CHEM 135: Chemical Biology

Fall 2016 | Mon • Wed • Fri • 9:10 am to 10 am | 120 Latimer Hall

Course objectives: How do inanimate molecules of carbon, hydrogen, oxygen and nitrogen (plus a few others) give rise to the living, breathing life we see around us? How do our cells harness the chemical energy of molecules to carry out the metabolic reactions that keep us moving, growing, and thinking? What is the underlying logic to the cellular pathways that initiate, sustain, and pass on our genetic material? The study of biochemistry and chemical biology seeks to answer these and many more questions.

Chem 135 is an introduction to the principles of chemical biology and biochemistry—the organizing chemical concepts of life itself. At the end of the semester, students should be familiar with definitions of chemical biology and biochemistry; the structure, function, and reactivity of the major classes of biomolecules; mechanisms and features of enzyme catalysis; principles of cellular metabolism; and the primary pathways of the central dogma.

Instructor: Evan W. Miller
227 Hildebrand Hall
evanwmiller@berkeley.edu (NOT evanmiller@berkeley.edu)
Office hours: Thursday, 3-4 pm and Friday, 4-5 pm in 227 Hildebrand Hall

Graduate Student Instructors (GSIs):

	Steven Boggess	*Tracey Hinder*	*Kristin Wucherer*
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Office Hours	Tues/Thurs 1-2 pm	Mon 1-3 pm	Tues 9-10 am; Wed 3-4 pm
Location	Bixby Commons	Bixby Commons	Bixby Commons

Textbook:

"Lehninger Principles of Biochemistry," by Nelson and Cox. (6th ed. preferred, 4th and 5th ed. are okay)

Course website: The course website is maintained through the UC Berkeley bCourses site. Please visit bcourses.berkeley.edu to find our course website (Chem 135, FA 2016). All course information will be distributed through the bCourse site. This includes syllabus, problem sets and solutions, announcements, handouts, grades, etc. You are responsible for announcements made through the bCourse Website.

We will use "Piazza" to facilitate group discussion. This is an application that runs through our bCourses site. Group discussion threads are moderated by the instructor and GSIs. *Please use Piazza instead of email to ask questions if you're struggling with concepts or problem sets; they will be answered more quickly on Piazza.* Posts can be completely anonymous and can be answered by fellow classmates as well as GSIs or instructors.

Prerequisites: Chem 3B or 112B; Bio 1A. This class will assume basic understanding of the principles of general and organic chemistry and cell biology. Concepts from these courses will not be extensively reviewed in class. Come see us during office hours if you need extra help or guidance!

Problem Sets: Approximately 6 problem sets will be available throughout the duration of the course. These are due at the beginning of the class period listed on the syllabus. Answer keys are posted immediately following the class in which the problem sets are due. I will not accept late problem sets. Group work is encouraged, but the answers to the questions must come from your own understanding (as opposed to simply copying down what the group decided was the best answer). We will grade some (not all) of the questions on each problem set, and the problem sets will be returned electronically via GradeScope. For this reason, be sure to follow the instructions for submitting your problem set, otherwise, we will not grade it. Instructions will be included with each problem set.

Participation: Active participation in Chem 135 is the best way to learn the material and succeed! Participation should include coming to class, actively taking notes/participating in lecture, asking questions (both in class and online via Piazza), and coming to office hours. You can receive up to 2% of your grade for participating in the online message boards on Piazza, either asking or answering questions posed by your classmates.

Seminars: One of the most amazing opportunities at UC Berkeley is the large number of seminars we have on campus. Every week there are several seminars that bring in leaders in their respective fields to give a ~1 hour lecture on their

research. If you are interested in the field of Chemical Biology, this is a great way to hear about current topics. Particularly relevant to our course are the following:

Mondays, 4 pm, 106 Stanley Hall, Structural and Quantitative Biology (SQB) Seminar

Tuesdays, 11 am, 120 Latimer Hall, Organic / Chemical Biology Seminar

But these seminars may also feature content related to what we discuss in class:

Wednesday, 12 noon, 101 Barker Hall, Microbiology Seminar

Wednesdays, 3:30 pm, 100 Genetics and Plant Biology Building, Cell Biology/Biochemistry/Genetics Semianr

Thursdays, 4 pm, 125 Li Ka Shing, Neuroscience Seminar

I encourage you to take advantage of this unique opportunity at Cal! In order to provide extra motivation, you will be required to attend at least one seminar and provide a written report. The report will be submitted electronically via bCourses and should contain the following:

Seminar attended + date

Name and home institution of speaker

1 paragraph describing what the speaker's lab investigates, in general (you can sometimes get this information during the seminar, but you may also find more background by reading about the speaker at their lab webpage and reading some of their research publications)

1 paragraph describing the topic of that particular seminar.

1 paragraph describing a link between the seminar topic and a theme or topic we have discussed in class.

The total length of the report should be no more than one page.

Grading: Grades will be based on problem sets (18%), seminar report (5%), Piazza participation (2%), three in-class exams (15%) and a final exam (30%). For each student, we will also calculate grades by taking the worst mid-term exam as 5% and the final as 40%. The best overall score will be used.

