

## Introduction to Biological Physics

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### Contact Information

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### Course Information

The course meets in room 110 of Smith Hall on Mondays, Wednesdays, and Fridays from 11:00 – 11:50. My office hours will be 10:00 - 11:00 on Tues. and Thurs. I am available other times as well, although it may be necessary to make an appointment. The final is on **Monday, Dec. 11: 10:15–12:30**.

### Texts

There is one required text and one recommended text that should be available at the bookstore.

- Required:** Philip Nelson, *Biological Physics: Energy, Entropy, and Life*.
- Recommended:** Rodney Cotterill, *Biophysics: An Introduction*.

These two texts overlap considerably, but the emphasis of the material is quite different. Cotterill is a very good updated version of a typical Biophysics text. Here, the focus is on physical descriptions of biomolecules and common biophysical experimental techniques. Nelson focuses on presenting fundamental principles that underlie physical description of biological molecules and processes. This text introduces rather advanced concepts at a very elementary level. The physical ideas discussed are very general and relevant to nearly all soft-matter systems (including biology).

The first part of the course will follow the organization of Nelson. Cotterill will be more useful in later topics where we discuss descriptions of specific types of biomolecules and biophysical methods.

There will also be some supplemental readings made available in class.

### Homework

You will be expected to be prepared for each class. Keep up with assigned reading from Nelson and supplemental material assigned in class.

Homework will be assigned approximately every week and will be due in class one week later. No late homework will be accepted unless arranged with me before the day it is due.

## Exams

There will be three exams based on assigned reading, lectures, and homework. The first two will be scheduled during the semester, and the final exam is cumulative.

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Exam 1	approximately 6 <sup>th</sup> week (Oct. 2–7)
Exam 2	approximately 11 <sup>th</sup> week (Nov. 6–10)
Final Exam	Mon. Dec. 11, 10:15–12:30

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## Presentations

A short presentation of a project of your choosing will be given to the class near the end of the semester. The assignment is to find a topic that you find interesting and tell the class what you learned about it. A good start is to start looking in Scientific American and Physics today at the library. Once you find something that interests you, come see me and I can make suggestions to help focus the topic and other references.

## Grading

Grades will be based on scores from assignments with the following weights:

Exams	60 % (20% each)
Homework	20 %
Project	10 %
Participation	10 %

There are no “extra-credit” assignments to improve your grade.

*University policy 3342-3-18 requires that students with disabilities be provided reasonable accommodations to ensure their equal access to course content. If you have a documented disability and require accommodations, please contact the instructor at the beginning of the semester to make arrangements for necessary classroom adjustments. Please note, you must first verify your eligibility for these through Student Disability Services (contact 330-672-3391 or visit [www.kent.edu/sds](http://www.kent.edu/sds) for more information on registration procedures).*

## Tentative Schedule of Topics

Subject	Number of Lectures	Topics	Reading	Supplemental Reading
Introduction	3	How life Generates Order Dimensional Analysis Molecules and Ideal Gas	Nelson 1: 3–29	
Components of the Cell	3	Cell Physiology Molecules in the Cell Molecular Devices	Nelson 2: 40–62	
Statistical Description of Molecules	3	Probability Temperature Boltzmann distribution Genetic Information	Nelson 3: 69–89	
Stochastic motion and diffusion	5	Brownian Motion Random Walks Diffusion Equation Biological Applications	Nelson 4: 108–132	Cotterill 5: 69 – 74
<b>Exam 1</b>				
Low Reynolds-Number World	4	Friction in Fluids Low Reynolds Number Motion Biological Applications	Nelson 5: 158–182	Cotterill 5: 76–80
Entropy, Temperature and Free Energy	5	Entropy and Disorder Second law Boltzmann's formula Chemical reaction kinetics	Nelson 6: 195–223	Cotterill 3: 43–58
Entropic Forces	5	Microscopic description osmotic pressure osmotic flow counter ions and charge screening	Nelson 7: 245–280	
Selected Methods in Biophysics	5	X-ray crystallography Nuclear Magnetic Resonance Scanning Tunneling Microscope Atomic Force Microscopy Molecular Dynamics	Cotterill 6: 83–112	

## Exam 2

### Tentative Schedule of Topics

Subject	Number of Lectures	Topics	Reading	Supplemental Reading
Biopolymers	5	Nucleic Acids DNA Conformations RNA Conformations Protein Conformations Polymer Statistics	Cotterill 7: 124–158	Nelson 9: 341–383
Biological Membranes	5	Lipid Bilayers Chemical Potential Self-Assembly of Amphiphiles	Nelson 8: 294–298 8: 322–332	Cotterill 8: 161–186

### Final Exam