

CHEM 326: Biochemistry I
Fall 2025
Tues-Thurs 8-9:15
Brossman 102

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Office: Caputo 218 Office Phone: 717-871-7439
Office Hours: Tues 9:30-10:30, Wed 2-4, Thurs 9:30-11:30, and by appointment.

Labs: Wed 2:00 – 4: 50 pm (A) Thurs 1:10 – 4:00 pm (B)

Course Description: CHEM 326 provides an introduction to the structure and properties, physical and chemical, of biological compounds (carbohydrates, lipids, nucleic acids, and proteins). Their metabolism and importance in life processes will be introduced. Laboratory studies explore the properties of biological molecules and techniques for their isolation, identification, and qualitative and quantitative analysis.

Pre-requisite or co-requisite: CHEM 232 or CHEM 235 (grade of C- or better).

Course Materials and Readings:

- Registration on D2L and access to course and laboratory materials posted on D2L.
- Achieve Essentials Access (available online with e-text *Principles of Biochemistry*, Nelson & Cox, 8th ed)
- We will be using two different e-textbooks this semester, depending on chapter:
 - Fundamentals of Biochemistry by Jakubowski and Flatt
 - Biochemistry Free for All by Ahern, Rajagopal, and Tan.
- If you prefer using a hard-copy textbook, any of the following would be appropriate:
 - Lehninger's Principles of Chemistry (7th or 8th edition)
 - Voet, Voet, and Pratt's Fundamentals of Biochemistry (4th or 5th edition)
 - Garrett and Grisham's Biochemistry (5th or 6th edition)
- Laboratory notebook: permanently-bound composition notebook. A variety of colors and styles are available for purchase in lab for \$1.

Course Overview:

This course is designed as an introduction to the chemistry that occurs in living systems. We will start with foundational information in Biochemistry (Section 1). The remainder of the course will focus on understanding cellular respiration with a molecular perspective. We will apply foundational biochemical knowledge to understand proteins (Section 2) and the chemistry they perform (Section 3). The last unit will apply knowledge of protein structure and function to metabolic biochemistry and cellular respiration (Section 4).



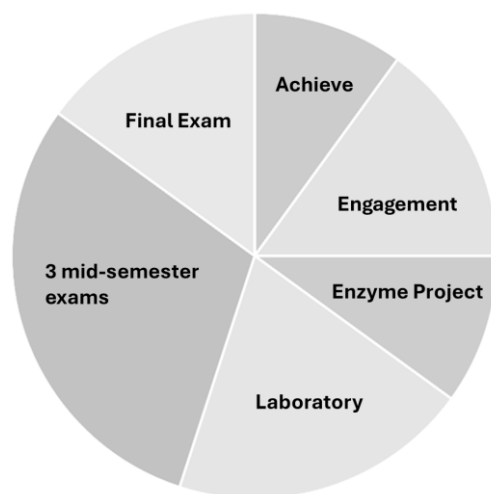
Course Objectives:

The main goal of this course is to understand the relevance of chemical principles within biological systems. Students actively engaged in this course should be able to:

- Integrate the essential chemical characteristics of major types of biochemical molecules with their biological relevance.
- Describe the key nucleotide and nucleic acid structures and recognize the processes responsible for the flow of genetic information within cells.
- Describe the key features of protein structure and recognize the major roles played by proteins and enzymes in biological systems.
- Apply structural and kinetic principles relevant to enzyme reactions and regulation.
- Describe characteristics that define lipids and recognize cellular and metabolic roles of the membrane.
- Understand carbohydrate metabolism in cells and the integration of related pathways for use, production, and storage of energy biomolecules.
- Appreciate the dynamic nature of biochemical principles and how ongoing research expands our collective understanding.
- Develop fundamental laboratory skills, understand their application to biochemical studies, and analyze data appropriately.

Evaluation of Learning:

Achieve Homework	10%
Engagement and Learning Activities	15%
Enzyme Project	10%
Laboratory Assignments	20%
Mid-Semester Exams (3)	30%
Comprehensive Final Exam	15%



NOTE: You must earn at least 60% in the lecture portion to pass CHEM 326. Your final grade will be assigned based on the combined lecture and laboratory scores.

Final letter grades will be assigned on a standard plus/minus scale:

B+ 87.0 – 89.9	A 93.0-100.0	A- 90.0 – 92.9
C+ 77.0 – 79.9	B 83.0 – 86.9	B- 80.0 – 82.9
D+ 67.0 – 69.9	C 73.0 – 76.9	C- 70.0 – 72.9
	D 63.0 – 66.9	D- 60.0 – 62.9
	F < 60.0	

Homework (10%):

Mastery of chemical and biochemical principles is developed through practice. Opportunities for you to interact with course content is available online through Achieve Essentials. These problems will include **required homework** and practice/review problems or activities. While only scores on assigned homework will count towards the course grade, you are encouraged to use a variety of resources that are helpful for your learning. You will have unlimited attempts to complete the homework, however there will be a small (1%) penalty for each attempt and a late penalty for homework submitted after the deadline. Homework deadlines will be **11:59 pm** the day they are due, frequently on Sunday with occasional mid-week assignments as needed (such as before an exam).

