

## Physics 150: Special Topics in Physics

# Introduction to Biological Physics

### Summary

This course will address basic physical questions posed by biological phenomena at the molecular and cellular level. After an introduction to the physical environs and structures of sub-cellular biology, the course will be organized roughly in thirds.

The first third of the class will focus on developing intuition for random walks, diffusion and the features of diffusive motion that underlie all biomolecular dynamics. The second third of the class will build on the basic concepts of thermal physics – temperature, energy, and entropy (that you might be seeing simultaneously in 119A) – to understand chemical forces and reactions that underlie and constrain biomolecular machinery. The final third applies these concepts to biomolecular state changes and specific biomolecular machinations.

This upper division Physics elective course can be taken for either 3 or 4 units. To earn four units, students must complete one extra homework problem per week, and one extra (take home) problem for each exam. Students who sign up for four credits and then don't perform well on the additional problems, will have the option of being graded for only three credits on the basis of the other problems. Undergraduates may not enroll for less than 3 units.

### Textbooks

Required: *Biological Physics: Energy, Information, Life*, Nelson, chapters 1-10.

Others of interest: *What is Life*, E. Schrödinger; *Random Walks in Biology*, H. Berg; *The Machinery of Life*, D. Goodsell; *Molecular Biology of the Cell*, B. Alberts, et al.

**Lecture:** North Hall 1111, Tue-Thu 3:30-4:50

### Instructor

D.K. Fygenon Office: 2419 Broida Tel: x2449 E-mail: [deborah@physics.ucsb.edu](mailto:deborah@physics.ucsb.edu)  
Office Hours: Mon, Fri 2:00-3:30, or by appointment

### Teaching Assistant

Kim Weirich Office: 2415 Broida Tel: x5603 E-mail: [kweirich@physics.ucsb.edu](mailto:kweirich@physics.ucsb.edu)  
Office Hours: Mon 4:00-5:00 and Thur 12:30-1:00 in PSR (Broida 1019)

**Course website:** <http://www.physics.ucsb.edu/~phys150>

### Evaluation

We will have weekly problem sets (due on Tuesdays), one midterm, and a final exam. The midterm will cover the material from the first six chapters, while the final will cover material from the last six chapters (note: there are only 10 chapters, so there will be some overlap), with an emphasis on the final four. Grading will be weighted as follows: 40% problem sets; 20% midterm; 40% final exam.

**Detailed Lecture plan on the next page....**

## Lecture plan

<i>Date</i>	<i>#</i>	<i>Topics</i>	<i>DUE</i>	<i>Reading</i>
9/25	1.	Class overview, Key ideas from Physics and Chemistry		CH. 1
9/30	2.	Elements of Biology	HW1	CH. 2
10/2	3.	Probability distributions in Physics and Genetics		CH. 3
10/7	4.	Brownian motion and other Random Walks	HW2	4.1-4.3
10/9	5.	Diffusion		4.4-4.6
10/14	6.	Biological Applications of Diffusion	HW3	4.6-5.1
10/16	7.	Viscosity and Life at Low Reynold's Number		5.2-5.3
10/21	8.	Review of Homework 3	HW4	
10/23	9.	Review of Homework 4		
10/28	10.	Review of Homework 5	HW5	
10/30	11.	MIDTERM		CH. 1-5
11/4	12.	Entropy, Temperature and the Second Law		6.1-6.3
11/6	13.	MIDTERM discussion		
11/13	14.	Open Systems	HW6	6.3-6.5
11/18	15.	Microscopic Systems & Entropy at Work		6.6 – 7.2
11/20	16.	Charges and the Special Properties of Water	HW7	7.3 – 7.5
11/25	17.	Chemical Forces and Self-Assembly		CH. 8
12/2	18.	Cooperativity and Allostery	HW8	CH.9
12/4	19.	Review		
12/9			HW9	
12/12		Final Exam (4:00 – 7:00)		CH. 4-9