Division of Water Management
City of Evansville
Evansville, IN 47708
November 29, 2010

Math 105 Students
University of Evansville
Evansville, IN 47722

Dear Math students,

Thank you so much for your assistance finding the life-time safe lead consumption levels. My boss was pleased with the explanation I was able to provide her supporting my conclusions. This fall, we at the Division of Water Management were confronted with an algae problem in the Ohio River (the source for our local drinking water). In order to remove the algae, we resorted to chemical treatment of the water. This technique had unfortunate side-effects. You may have noticed the unpleasant odor and taste of the tap water in our community this fall.

We are in the process of researching algae removal techniques that will have a lesser impact on the taste and smell of the water. One idea that is looking promising is the use of natural occurring bacteria that consume algae. I could really use your helping developing a mathematical model that will predict the number of bacteria present at a given time. The tricky part is that the bacteria population is influenced by the temperature of the water and the water temperature at our treatment facility depends on the time of day. Tests in the lab have determined that the number bacteria present, N, in thousands per gallon of water is related to the Celsius temperature, C, by the function

$$N(C) = -0.05C^2 + 2.85C + 10, \quad \text{for} \quad 10 \leq C \leq 40.$$

The temperature (for the summer months) depends upon the time of day, t in hours after midnight, by the function

$$C(t) = -0.0093t^3 + 0.33t^2 - 2.49t + 24, \quad \text{for} \quad 0 \leq t < 24.$$

How can I combine these two functions to express the number of bacteria in terms of time? For example, what is the population at 6 AM? at noon? at 6 PM? at midnight? I would also like to know what time of day the bacteria reaches is minimum and maximum population levels. Since the semester is winding down and many of you will be busy with finals and holiday travel, I'd greatly appreciate it if you could respond by Monday, December 6.

Sincerely,

Needepe N. Sludge