Engagement and Learning Activities (10%):

In addition to online homework, we will also have a variety of assigned "Learning Activities" designed to help you practice and gain mastery of course material. These could be handouts, homework, or quizzes. These will be assigned in-class, included on Road Maps, and posted on D2L. We will also have frequent short class surveys including post-exam surveys, metacognitive reflection questions, etc. which will help you reflect on your learning this semester.

It is also essential to engage with our campus community. Participating/attending campus events has an impact on sense of belonging on campus which can help with improved grades and retention (#goals). Therefore, you are expected to **attend at least one unique event in each quarter of the semester** (Units 1-4) and report back on a Microsoft form. The event could be a seminar, sporting event, tabling event, club meeting, special event, etc. We will have a google spreadsheet with running list of events. Everyone in the class can post an event to share with the class. You may attend an event not listed on the spreadsheet.

Enzyme Project (10%):

During the second half of the semester you will work on an individual enzyme project that will apply your growing knowledge of enzyme function, structure, and kinetics to a unique enzyme, gain experience searching and reading scientific literature, and be inspired by enzymes. This project will be scaffolded through several assignments including

- (1) Choosing an enzyme and accompanying structure-based journal article
- (2) Completing a series of assignments related to your enzyme and its structure, function, mechanism, and kinetics.
- (3) Create art (broadly defined) inspired by your enzyme.

An official prompt and specific assignment questions will be provided at the start of the project. Guidance and assistance in navigating scientific literature will be provided.

Exams:

We will have three exams during the semester and one comprehensive final exam that will require the full class period and will test your ability to integrate fundamental course concepts on the applied, analytical, and synthetic levels.

Make-up Policy: If you know you will miss an exam ahead of time (for an absence excused based on Millersville's approved guidelines), you must inform me one week in

advance, ideally in person. You will be expected to take the exam before the scheduled date. If you are sick on the day of an exam, we will work together for you to make up the exam as soon as possible. Any unexcused absence from an exam will result in a zero.

Testing Accommodations: Any student who meets the eligibility requirements to receive academic accommodations through learning services should speak with the Office of Learning Services in Lyle Hall as early in the semester as possible. You should give me a Testing Accommodation request form ("green sheet") as soon as possible and plan to take quiz/exams on the same day and time at the Office of Learning Services. For more information see: <http://www.millersville.edu/learningservices>

Laboratory

Please refer to the Lab Syllabus for more specific details.

- Lab Evaluation for each experiment will consist of:

Pre-Lab Questions	5 pts
Post-lab Assignment	~15 pts (will vary by assignment length/time)
Laboratory Notebook	5 pts
- Specific point values for assessments listed above may vary according to the lab and questions asked.
- Please notify me if you have any special circumstances (allergies, sensitivities, or pregnancy) that might require alternative lab arrangements.
- Students are expected to respect and follow all safety instructions given in lab.
- Students are expected to access lab information via D2L where I will post background info, protocols, and information or representative data if necessary.
- Pre-lab questions will be completed in D2L and will be due **8 am the day of the lab**.
- Lab notebooks will be turned in weekly and include post-lab questions. Any supplemental graphs or images can be submitted to D2L by the deadline (see lab syllabus).

Advice for Succeeding in Biochemistry:

- Use active studying techniques! Complete practice problems! Consider re-working handouts, achieve questions, and in-class questions. Consider making up questions (altering numbers or AA sequences) for additional practice. Challenge yourself to answer questions without your notes first!
- Advice from former Biochemistry students:
 - Do practice problems!
 - Don't be afraid to ask Dr. MD or your classmates for help.
 - Study your side chains and don't push it off to a few days before the exam.
 - Attend class because the lecture activities are very helpful.
 - Be ready to pull in your knowledge from other classes!
 - Study application of material, not just memorizing content.

- Chemistry Peer-Learning Hours are available for free and all of our chemistry tutors have taken Biochemistry. This semester, peer-learning will meet in Caputo 211 on Tues 5-7 pm, Wed 5-7pm, and Thurs 4:30-6:30.

Course Policies:

Class Attendance and Participation

You are expected to attend all classes prepared to actively participate in the classroom, including asking questions, responding to questions, and contributing to group, class, and laboratory discussion. You are responsible for all material presented in class and distributed via D2L. You are also expected to complete all of the Laboratory Experiments. Only graded work missed for an absence excused based on Millersville's approved guidelines (found online and at the end of the syllabus) may be made up. Please contact me as soon as possible to reschedule. Any graded work conducted outside the scheduled time may differ significantly in form and exact content from the in-class version.

Use of Electronic Equipment:

Studies show that learning in a classroom is enhanced in a personal screen-free environment. Therefore, the use of cell phones, laptops, tablets, etc. is strongly discouraged in class unless otherwise approved by me in advance. Distractibility is real and puppy videos are adorable.

