

**CHEM 115 PO-01: Biochemistry**

**Instructor**

Prof. Jane M. Liu (SN 216)  
[jane.liu@pomona.edu](mailto:jane.liu@pomona.edu); (909-607-8832)

**Office Hours**

M 3-5 pm; W 8:00-10:00 am; [or by appointment](#)

**Class**

Tues & Thurs, 7:30 am – 8:45 am

**PRE-REQUISITE: CHEM 110A**

*All times are PST/PDT unless otherwise stated.*

**A Message from Prof. Liu:**

**Welcome!** I want our classroom to be inclusive, equitable, and full of participation. As your instructor, I am committed to creating a classroom environment that welcomes and supports all students, regardless of race, gender, religious beliefs, etc. I expect that your unique background will enrich our learning environment and I am excited to have you in this class. We all have implicit biases, and I will try to continually examine my judgments, words, and actions to keep my biases in check and treat everyone fairly. I hope that you will do the same and that you will let me know if there is anything I can do to make sure everyone is encouraged to succeed in this class. If there are any aspects of the instruction or design of the course that result in barriers to your learning, please let me know as soon as possible. If you do not feel comfortable approaching me directly, please feel free to reach out to one of our class mentors: Kate Denend, Caitlin Halligan, Maris Kamalu and Jason Lu.

It is common that college students experience a great deal of stress. In a class of this size, there will likely be a number of individuals who are going through hard times and who are experiencing psychological difficulties. If you are feeling miserable, or you think you are experiencing psychological problems, please do seek help! If you think you may benefit from psychological help, please reach out to Monsour Counseling and Psychological Services (MCAPS), 909-621-8202. For students living outside California, Monsour staff will provide a one-time consultation or crisis appointment. They will then work with out-of-state students to find a local clinician to provide regular care. Also note that Campus Health via the TimelyMD app will continue to be available for to all students. This service provides free and unlimited medical and mental health services. To register and access this service, please go to the [CAMPUS.HEALTH website](#) and use customized password/code POMONA2020.

**Technological Needs and Considerations for An Online Course:**

We will use Zoom extensively in this class. All materials for this course will be posted in Sakai. Documents for the course will be in the form of Word or Excel documents, PDFs and PowerPoint files. Live polling will be done using a web browser or a smart phone. Some homework assignments will require access to a web browser and the use of [PyMOL](#) (create an account).

**The primary means that Prof. Liu will communicate with the class is via email. You should expect several emails from her each week. Emailing Prof. Liu is a great way to communicate with her!**

If you have any concerns about internet connectivity and your ability to engage in this course -- please do speak with Prof. Liu. She has ideas and alternatives in mind!! Also note that Pomona's ITS is

available to help you -- check out their new chat line! If you are having ANY issues getting a response from ITS, please let Prof. Liu know. She will advocate for your needs to be met.

To request a computer or WiFi hotspot: <https://www.pomona.edu/administration/its/sta>

Tips to resolve slow internet speed: <https://bit.ly/3jshiE4>

Support from ITS with various remote learning issues: <https://bit.ly/2OJEYpb>

ASPC's comprehensive guide to campus: <http://tinyurl.com/springresources>

Access software, files and journal articles on Pomona's network: <https://tinyurl.com/yxb4hslv>

Online student's manual for success: <https://bit.ly/3hgcYps>

## COURSE GOALS

This upper-level course, for those students with a background in both general chemistry and organic chemistry, will address the following questions:

- How has equity and access affected biochemistry and related fields?
- How does the shape, structure and functional groups of macromolecules and metabolites relate to their biological reactivity and function?
- How do we isolate, manipulate and study a specific protein of interest from a cell?
- How do we study an enzyme's activity?
- How do molecules functionally interact in a cell?

The study of biochemistry investigates the interplay between biological macromolecules such as proteins and nucleic acids, and low molecular weight molecules (such as the products of glucose metabolism). In this course, you will apply your knowledge of intermolecular forces, thermodynamics (when a reaction occurs), chemical kinetics (how fast a reaction occurs), and chemical structure and functionality to understand how biological molecules (and *life*) work.

