

BIOCHEMISTRY 5721: PHYSICAL BIOCHEMISTRY I, AU21

MoWeFr 9:10AM – 10:05AM (14 weeks), Scott Lab E001

Instructor: Mark P. Foster; 734 Riffe

Office hours: Mon 1:00 – 2:00 pm, or by appointment; <https://go.osu.edu/mpfoster-office-hours>

TAs: Joseph Hazel, William Moeller, Robert Shinkle, Cameron Storch

Recitations: M, T, W, F, 1:50-2:45pm, Biological Sciences 668

LEARNING OBJECTIVES

Part I: Thermodynamics and kinetics. Apply physical principles to the study of the microscopic and macroscopic properties of biological molecules, their interactions, reactions and solutions.

COURSE STRUCTURE

Interactive lectures to introduce key concepts; weekly homework assignments; weekly online quizzes; in-person evening exams; in-person recitations.

GRADING

Homework assignments: 25%. Quizzes: 25%. Exams (2 midterms, 1 final): 50%. Letter grades will be assigned following an adjusted University Standard Grading Scheme.

TEXT

Tinoco et al., 5th ed. Physical Chemistry: Principles and Applications in Biological Sciences, 5th Edition; Pearson Press; ISBN-13: 9780136056065. Available electronically via CarmenBooks (unless opted out of the textbook fee).

TOPICS

- Microscopic and Macroscopic Properties of Biomolecules
- First Law of Thermodynamics (Chapter 2)
- Second Law of Thermodynamics (Chapter 3)
- Chemical Equilibria (Chapter 4)
- Statistical Mechanics (Chapter 5)
- Diffusion, Sedimentation (Chapter 8)
- Chemical Kinetics (Chapter 9)
- Enzyme Kinetics (Chapter 10)

CLASS MATERIALS

Assigned text readings, homework assignments, and take-home quizzes via <http://carmen.osu.edu>.

COMMUNICATION

Questions regarding class material, including lectures, examples, homework and exams should be raised in class, in recitations, or posted on the online discussion page. For matters of an individual nature, the instructor and course TAs can be reached in person, or via the Carmen Inbox.

ASSIGNMENTS

Problem sets will be assigned throughout the course; students are *encouraged* to work in groups to solve homework problems, but *each student must submit their own work*. Clearly legible homework

assignments must be submitted *electronically* via Carmen as a *single PDF*; emailed submissions will not be evaluated. Students generally will have one week between the time the homework is assigned and when it is due. DON'T wait until the day before it's due to start it. Expect to spend ~2 hours on homework for each hour of lecture (~6 h for a typical assignment). Homework will be accepted until midnight on the due date with no penalty. Late assignments will be assessed as a 20% per day deduction in the grade for the assignment. Some questions on homework assignments will only be evaluated for effort. The lowest scoring assignment will be dropped.

QUIZZES

Online quizzes will be used to evaluate and assess progress and comprehension of the topics covered. The lowest scoring quiz grade will be dropped. Quizzes are NOT group assignments and must be completed individually. *Collaboration on quizzes represents academic misconduct and must be reported.*

COMPUTATION, DATA ANALYSIS, PLOTTING, FITTING

We will use computer software (e.g., Python via Jupyter Notebooks) to analyze properties of data, plot data and functions, and perform model fitting using non-linear regression. No prior background in computer programming is expected. Python can be accessed via various servers, requiring only a web browser; alternatively, students can choose to install Python on their computers. Students may also use comparable software of their choice (e.g., MATLAB, Prism, Origin, SigmaPlot, R, gnuplot, etc.).

RECITATIONS

TAs will answer questions and lead interactive individual and group in-class activities to allow students to work in groups to learn, problem solve, and to apply concepts to examples from the textbook.

MISCONDUCT

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

ACCESSIBILITY

Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614- 292-3307, slds@osu.edu; <http://slds.osu.edu>.

