈ 10 hours
   (Use guess and check to find your answer.)   ← table answer

$b = 4^n$, so when will $4^n \approx 1,000,000$?

$4^8 = 65,536$
$4^9 = 262,144$
between
$4^{10} = 1,048,576$

Guess & Check
$4^{9.9} = 912,838$
$4^{9.966} = 1,000,299$
$4^{9.9656} = 999,744$
$4^{9.9657} = 999,883$
$4^{9.9658} = 1,000,021$ ★ closest!

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Growing, Growing, Growing: Investigation 2

Objectives: I can model an exponential relationship with a function table and graph.

1. Ghost Lake is a popular site for fisherman, campers, and boaters. In recent years, a certain water plant has been growing on the lake at an alarming rate. At present, 1,000 square feet are covered by the plant. The Dept. of Natural Resources estimates that the area is doubling every month.

A) An equation that represents the growth pattern of the plant on Ghost Lake is
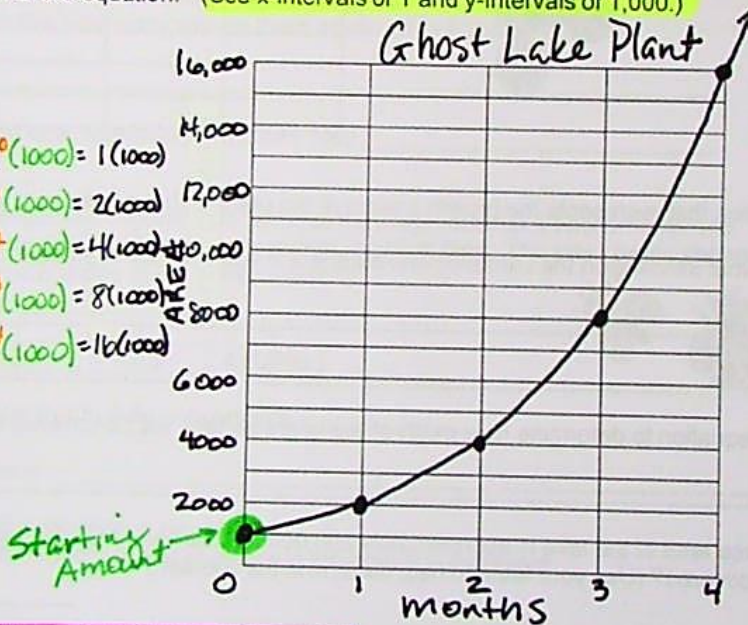
$$a = 2^m * 1000$$

Explain what information the variables and numbers in the equation represent.

Numbers: _1000 – Starting area_   _2 – doubling each month_

Variables: _a – total area covered_   _m – number of months_

B) Make a table and a graph of the equation. (Use x-intervals of 1 and y-intervals of 1,000.)

(m) # of months	(a) total area	
0	1000	$2^0(1000) = 1(1000)$
1	2000	$2^1(1000) = 2(1000)$
2	4000	$2^2(1000) = 4(1000)$
3	8000	$2^3(1000) = 8(1000)$
4	16,000	$2^4(1000) = 16(1000)$

Ghost Lake Plant

Starting Amount →

months

C) The surface area of Ghost Lake is 25,000,000 square feet. How much of the lake's surface will be covered with the water plant by the end of the year? (Show your work.)

1 year = 12 months, so m = 12. $a = 2^{12}(1000) = 4096(1000) = 4,096,000 \text{ ft}^2$

D) In how many months will the plant completely cover the surface of the lake? _≈ 14.61 months_

$2^{14} = 16,384$

$2^{15} = 32,768$

} between

$2^{14.5} ≈ 23,170.5$

$2^{14.6} ≈ 24,833.5$

$\boxed{*2^{14.61} ≈ 25,006}$

$2^{14.61}(1000)$

$25,006(1000)$

$25,006,000 \text{ ft}^2$