**After successfully completing this course, students will be able to:**

- Articulate their personal responsibility – and those of their STEM colleagues – for eliminating injustice and creating more equitable outcomes in biochemistry and related fields
- Apply the properties of water, chemical equilibria, and thermodynamics to understand biology at the molecular level
- Describe/identify the forces that direct/stabilize different macromolecular structures
- Predict how changes in amino acid (or nucleotide) sequence can affect macromolecular structure and function
- Explain why catalysis is central to life and how enzymes and cofactors are able to affect reaction rate enhancement; in particular, the importance and mechanisms of “coupling” in the harnessing of favorable reactions to do biochemical “work”
- Articulate and apply what the enzyme parameters of  $K_M$ ,  $V_{max}$ ,  $k_{cat}$  and  $k_{cat}/K_M$  tell us about an enzyme

- Explain inhibition processes and different methods for regulating biological processes and/or flux through a pathway
- Describe the interactions of biomolecules both quantitatively and qualitatively (in many cases, including mechanistic details and the molecular basis of selectivity)
- Recognize the flow of metabolic intermediates through a pathway and communicate information about metabolic pathways using diagrams, especially in the context of human/medical biochemistry
- Describe multiple experimental methods used in biochemistry, interpret data from these methods to form conclusions, and develop a testable hypothesis to answer a question
- Summarize and analyze primary literature and data, and apply gathered information to new situations

#### Engagement with this course will allow students to:

- Increase problem solving skills such as: critical thinking, data analysis, graphical analysis
- Increase process skills such as: communication of scientific concepts and experimental results; group dynamics and teamwork; management and self-assessment
- Develop an engaged community of active learners who are intentional about their educational choices

#### OUTCOMES

For each topic, you will be provided a list of learning outcomes so that you can gauge your mastery of the materials and skills covered in CHEM 115.

#### COURSE MATERIALS

- Voet, Voet and Pratt. *Fundamentals of Biochemistry, 5th Edition*. Older editions of this textbook are also fine. Any undergraduate biochemistry textbook can be appropriate; reading is assigned by "topic", so a quick search in the index of any textbook should direct you to the relevant pages.
- Video MiniLectures and additional resources, Key Questions, Worksheets, Problem Sets and additional Papers will be posted on Sakai.
- Calculator and an active email account. Prof. Liu emails the class frequently. You are expected to check your school email account for these emails and to read them.

#### COURSE OVERVIEW

**Before class:** You will frequently be given initial assignments to work on as an individual before class. Prioritize watching the videos but understand that skimming the assigned reading will help clarify the material further. The Key Questions (on Sakai) are meant to guide you through the reading and help you focus on the major points that Prof. Liu considers important for the course. These assignments must be ready at the start of class – your preparation will form part of your weekly participation grade.

**In class:** During our class meeting time, you will frequently function as a member of a [Learning Team](#), developing and examining chemistry concepts as a unit. Your team effort and participation are part of your weekly participation grade. The team responses to a few critical questions on each in-class activity will be evaluated for strength of concept and effective communication of the concept. The team will also strategize on ways to improve teamwork and team products. These responses will also form part of your weekly participation grade.

**After class:** Application exercises will be assigned for each activity. Together with problems from the text, they will form your **problem sets** that will be collected and graded for each individual. **Actively** working these homework problems is essential for your understanding of the material, as they bring your concept development full circle.

**Problem Sets** (5 pts/question): Due on specified **Fridays** at noon (office, Sakai OR email)

**Recorder Sheets** (3 pts/ea): Due by 11:50 pm day activity is finished (office, Sakai OR email)

**Strategist Sheets** (2 pts/ea): Due on Fridays at noon (office, Sakai OR email)

**Performance Evaluations** (extra credit, up to 3 pts/ea): Due on specified Fridays at noon (office, Sakai OR email)

**Office Hours:** These are guaranteed times when Prof. Liu can be found on Zoom, ready and waiting for you to come by. You can come by with specific questions. Lots of students do this: they've organized their class notes, homework, etc. and they bring those documents with them, along with the textbook and ask Prof. Liu specific questions. Some students take notes while they and Prof. Liu chat. Some example of specific questions you might ask Prof. Liu:

*I didn't understand XX when we talked about it in class. Can we go over it again?*

*I don't understand how to start this problem on the problem set. Can you help me get started?*

*I don't understand what this paragraph in the textbook means. What should I be thinking about?*

*I keep getting the wrong answer for this back-of-the-chapter problem. Where am I going wrong?*

If you do not have a specific question, you can still go to office hours! It may help if you have at least a starting point for the conversation. Some things you might say are:

*So.... Thermodynamics. Yeah. Tell me about that.*

*I haven't started the problem set yet, but I thought I could do that now, with you here to help me.*

*Organic chemistry was really hard for me. So, I'm scared.*

*I want to do well in this class. What should I do?*

If you do not have a specific question and you do not have a starting point for the conversation, that is OK too! By just chatting with Prof. Liu about the course, questions will surely evolve.