Final Exam: A comprehensive final exam will be held **Thursday, December 15, 2016**, from **7 pm to 10 pm** in **Latimer 120**.

Ethics/Honor Code: "As a member of the UC Berkeley community, I act with honesty, integrity and respect for others."

Chem 135 Fall 2016: Lecture and Exam Schedule
(all dates are approximate -- see bCourse site for up-to-date schedule)

Day	Date	Lecture	Topic	Notes	Chapter
Wed	Aug 24	1	Course Introduction / Chemical Biology		1
Fri	Aug 26	2	Water, pH, pKa, Hydrophobic effect		1,2
Mon	Aug 29	3	Amino Acids, pKa, and Protein Structure		3
Wed	Aug 31	4	Elements of Protein Structure		4
Fri	Sep 2	5	Protein Folds, Binding. Chemical Biology Highlight 1	PS 1 due	5
Mon	**Sep 5**	**---**	**Labor Day**		
Wed	Sep 7	6	Enzyme Catalysis: RNase A		6
Fri	Sep 9	7	Enzyme Catalysis: Proteases and other types of catalysis		6
Mon	Sep 12	8	Michaelis-Menten kinetics		6
Wed	Sep 14	9	Michaelis-Menten kinetics / Reversible Inhibition		6
Fri	Sep 16	10	Enzyme Inhibition – irreversible	PS 2 due	6
Mon	Sep 19	11	Chemical Biology Highlight 2: Benjamin Cravatt		6
Mon	*Sep 19*	*Review 1*	*Optional Review Session. 5 – 6:30 pm. Latimer 120**		
Wed	**Sep 21**	**Exam 1**	**Exam 1 – in class**		
Fri	Sep 23	12	Central Dogma and Nucleic Acid Structure		8
Mon	Sep 26	13	Base pairing and enzymes that act on DNA		8, 25
Wed	Sep 28	14	DNA polymerase and replication		8, 25

Fri	Sep 30	15	PCR, cloning, Sanger sequencing		8,9
Mon	Oct 3	16	Chemical Biology Highlight 3: Next-Gen DNA Sequencing		9
Wed	Oct 5	17	Transcription and Gene regulation		9,26
Fri	Oct 7	18	CRISPR/Cas9		
Mon	Oct 10	19	The Genetic Code and Translation		27
Wed	Oct 12	20	The Genetic Code and Translation II		27
Fri	Oct 14	21	Chemical Biology Highlight 4: Unnatural Amino Acids	PS 3 due	27
Fri	*Oct 14*	*Review 2*	*Optional Review Session. 6 – 7:30 pm. Latimer 120**		
Mon	**Oct 17**	**Exam 2**	**Exam 2 – in class**		---
Wed	Oct 19	22	Carbohydrate structure and function I		7
Fri	Oct 21	23	Carbohydrate structure and function II		7,13
Mon	Oct 24	24	Bioenergetics and Metabolism		13
Wed	Oct 26	25	Glucose Metabolism 1: Glycolysis	PS 4 due	14
Fri	Oct 28	26	Glucose Metabolism 2: Gluconeogenesis / Fermentation		14
Mon	Oct 31	27	Citric Acid Cycle I		16
Wed	Nov 2	28	Citric Acid Cycle II		16
Fri	Nov 4	29	Membranes and Ion Channels		11,12
Mon	Nov 7	30	Chemical Biology Highlight 4: Fluorescent Sensors	PS 5 due	
Mon	*Nov 7*	*Review 3*	*Optional Review Session. 6 – 7:30 pm. Latimer 120**		
Wed	**Nov 9**	**Exam 3**	**Exam 3**		
Fri	**Nov 11**	**---**	**Veterans' Day**		
Mon	Nov 14	31	Oxidative phosphorylation I		19
Wed	Nov 16	32	Oxidative phosphorylation II		19
Fri	Nov 18	33	Photosynthesis		20
Mon	Nov 21	34	Fatty Acid Metabolism I		17
Wed	**Nov 23**	**---**	**No Class, Thanksgiving Holiday**		
Fri	**Nov 25**	**---**	**No Class, Thanksgiving Holiday**		
Mon	Nov 28	35	Fatty Acid Metabolism II		21
Wed	Nov 30	36	Amino Acid Metabolism		22
Fri	Dec 2	37	Chemical Biology Highlight 5: Bioconjugation	PS 6 due	
Mon	Dec 5	RRR	Review Session 1**		
Wed	Dec 7	RRR	Review Session 2**		
Fri	Dec 9	RRR	Review Session 3**		
Thurs	**Dec 15**	**FINAL**	**FINAL EXAM. 7 pm to 10 pm.**		

* Review sessions before exams are optional, will be led by Prof. Miller, and will be held in Latimer 120. Review Session 1 begins at 5 pm, while Review Sessions 2 and 3 start at 6 pm.

** OPTIONAL: No new material will be covered during RRR review sessions. The review sessions will be led by Prof. Miller and will meet at the same time and place as our regularly scheduled class.