Total Score: ___/30

Name _____
Section Number _____

Homework 3
Due April 24th at the beginning of lecture

Instructions:

You are welcome to discuss concepts with your classmates but must compose your own answers. If you are unsure of the honor code for this course, please ask or look at the course website. http://www.its.caltech.edu/~bi1/Bi1__Micro-_to_Macro-Biology/Policies.html
The goal of this assignment is to help you understand a dense research paper. Many of the questions do not have a single correct answer. You will be given full credit as long as your answer is reasonable.
The answers must be legible and should not extend past the allotted space. Keep in mind that a few well-written sentences can give a higher score than a whole page of text.
Remember to write your full name and section number on each page.

Part A:
Microbes profoundly impact their physical, chemical, and biological environments. This week's homework paper is an example of the interactions between three species: the parasite *Toxoplasma gondii,* its rat host, and cats.
Read the paper carefully and answer the following questions.
Berdoy, M, et al. (2000) "Fatal attraction in rats infected with *Toxoplasma gondii." Proc. R. Soc. Lond.* B. 267: 1591-1594

1. What is the hypothesis being tested? (1-2 sentences) (3 points)

2. Describe the results of the experiment in your own words. (2-3 sentences) (4 points)

3. What is the significance of the experiment? (1-2 sentences) (3 points)

4. Up to a third of farm animals may be infected with *Toxoplasma gondii*.[1] Considering these organisms are dead-end hosts for the parasite, why do you think this might be the case? (There is no 'correct' answer for this – just give a reasonable hypothesis).[2] (1-2 sentences) (3 points)

[1] http://www.aaem.pl/pdf/17125.htm
[2] If you're interested in reading about the effects that some scientists think *Toxoplasma gondii* has on humans, take a look at the article "How Your Cat is Making You Crazy" from *The Atlantic*'s March 2012 issue!

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Part B:
From the lecture reading, you know that an *Escherichia coli* bacterium can vary the tumbling frequency based on the attractant and repellant concentration gradients. A sensed change in the concentration in one of these affects the rotation of the bacterium's flagella motors via the bacterial chemotaxis protein circuit.

Read the paper carefully and answer the following questions.
Alon, U (2007) "Robustness of protein circuits: The example of bacterial chemotaxis." In: *An Introduction to Systems Biology*, Chapman & Hall/CRC. 137-159.

1. Briefly describe what feedback loops and exact adaptation are, and how they relate to the chemotaxis circuit discussed. (4-5 sentences) (5 points)

2. What is the major difference between the two toy models of exact adaptation? (1-2 sentences) (2 points)

3. The diagram in Figure 7.6 describes the signal transduction network. Using this figure and the text, what would you expect to happen to the tumbling frequency and the concentrations of the chemotaxis proteins <u>initially</u> if the bacterium is an environment (10 points)

	tumbling frequency	CheA	CheA-P	CheY	CheY-P	CheZ	CheR	CheB
a. at steady-state								
b. where the concentration of attractant is increasing								
c. where the concentration of repellent is increasing								

d. How does this differ in the long run?