## Assessments

<u>Final Grade Calculation</u>		<u>Grading Scale</u>			
Mid-term exams:	30%	A	93-100	C	73-76
Final exam:	20%	A-	90-92	C-	70-72
Team participation:	10%	B+	87-89	D+	67-69
Problem Sets/Other:	15%	B	83-86	D	63-66
Laboratory:	25%	B-	80-82	D-	60-62
		C+	77-79	F	≤59

*There is no curve for this course – you need only worry about your own performance. Please note that an “A” grade represents excellent mastery and intelligent discussion of concepts covered in this course.*

**Problem Sets:** The PSs in this class will provide opportunities to practice applying concepts covered in class, and they will also be used to cover material that is an *extension* of concepts covered in class or assigned reading. Questions from the PSs (including those that were not required) are fair game for the exams. Each question is generally worth 5 points and **rubrics for the grading of PS questions and reflections on readings is available on Sakai. Your answers must be typed up and in your own words (see academic integrity statement below).**

**Exams:** The exams will be comprised of short answer and short essay questions. The questions will be drawn from lectures, in-class activities, problem sets and discussions, as well as relevant primary literature that you may not have been previously assigned. No make-up exams will be given. If you know in advance that you will miss an exam, please notify Prof. Liu at least one week ahead of time so that alternative arrangements can be made. If you miss an exam due to a documented health or family-related emergency, your other two exams will each count 25% of your total grade. **The final exam will be cumulative.**

**Grading Policy:** Any query regarding scores on graded assignments or exams should be presented within three days of return of the assignment/exam. It is the student’s responsibility to reach out to the professor to make any adjustments. Please note that Prof. Liu reserves the right to regrade the entire submission, and as a result, she may raise or lower your entire score. After three days, all scores become final and unalterable.

**Attendance:** Attendance in class is important in an active learning environment. In addition to mastering the material yourself, you are responsible for assisting the other members of your team in their understanding of the material. Unless you have developed an alternative agreement with Prof. Liu, you should try to not miss class. Please be respectful of Prof. Liu and your fellow classmates and show up to class on time. You can expect your grade to drop substantially with 3 or more absences. Valid reasons for missing class are illness, religious observations or family emergencies. **You are responsible for handing in all assignments on time and obtaining all activities, regardless of missed classes.**

**Due date extension policy:** In general, Prof. Liu expects work to be turned in by the communicated due date, which were all decided with careful consideration of all of the assignments throughout the

semester, along with assignments and exams in other courses that students are commonly cross-enrolled in. Learning to manage due dates and multiple responsibilities will also be helpful for future jobs and internships. However, Prof. Liu recognizes that the lives of students are *busy* and in life the only thing that one can really expect is the unexpected. The current state of the world and the realities of our far-from-normal learning environment are also likely to place you under increased pressures and disruptions. Thus, in this class, you each will have **three "Flex Tokens"**. Application of the Flex Token allows you to receive a no-questions-asked deadline extension. By the original due date, you should communicate your use of the Flex Token to Prof. Liu and together you can determine an alternate due date.

When Flex Tokens are not used, **late work will be accepted** for all assignments (except exams). However, for every 24 hours that the assignment is tardy, a 10% deduction will be applied to your grade on that assignment.

**Laboratory:** The purpose of *doing* biochemistry is to gain experience in experimental methods that you'll be reading about throughout the semester. Unless an alternative has been arranged with your laboratory instructor, attendance on your scheduled lab day is expected. In order to receive a passing grade in CHEM 115, you must receive a 70% or higher in CHEM 115L.

**Special circumstances:** If there are special circumstances, such as illness or other form of emergency, which should be taken into account with regard to any of the stated class policies, please inform Prof. Liu as soon as possible so that alternative arrangements can be made.

