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 a single bacterium lands on your tooth and starts multiplying by a factor of 4 every hour.

1. Complete the table below to model the bacteria growth over several hours.

Hours	0	1	2	3	4	5
Number of Bacteria	1	4	16			

2. Graph the data in the table below. Be sure to label your graph and axes.

3. Is this graph linear or exponential?

4. Write the *NOW-NEXT* form to show the pattern of growth.
   NEXT = _____ * *NOW*

5. What is the common ratio *r*?

6. Use the common ratio *r* to write a rule to showing how to calculate the number of bacteria *y* after *x* hours.

y = the number of bacteria produced in that hour
x = the number of hours
r = the common ratio or rate of change
a_1 = the initial term of the sequence or the starting point

Use the above information to write the explicit form of the exponential function $y = a_1 \cdot r^x$. Notice how similar it is to the NOW-NEXT recursive form.

$$NEXT = NOW \cdot r$$
$$\downarrow \quad \downarrow \quad \downarrow$$
$$y = a_1 \cdot r^x$$
$$\downarrow \quad \downarrow \quad \downarrow$$
$$y = 1 \cdot 4^x$$

The *NEXT* and *y* components both represent the number of bacteria generated during the hour. The *NOW* and a_1 both represent the starting point and *r* is the rate of change or the common ratio, which is 4 in this example.

7. Use the rule in step 6 to determine the number of bacteria in the colony after 7 hours. Verify the number of bacteria by either continuing the table in step 1 or continuing the graph in step 2.

8. After how many hours will there be at least 1,000,000 bacteria in the colony?

9. Suppose that instead of 1 bacterium, 50 bacteria land in your mouth. Write an explicit equation which describes the number of bacteria *y* in this colony after *x* hours.

10. What is different in this equation from the equation in step 6?

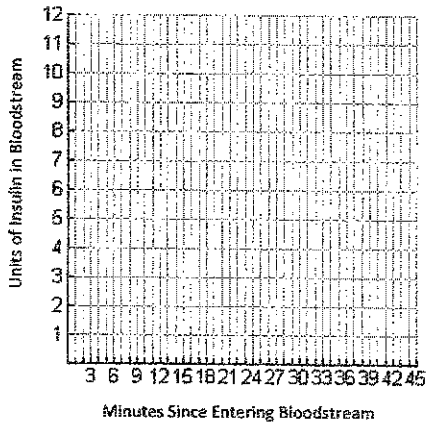
11. Using your new equation, determine the number of bacteria in the colony after 8 hours and after 10 hours.

12. Which method for determining the number of bacteria is easier for you? Using a table, graph, NOW-NEXT, or equation? Explain.

1. Diabe

Diabetes, a disorder in which the body cannot metabolize glucose properly, affects people of all ages. In some cases, the diabetic's body is unable to produce insulin (needed to produce glucose). These diabetics must inject themselves with medication containing insulin. Once inside the bloodstream, the insulin breaks down rather quickly. The following equation shows a typical pattern of insulin decrease.

$$y = 10(0.95)^x$$



1. Complete the table below and plot the points.

x	y
0	
6	
9	
15	
24	
33	
45	

2. What is the meaning of the number 10 in the equation? What is the meaning of the number 0.95 in the equation?

3. Medical scientists are often interested in the time it takes for a drug to be reduced to one half of the original dose. They call this time the half-life of the drug. What appears to be the half-life of insulin in this case?

2. Eyes on the Prize

In a particular golf tournament, the money a player wins depends on his finishing place in the standings. The first place winner wins $\frac{1}{2}$ of the $1,048,576 in total prize money. The second place finisher wins $\frac{1}{2}$ of what is left; then the third place finisher wins $\frac{1}{2}$ of what is left, and so on.

1. What fraction of the total prize money is won
   a. By the second place finisher?

   b. By the third place finisher?

   c. By the fourth place finisher?

2. Make a table showing the actual prize money in dollars won by each other the first five place finishers.

Place	1	2	3	4	5
Prize ($)					

3. Write a rule showing how to calculate the fraction of the total prize money won by the player finishing in any place.