Physical Biochemistry
BIOL 4001

Fall Semester 2013

Term: August 26 – December 13
Class times: TTh 9:00am – 10:20am
Location: 201 Williams Hall

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Office hours: Tue 3pm – 5pm (Office 1)
Thu 3pm – 5pm (Office 2)
or by appointment


Additional recommended sources:

Course overview: The course objective is to introduce and develop physical concepts for the biochemist by using ideas from physical chemistry (rather than pure mathematical formulations) to exemplify biochemically relevant phenomena. The desired outcome is for students to gain a basic understanding of how solution dynamics, thermodynamics, kinetics, and spectroscopy can be applied to biochemical problems. In addition, the course aims to provide a solid background in biophysical chemistry for those students who wish to pursue further study in this field of science. Progress will be assessed through homework assignments, in-class discussions, quizzes and exams.

Homework: Problems will be assigned from the textbook and other sources. These will be collected and graded. You may discuss homework assignments with your classmates or use online resources for help, but you must submit your own work. Homework is due in no later than 5pm on the due date.
Grading policy: Homework 20%
Quizzes 20%
Midterm 25%
Final 35%

Tentative schedule:

**Biochemical Thermodynamics**
- **Week 1:** The First Law
- **Week 2:** The Second Law
- **Week 3:** Phase Equilibria
  - HW1
- **Week 4:** Chemical Equilibrium
  - Quiz1
- **Week 5:** Ion and Electron Transport

**The Kinetics of Life Processes**
- **Week 6:** The Rates of Reactions
  - HW2
- **Week 7:** Accounting for the Rate Laws
  - Quiz2
- **Week 8:** Complex Biochemical Processes

**Biomolecular structure**
- **Week 9:** The Dynamics of Macroscopic Systems
  - HW3
- **Week 10:** The Chemical Bond
  - Quiz3
- **Week 11:** Macromolecules and Self-Assembly
- **Week 12:** Statistical Aspects of Structure and Change

**Biochemical Spectroscopy**
- **Week 13:** Optical Spectroscopy and Photobiology
- **Week 14:** Magnetic Resonance

**Students with disabilities:** If any student feels that he/she has a disability and needs special accommodations of any nature whatsoever, the instructor will work with you to provide reasonable accommodations to ensure that you have a fair opportunity to perform in this class. Please advise the instructor of such disability and the desired accommodations at some point before, during or immediately after the first scheduled class period.
FAQ

Why should biochemistry students study pchem?

We may define biochemistry as the field of science comprising the knowledge of the properties of chemical reactions and physical processes also involving molecules of biological interest. Under this definition we can easily understand the importance of knowing basic physical principles, which ultimately explain the driving forces defining both the feasibility and rates of chemical and physical processes. Chemical reactions and physical interactions are responsible for the function, malfunction, or death of individual cells or multi-cellular organisms. We can see, then, that as our knowledge of the physical principles governing biological processes improves so does our ability to understand biology, physiology and even medicine.

Why do schools require a course in pchem for students pursuing a degree in biochemistry?

An elementary class of pchem is a key element of a plan of study designed for a degree in biochemistry and/or molecular biology. Basic elements of physical chemistry are needed to understand protein synthesis and folding, protein stability, protein-protein interaction, protein-ligand interactions, biogenesis of membranes, lipid-lipid and lipid-protein interactions, enzyme kinetics, RNA or DNA synthesis, protein-nucleic acid interactions, control of metabolic pathways, membrane potential and excitability, etc. Pchem gives you the opportunity to understand why something happens. Without it you may know a few facts, you may have information. However, you will not have the knowledge to predict a similar occurrence under similar circumstances.

How can pchem benefit my career?

• Medicine: An elementary class of physical chemistry will greatly benefit students planning on attending medical school. The greater the depth of the physical chemical perspective of a medical student the easier will be the understanding and memorization of important medical topics. The information and rationale provided by a pchem course contribute to the global education of medical doctors increasing their knowledge and improving the common sense that cannot be achieved in a formation based only on information. For example thermodynamics is a key element in the understanding, research and practice of sports physiology; pchem will enhance the ability to understand the complex processes of ion and water transport in kidney, or the delicate acid-base equilibrium in blood that must be carefully monitored and balanced to allow the survival of numerous intensive care patients; similarly, the students will be better prepared to understand the phenomena of gas and water exchange that takes place in lungs and the role of the composition of the breathing atmosphere in the acid-base equilibrium and oxygenation of blood.
- **Research in biosciences:** Successful experimental research in biosciences, such as that required for students pursuing a Ph.D. in biochemistry, requires the consideration of the possible interactions and effects among the components and conditions of a reaction mixture: solvent, salts, pH, protein, lipids, RNA, DNA, substrates, temperature, etc.

- **Biotechnology:** Physics and chemistry are also essential disciplines for the advancement of biotechnology. Students pursuing a career in biotechnology will be highly benefited by a strong physical chemical background. Food processing, or food technology, is based on the physical chemical manipulation of mixtures of proteins and lipids, among other components, to achieve products of different physical properties.

- **Pharmaceutical sciences:** A successful career in will be more likely for graduates with strong backgrounds in physical chemistry. Most experimental and theoretical approaches used in the pharmaceutical industry to design, discover and test potentially useful drugs require physical chemical methods.