HEALTH AND SAFETY REQUIREMENTS

Students, faculty and staff are required to comply with and stay up to date on all university safety and health guidance (<https://safeandhealthy.osu.edu/>). Information on accommodation requests, related to COVID-19 or otherwise, can be found at <https://safeandhealthy.osu.edu/accommodations>, or by contacting Student Life Disability Services: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Biochemistry 5721– Syllabus 08/23/2022

LECTURE PLAN (SUBJECT TO CHANGE)

Date	Day	Topic	Assignment
2022-08-24	Wed	Introduction, Syllabus	
2022-08-26	Fri	Micro- and macroscopic properties of molecules and mixtures	
2022-08-29	Mon	Kinetic theory of gasses, temperature	Asg 0
2022-08-31	Wed	Data visualization	Quiz 1
2022-09-02	Fri	Definitions, Units, Heat, Work	Asg 1
2022-09-05	Mon	<i>(Labor Day -- no classes)</i>	
2022-09-07	Wed	First Law	Quiz 2
2022-09-09	Fri	Heat capacity	Asg 2
2022-09-12	Mon	Enthalpy, molecular origins of C	
2022-09-14	Wed	Phase changes, reactions	Quiz 3
2022-09-16	Fri	Entropy and 2nd Law	Asg 3
2022-09-19	Mon	Carnot Cycle	
2022-09-21	Wed	Entropy changes in reactions	Quiz 4
2022-09-23	Fri	Gibbs Free Energy	Asg 4
2022-09-26	Mon	Equilibria, Chemical Potential, Activity Coefficients, Standard States	
2022-09-28	Wed	<i>(Exam)</i>	Midterm 1
2022-09-30	Fri	Chemical equilibria - concepts revisited	
2022-10-03	Mon	Ideal and non-ideal solutions; mass balance and equilibria	
2022-10-05	Wed	Temperature Dependence, ligand binding, ionization	Quiz 5
2022-10-07	Fri	Maxwell-Boltzmann distribution	Asg 5
2022-10-10	Mon	Probability, Binomial Statistics	
2022-10-12	Wed	Partition function	Quiz 6
2022-10-14	Fri	<i>(Fall break - no classes)</i>	
2022-10-17	Mon	Polymer binding, Cooperative transitions	Asg 6
2022-10-19	Wed	Nearest neighbor interactions, and statistical weights	Quiz 7
2022-10-21	Fri	Cooperativity	Asg 7
2022-10-24	Mon	<i>Case Studies</i>	
2022-10-26	Wed	Diffusion	Quiz 8
2022-10-28	Fri	Stat Mech, Diffusion	Asg 8
2022-10-31	Mon	Sedimentation, Viscosity	
2022-11-02	Wed	<i>(Exam)</i>	Midterm 2
2022-11-04	Fri	Chemical kinetics, intro	
2022-11-07	Mon	Reaction order and Mechanism	
2022-11-09	Wed	Parallel and series reactions	Quiz 9
2022-11-11	Fri	Complex reactions and approximations, Microscopic Reversibility	Asg 9
2022-11-14	Mon	Arrhenius, Eyring and Transition-State theory	
2022-11-16	Wed	Ionic reactions, relaxation kinetics	Quiz 10
2022-11-18	Fri	Diffusion controlled reactions	Asg 10
2022-11-21	Mon	Single molecule kinetics, Enzymes	
2022-11-23	Wed	<i>(Thanksgiving Holiday - no classes)</i>	
2022-11-25	Fri	<i>(Thanksgiving Holiday - no classes)</i>	
2022-11-28	Mon	Enzyme Kinetics; Michaelins-Menten	Asg 11
2022-11-30	Wed	Enzymatic data analysis; non-linear and linear modes	Quiz 11
2022-12-02	Fri	Enzyme inhibition	
2022-12-05	Mon	Allosteric Enzymes	Asg12
2022-12-07	Wed	Review	Quiz 12
2022-12-12	Mon	Final Exam 10am	