**Activity 5.3.1 Can We Eat the Chicken?**

Suppose you go over to a friend’s house and they have raw chicken on their counter. When you inquire why the chicken is on the counter looking warm, your friend’s mom is upset for she says she forgot to refrigerate the chicken and must now discard it. You ask why and your friend’s mom, Mrs. Lee responds that poultry is a high risk food for food poisoning because it is a moist food and it was a warm day. You went on the web and one source stated a single bacterium could multiply to 2,000,000 in just 7 hours and a second source stated under ideal conditions you could have 70,000,000 in just 12 hours. You know from science and math class that it is reasonable to assume exponential growth for bacteria at least in the short term.

1. Verify that for the first source the bacteria double about every 20 minutes .
2. Complete the table of values for the bacteria that double every half hour to verify that in 12 hours there will be about 70 million bacteria.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| t | bacteria | t | bacteria | t | bacteria |
| 0 |  |  |  |  |  |
| 30 min |  |  |  |  |  |
| 1 |  |  |  |  |  |
| 1 hr |  |  |  |  |  |
| 1 hr 30 min |  |  |  |  |  |
| 2 hr |  |  |  |  |  |
| 2 hr 30 min |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

1. Make a graph on the graph paper provided by your teacher for the number of cells vs hours for the second source. On the horizontal axis place the hours through 12 and on the vertical scale from up to 17,000,000 cells using at least two block for each 1,000,000.

As you make your graph you should have a problem. What is it? Hint: Each axis has a linear scale. Consider the points (0,1), (.5,2), (1,4), (1.5, 8), (2, 16) at the beginning of your graph and (12, 70,000,000) .

The problem with using a uniform scale is it does not depict numbers over several magnitudes well. A small scale will show every value well BUT the grid needs to be too big to show the very large values and a large scale interval makes all the small values fall on top of each other near zero.

1. To correct the problem we have with our first graph we can use a different scale. A logarithmic scale is one in which the units on an axis are the exponents or logarithms of a base number and it is typically used when the increase or decrease in value on that axis is exponential. Let us change the vertical scale. Redraw the chart this time on a new piece of graph paper with a vertical axis that has log (# of cells). Your horizontal scale will still go from 1 to 12 but your vertical scale will now go from 0 to 8 since it is log (number of bacteria). If you look at just columns 1 and 3, why do you not have to look up the logarithm of every number in column 2 ?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ What do you notice about your new graph ? How does it differ from the first graph?

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| T in hr. | bacteria | log(bacteria) | T in hr. | bacteria | log(bacteria) | T in hr. | bacteria | log(bacteria) |
| 0 | 1 | 0 | 5 | 2056 |  | 10 | 2,105,344 |  |
| .5 | 2 |  | 5.5 | 4112 |  | 10.5 | 4,210,688 |  |
| 1 | 4 |  | 6 | 8224 |  | 11 | 8,421,376 |  |
| 1.5 | 8 |  | 6.5 | 16448 | 4.2 | 11.5 | 16,842,752 |  |
| 2 | 16 | 1.2 | 7 | 32896 |  | 12 | 33,685,504 |  |
| 2.5 | 32 |  | 7.5 | 65792 |  | 12.5 | 67,371,008 |  |
| 3 | 64 |  | 8 | 131,584 |  |  |  |  |
| 3.5 | 128 |  | 8.5 | 263,168 |  |  |  |  |
| 4 | 512 | 2.7 | 9 | 526,336 |  |  |  |  |
| 4.5 | 1024 | 3 | 9.5 |  |  |  |  |  |

1. You may have modeled the problem in number 1 with the function f(t) = 1 (23t), t in hours. If you did not, now evaluate the function for a few values to convince yourself the model is a good one. Graph this function on your grapher and then also graph g(x) = 8x.
2. Explain why you are getting the graphs you are.
3. How do the graphs compare to the graph of k(x) = 2x.
4. You may have modeled the problem in number 2 with the function f(t) = 1 (22t), t in hours. Using your grapher, graph f(t) = 1 (22t), and k(x) = 2t. Earlier in this course you considered the transformation r(x) = f(*a*x) when f was a quadratic or polynomial or absolute value function. What is the role of the parameter *a*?In the next unit on trigonometric functions, the role of *a* will become even more clear.