BE/APh 161: Physical Biology of the Cell, Winter 2019
Homework #10
Due 2:30 PM, March 20, 2019.

Please submit this homework as a PDF (no Word documents or text emails). If your solution involves code, please also send that, as a Jupyter notebook if appropriate.

This is a special homework in that the questions are very open ended. I find that thinking about how you would teach a class really helps codify the central principles and help you to see the forest through the trees. While different from the other homeworks this term, this homework will certainly be very valuable to both you and me.

Problem 10.1 (Problem for this class, 70 points)**.**
Write a substantial problem with a complete solution that you think would be enlightening to assign to next year's students. Do not write short problems (like problems 1.4 or 7.1), but a more complete problem (like problems 5.2 or 6.2). The topic of the problem may be inspired by anything covered in lecture or in any of the readings (including chapters of books on the references page of the website that we did not explicitly go over this term). Explain why you think the problem you came up with will be enlightening for the students who do it.

Problem 10.2 (Your turn, 30 points)**.**
This problem statement is modified from a problem Rob Phillips assigned in this course when he taught it. He basically asked exactly what I would like to ask you.

a) Some have argued that only by quantitation will we really be able to come to terms with the complexity of living organisms. The quantitative approach advocated in this class is meant to give you a feel for how such quantitative dissection of biological problems might work. Others have argued that the approach we have taken is a mopping up operation which amounts to dotting the i's and crossing the t's already worked out by biologists. Write one paragraph defending each of these two points of view. One document you might find interesting to look at is Bio2010 from the National Academies of Sciences.

b) For this part of this problem, I would like you to develop a syllabus for a course (like this one) to train quantitative cell biologists. Make a syllabus for the course. Start with one brief paragraph on the mission of your course. Issues that you might want to consider include:

    i) Is it important to do hard calculations, or is that the province of other physics courses and our goal here is to illustrate the style of thinking?

ii) Are street-fighting estimates a part of the way you will present the material (if yes, why; if no, why not?).

iii) How will you organize the material? Note that in typical biology books DNA and actin would never be in the same chapter, but for *PBoC2* they are both in Chapter 10 as examples of "beam theory."

iv) The course is only 10 weeks long. What will you cover, what will you skip, and why? How will you balance the desire to cover more topics with the resulting superficiality?

This is not a look up something in Wikipedia question, nor is it a request to regurgitate what I did in the course. There is substantial overlap between what I do in the course and what Rob does when he teaches it, but there are clear differences as well. In many senses, physical biology of the cell is a new and unfinished topic. I am asking you how to organize this topic and to present it to advanced Caltech undergrads and to grad students at the beginning of their grad careers. What are the important points?

c) Finally, I would like a little feedback on this edition of the course. What subject did you find most interesting from the course? What subject did you find least interesting? Did you like working out estimates and other problems in class? Would you like more or less of that, or is it about right? Please answer with several sentences only, but justify your outlook and tastes (to the extent possible).