**Disability Accommodations:** Your experience in this class is important to Prof. Liu. Pomona College is committed to making all courses accessible for everyone and **Prof. Liu is committed to making this particular course accessible to you**. If you need academic accommodations, please contact the Accessibility Resources and Services (ARS) in the Dean of Students office and visit the Accommodation Services page for more information about how the accommodation process.

Prof. Liu encourages you to come talk to her about your accommodations. As a Pomona faculty member, she is dedicated to supporting all students in her courses. Together you will develop strategies to meet both your needs and the requirements of the course.

If you have any questions about accommodations, please reach out to Accessibility Resources and Services (ARS) at [disability@pomona.edu](mailto:disability@pomona.edu) or 909-621-8017.

**Academic ethics and integrity policy:** You are expected to abide by the Pomona College Standards of Academic Honesty. For the official policy go to: [http://catalog.pomona.edu/content.php?catoid=28&navoid=5638&hl=%22academic+integrity%22&returnto=search#academic\\_honesty](http://catalog.pomona.edu/content.php?catoid=28&navoid=5638&hl=%22academic+integrity%22&returnto=search#academic_honesty). Plagiarism, whether deliberate or unintentional, and cheating on examinations is not acceptable.

You are encouraged to collaborate with other students on individual assignments in this course. However, each student must each turn in their own assignment. If you work on a problem with others, write up your solution in your own words and acknowledge the assistance you received from others in your write up. It is important that you develop the ability to work independently as well as the ability

to problem-solve with others. The goal is for you to learn how to collaborate with others and at the same time develop your own deep understanding of the course material.

The use of previously posted homework solutions in the preparation of your homework assignments is strictly prohibited. This includes referring to solutions associated with homework turned in by a student in a previous version of the course or answers you find online.

**Schedule (Subject to Change):**

Wk	(Lecture) Date	Topic	Tags	Assignments Due
<b>Get to Know the Players!</b>				
1	(1) 8/25	Introduction to Biochem; NCI, Thermodynamics	community	
	(2) 8/27	Water, Acids and Bases, Buffers	racism	
2	(3) 9/1	Amino Acids and Peptide Bonds	stereotypes, biases	<b>PS 1</b> (9/4 - noon)
	(4) 9/3	Protein Folding	racism, diversity	
3	(5) 9/8	Working with Proteins	primary paper	
	(6) 9/10	Working with Proteins	primary paper	
4	(7) 9/15	Hemoglobin	sickle-cell, race	<b>PS 2</b> (9/18 - noon)
	(8) 9/17	Molecular Recognition	immune system	
5	(9) 9/22	Enzyme Catalysis	HIV / AIDS	
	(10) 9/24	Enzyme Mechanisms; <b>Exam 1 OUT</b>		
6	(11) 9/29	Enzyme Inhibition I		<b>Exam 1</b> (9/29 – 7:30 am)
	(12) 10/1	Enzyme Inhibition II		
7	(13) 10/6	Lipids and Membranes		<b>PS 3</b> (10/9 - noon)
	(14) 10/8	Membrane Transport		
8	(15) 10/13	Model Protocell	evolution, primary	
	(16) 10/15	Model Protocell	paper	
<b>See Them in Action!</b>				
9	(17) 10/20	Signal Transduction (GPCRs)	primary paper,	<b>PS 4</b> (10/23 - noon)
	(18) 10/22	Signal Transduction, Biosynthesis of Catecholamines	Parkinson's	
10	(19) 10/27	Metabolism Overview	diabetes	
	(20) 10/29	Glycolysis; <b>EXAM 2 OUT</b>		
11	(21) 11/3	Gluconeogenesis		<b>Exam 2</b> (11/3 – 7:30 am)
	(22) 11/5	Regulation of Glycolysis and Gluconeogenesis;		
12	(23) 11/10	PDH		
	(24) 11/12	TCA for All?	primary paper	

13	(25) 11/17	TCA for All?	primary paper	<b>PS 5</b> (11/20 – noon)
	(26) 11/19	Oxidative Phosphorylation		
14	(27) 11/24	<b>Applications to Modern Biochemistry</b>	COVID	<b><i>Final Due to Prof. Liu</i></b> <b><i>11/30, 10 pm.</i></b>
		Drug Discovery; <b>Final OUT</b>		