CHEM 135: Chemical Biology

Fall 2019 | Mon • Wed • Fri • 10:10 am to 11 am | 145 Dwinelle 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
Office hours: Thursday and Friday, 2:30-3:30 pm in 227 Hildebrand Hall

Graduate Student Instructors (GSIs):

	Monica Gonzalez	*Josh Turnbull*	*Jamie Gleason*
Office Hours	**Mon**; 1-3 pm	**Tues**; 4-5 pm **Wed**; 9-10 am	**Wed** 3-5 pm
Location	1 Lewis Hall	1 Lewis Hall	1 Lewis Hall

Textbook:

"Lehninger Principles of Biochemistry," by Nelson and Cox. (7th ed. preferred, 5th and 6th 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 2019). 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 anonymous to other students and can be answered by fellow classmates as well as GSIs or instructors.

Prerequisites: Chem 3B or 12B; 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. 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.

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.

Grading: Grades will be based on problem sets (15%), seminar report (5%), Piazza participation (5%), 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.

Mid-term Exams: We will have three mid-term exams. Each exam will cover content related to that section of the course. Exams will be given in-class.

Final Exam: A comprehensive final exam will be held **Monday, December 16, 2019**, beginning at **8 am** in **a location to be determined**.

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

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

Online calendar for additional Chemistry-related seminars:

https://events.berkeley.edu/index.php/calendar/sn/chem.html

The seminars below may also feature content related to what we discuss in class:

Wednesdays, 11:00 am, 100 Genetics and Plant Biology Building, Cell Biology/Biochemistry/Genetics Seminar

Thursdays, 3:30 pm, 101 LSA, Neuroscience Seminar

Online calendar for MCB-related seminars: http://events.berkeley.edu/index.php/calendar/sn/mcb.html

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.

Chem 135 Fall 2019: Lecture and Exam Schedule
(all lecture topics/dates are approximate -- see bCourse site for up-to-date schedule)

Day	Date	Lecture	Topic	Notes	Chapter
Wed	Aug 28	1	Course Introduction / Chemical Biology		1
Fri	Sug 30	2	Water, pH, pKa, Hydrophobic effect		1,2
Mon	Sep 2	---	**No class**	Labor Day	---
Wed	Sep 4	3	Amino Acids, pKa, and Protein Structure		3
Fri	Sep 6	4	Elements of Protein Structure		4
Mon	Sep 9	5	Protein Folds, Binding. Chemical Biology Highlight 1	PS 1 due	5
Wed	Sep 11	6	Enzyme Catalysis: RNase A		6
Fri	Sep 13	7	Enzyme Catalysis: Proteases and other types of catalysis		6
Mon	Sep 16	8	Michaelis-Menten kinetics		6
Wed	Sep 18	9	Michaelis-Menten kinetics / Reversible Inhibition		6

Fri	Sep 20	10	irreversible inhibition / Chemical Biology Highlight 2	PS2 due	6
Fri	*Sep 20*	*Review 1*	*Optional Review Session. 5:30 – 7 pm.**		
Mon	Sep 23	---	**Exam 1 - in class**		
Wed	Sep 25	11	Central Dogma and Nucleic Acid Structure		8
Fri	Sep 27	12	Base pairing and enzymes that act on DNA		8, 25
Mon	Sep 30	13	DNA polymerase and replication		8, 25
Wed	Oct 2	14	PCR, cloning, Sanger sequencing		8, 9
Fri	Oct 4	15	Transcription and Gene regulation		9, 26
Mon	Oct 7	16	Transcription and Genetic Code		27
Wed	Oct 9		PG&E power outage		
Fri	Oct 11		PG&E power outage		
Mon	Oct 14	17	The Genetic Code and Translation		
Wed	Oct 16	18	Translation and Unnatural amino acids (ChemBio)	PS3 due	
Fri	Oct 18	19	Unnatural amino acids + Sugar intro		
Fri	*Oct 18*	*Review 2*	*Optional Review Session. 5:30 – 7 pm.**		
Mon	Oct 21	20	Carbohydrate structure and function		*7*
Wed	Oct 23		**Exam 2 - in class**		
Fri	Oct 25	21	Bioenergetics and Metabolism		13
Mon	Oct 28	---	PG&E power outage		
Wed	Oct 30	22	Glucose Metabolism 1: Glycolysis		14
Fri	Nov 1	23	Glucose Metabolism 2: Glycolysis 2 + pyruvate		14
Mon	Nov 4	24	Citric Acid Cycle I		16
Wed	Nov 6	25	Citric Acid Cycle II		16
Fri	Nov 8	26	Gluconeogenesis	PS4 due	
Mon	Nov 11	---	**No class**	Veterans Day	
Wed	Nov 13	27	Oxidative phosphorylation I		14
Wed	*Nov 13*	*Review 3*	*Optional Review Session. 5:30 – 7 pm.**		
Fri	Nov 15	---	**Exam 3 - in class**		19
Mon	Nov 18	28	Oxidative phosphorylation II		19
Wed	Nov 20	29	Photosynthesis		20
Fri	Nov 22	30	Fatty Acid Metabolism I		17
Mon	Nov 25	31	Chemical Biology Highlight 6		
Wed	Nov 27	---	**No class**		
Fri	Nov 29	---	**No class -Thanksgiving Holiday**		
Mon	Dec 2	32	Fatty Acid Metabolism II		21
Wed	Dec 4	33	Chemical Biology Highlight 7	PS5 due	
Fri	Dec 6	34	Amino Acid Metabolism I		18
Mon	Dec 9	RRR	Review Session 1**		
Wed	Dec 11	RRR	Review Session 2**		
Fri	Dec 13	RRR	Review Session 3**		
Mon	Dec 16	Final Exam	8 am. Location will be announced later.		

* Review sessions before exams are optional, will be led by Prof. Miller, and will be held in Latimer 120. No new material will be introduced or covered.

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