

Chem 761

Biophysical Chemistry

Spring 2024

Course meetings:

Tu and Th, 5:00–6:15 PM Pacific Time, in person in GMCS 329

Office hours:

F 3:00–4:00 PM Pacific Time. By appointment. Office hours will be held in CSL 334 or on Zoom at <https://SDSU.zoom.us/my/rgarmann>

Instructor:

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Course overview:

Chem 761 is a graduate-level course aimed at developing our physical intuition in experimental biochemistry and molecular biology, with the ultimate goal of enhancing our instincts and critical thinking skills in the laboratory. Our approach will not involve solving integrals or differential equations; rather, we will focus on understanding the fundamental physical concepts that govern the behavior of biomolecular systems and the different tools researchers use to study these systems. For the first half of the course, we will cover various experimental methods for measuring the size and structure of macromolecules; for the second half, we will examine the role of energy, entropy, and free energy in determining the behaviors of these molecules and the interactions between them. Throughout, we will discuss the essential role that theory has played in developing our current understanding of molecular biology. And we will probably talk a lot about viruses. We will also spend time honing our scientific writing and presentation skills. Depending on time and interest, we might also do some practical training using open-source software packages like ImageJ to interpret scientific images or AlphaFold to predict protein structures and interactions, or we might write some simple code in Python to gain experience processing experimental results and fitting simple models to data.

Specific learning objectives:

- 1) Understand the working principles of several foundational biophysical techniques, including static and dynamic light scattering, electrophoresis, electron microscopy, atomic force microscopy, sedimentation, and others.
- 2) Critically evaluate the limitations and assumptions inherent to all biomolecular characterization methods.
- 3) Recognize and articulate the contributions of scientists from historically underrepresented groups in shaping our understanding of biomolecular structure and function.
- 4) Apply thermodynamic principles, especially the concepts of entropy and free energy, to predict the likelihood of biochemical processes.
- 5) Fit mathematical models to experimental data to derive information about biomolecular systems, such as thermodynamic parameters, binding affinities, cooperativity, or modes of enzyme inhibition.

Prerequisites: Chem 560

Textbook:

There is no required textbook for this course. However, if there were a required textbook, it would be the little book by Ron Milo and Rob Phillips, titled *Cell Biology by the Numbers*. This book is fantastic. It outlines an extremely powerful framework for thinking about biology and contains a bunch of really useful numbers. If you've got \$40 laying around, consider picking up a copy online. You won't be disappointed.

Since there's no required textbook, I'll make sure to post electronic copies of any required reading to the Canvas site for our class.

Additional info:

Homework: Homework problems will be assigned approximately every other week throughout the semester.

Reflections: For weeks without assigned homework, we'll have short writing assignments where you reflect on a topic we covered in class and describe how it relates to your own life or research.

Quizzes: We'll have short quizzes every other week or so throughout the semester.

Presentations: Each student will give two 10-min presentations throughout the semester. The presentations will describe a physical concept and how it relates to a current area of biochemical research—ideally, you'll present on physical concept that you have personally encountered in your own research at SDSU.

Grading:

Homework: 25%

Reflections: 25%

Quizzes: 25%

Participation and Presentations: 25%

At the end of the semester, your final score will be computed by summing up your scores on Homework, Reflections, Quizzes, and Presentations, each weighted equally. If you receive above 90%, you will certainly get an A in the course; if you receive above 80%, you will get at least a B; above 70%, at least a C; and above 60%, at least a D. If you get less than 60% you are in danger of getting an F. However, the course will be graded on a curve, so it is possible to get an A in the course even if you receive less than 90%, or to get a B with less than 80%, and so on. We won't know what the curve looks like until the end of the semester, but I will keep you updated about the shape of the curve, so that you can have a good idea about how you are doing, and if you will need to bring up your score to get the grade you want.

Schedule conflicts: My goal is that every student will attend and participate in every class session. However, things will inevitably come up. If you have a conflict with one of our classes, please let me know as soon as you can. If you know in advance that you have a conflict, email me at least one week beforehand with your reason for why you can't make it. This will be especially important for dealing with conflicts on days that we have quizzes and presentations.

Accommodations: If you are a student with a disability and you need accommodations for this class, please contact Student Ability Success Center (sascinfo@sdsu.edu, <http://sdsu.edu/sasc>) to get an accommodation letter as soon as possible. Please allow 10-14 business days for this process. Accommodations are not retroactive, and I can't provide accommodations based upon disability until I've received an accommodation letter from Student Ability Success Center.

Statement on Cheating and Plagiarism: The University adheres to a strict [policy](#) regarding cheating and plagiarism. The California State University system requires instructors to report all instances of academic misconduct to the Center for Student Rights and Responsibilities. Academic dishonesty will result in disciplinary review by the University and may lead to probation, suspension, or expulsion. Instructors may also, at their discretion, penalize student grades on any assignment or assessment discovered to have been produced in an academically dishonest manner. The [Student Conduct Code](#) prohibits conduct disruptive to instruction, including academic dishonesty and the unauthorized recording, dissemination, or publication (including on websites or social media) of lectures or other course materials.

Link to student handbook: [SDSU Student Academic Success Handbook](#)

Land acknowledgment: For millennia, the Kumeyaay people have been a part of this land. This land has nourished, healed, protected and embraced them for many generations in a relationship of balance and harmony. As members of the San Diego State University community, we acknowledge this legacy. We promote this balance and harmony. We find inspiration from this land, the land of the Kumeyaay.

Disclaimer: I have made every effort to make this Syllabus as complete and accurate as possible. But there will inevitably be changes during the semester. These will be posted on the Chem 761 Canvas site and announced in class. It is the responsibility of each student to pay attention and be aware of these changes.