SYLLABUS

(A) Grading

Grades will be determined from a combination of two requirements, both contributing 50% to the final grade:

a: Students will hand in (approximately) bi-weekly, graded problem sheets.

b: At the end of the term, each student will give a seminar about a course-related scientific subject. A list of topics from which the students can choose will be provided in the first half of the course.

(B) Textbook

The course will be based on the text Physical Biology of the Cell (2nd edition) by Rob Phillips et al. (Garland Science, New York, NY, 2013, ISBN 978-0-8153-4450-6). It is strongly recommended that students own a copy of this text.

(C) Prerequisites: 33-765 (Statistical Mechanics) or permission of instructor.

(D) Course topics

The course follows the structure of the textbook. It is organized as follows (but we will not be able to cover all topics equally deeply).

The first part of the book introduces basic biological facts and strategies in Biological Physics. This introductory part will not be extensively covered in the course. It is expected that students familiarize themselves with these facts in self-study.

Part I: The Facts of Life

Chapter 1—Why: Biology By the Numbers
Chapter 2—What and Where: Construction Plans for Cells and Organisms
Chapter 3—When: Stopwatches at Many Scales
Chapter 4—Who: "Bless the Little Beasties"

The subsequent parts will be treated in more detail, concentrating in selected topics with an emphasis on current research.

Part II: Equilibrium and Statistical Mechanics; Membrane Biophysics

Part III: Biological Dynamics and Crowding

Part IV: Biological Pattern Formation
(E) Student Seminars

Each student is required to cover a topic of his/her choice out of the literature from a list of ~ 20 topics. Student suggestions of papers to review are welcome.

Toward the end of the course (after Easter), you will present a half-hour seminar to the class in which you report the essence of a (historic or modern) biophysics experiment or experimental/theoretical technique. The material to be covered may consist of a review article or a series shorter, original research papers. The class will discuss and follow up on your presentation with questions. There will be two of these seminars presented per lecture day.

(F) Achievement Goals

In this course, students will gain a deep appreciation of the fact that very basic physical and chemical principles underly many central life processes. Life is not only compatible with the laws of physics and chemistry, rather, it exploits them in ingenious ways. After taking the course, students should be able to name examples of such situations for which they can provide a coherent line of reasoning that outlines these connections. They will be able to explain key experiments by which these connections either have been found or are nowadays routinely established, and outline simple back-of-the-envelope estimates by which one can convince oneself of either the validity or inapplicability of certain popular models and ideas. They should also have become sufficiently familiar with the key terminology frequently encountered in biology, such that they can start to further educate themselves by consulting biological and biophysical literature.