Computer Resources

Students are expected to use D2L for CHEM 326. This provides mechanisms for contact, distribution of information, and data, submission of written work, completion of peer reviews, etc. Students are also responsible for all course information sent to their campus email address.

Diversity and Inclusion Policy

This course is a judgement free and anti-racist learning environment. It is my intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Everyone will treat one another with respect and consideration at all times.

Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with religious events, please let me know so that we can make arrangements for you.

As your instructor I will:

- Learn and correctly pronounce everyone's name
- Use correct pronouns for those who wish to indicate this to me/the class
- Work to accommodate/prevent English language related challenges
- Focus on continuous improvement: Please let me know if something said or done in the classroom, by either myself or other students, is particularly troubling or causes discomfort or offense. While our intention may not be to cause discomfort or offense, the impact of what happens throughout the course is not to be ignored and is something that I consider to be very important and deserving of attention.

If you feel like your performance in the class is being impacted by your experiences outside of class, please don't hesitate to come and talk with me. I will not judge you or think less of you. You do not owe me an explanation of your health (physical or mental). I truly believe we are a team working towards the same goal: your success. When you are successful as my student, I am successful as your instructor!

Illness Policy

It is important to attend class and fully engage with course material to maximize learning of Biochemistry. However, if you feel unwell please stay home.

- If you do not attend class, please contact a classmate to obtain notes. Any handouts or mid-class activities will be posted on D2L. Biochemistry content videos that cover the basics of material discussed in class are posted on D2L.
- If you are unable to attend lab, please contact me as soon as possible.
- If you would like to request virtual office hours, please let me know and we can meet via zoom. Office hours will be held virtually via Zoom and in-person. You may attend in any modality you prefer. I am also able to schedule in-person or virtual meetings to discuss course content.
- If you are experiencing a prolonged illness (more than two (2) weeks), please contact me.
- It is possible that students and instructor might have frequent and unexpected childcare or school closures. If you are a primary caregiver of a child (e.g. parent or guardian), please contact me and we can set up a custom plan for how to manage attendance and assignments if there are closures. Likewise, I will share plans if I am unable to attend in person.
- If there are other situations that will impact a your ability to participate in this course, please contact me as soon as possible.

Academic Honesty

Students are expected to abide by the policy outlined by Millersville University shown below. Students will collaborate on collecting, interpreting, and reporting data. Students are expected to contribute equally on collaborative work. Fabrication of data or plagiarism in preparing reports will NOT be tolerated in this course. Students should not post course material on online study sites such as Chegg. Anyone caught cheating in these ways will be assigned a score of zero on the work.

I am also aware of the recent emergence of AI software such as ChatGPT as a means of completing assignments (essays, papers, etc). Use of this software to complete assignments is plagiarism, as defined in the Millersville University Student Handbook. If someone uses AI assignments their grade will be lowered or given a score of 0. Continued use of this software will result in harsher academic measures.

According to Millersville University's Academic Honesty Policy: *"Students of the University are expected to be honest and forthright in their academic endeavors."* If you break the academic honesty policy, there are severe penalties. A failing grade will be assigned and you may be prosecuted by an Academic Review board. Actions that violate the Academic Honesty Policy are:

1. Plagiarism: inclusion of someone else's words, ideas, or data as one's own work.
2. Fabrication: falsification of research or other findings.
3. Cheating: the act or attempted act of deception by which an individual tries to misrepresent that the individual has mastered subject matter in an academic project or the attempt to gain an advantage by the use of illegal or illegitimate means. Submitting in-class participation cards for another student is considered cheating.
4. Academic Misconduct: violation of University policies by tampering with grades or participating in the distribution of any part of a test before its administration.

For more information see:

- <https://www.millersville.edu/cae/teaching-and-learning/academic-integrity.php>

- <https://www.millersville.edu/about/administration/policies/pdf/academics/academic-policy-academic-honesty-and-dishonesty.pdf>

Student Conduct and Community Standards:

<https://www.millersville.edu/studentconduct/files/studentcodeofconduct.pdf>

Official Attendance Policy

1. Students are expected to attend all classes. It is the student's responsibility to complete all course requirements even if a class is missed. If a student misses class for an officially excused reason, then the student is entitled to make up the missed work but only at the convenience of the faculty member. Responsibility for materials presented in, assignments made for, and tests/quizzes given in regularly scheduled classes lies solely with the student.
2. The Millersville University policy states that faculty will excuse absence for the following reasons:
 - a. personal illness
 - b. death or critical illness in the family
 - c. participation in a university-sponsored activity
 - d. jury duty
 - e. military duties
 - f. religious holidays
3. Faculty judge the validity of student absences from class within the University's approved guidelines and may require documentation for excuse absences. Faculty will evaluate any reason, other than those listed above, for a student missing class and determine whether the absence is justified. In these circumstances, a student may make up missed work at the discretion of the instructor.
4. In the case of foreseeable absences, students are encouraged to notify the faculty member in advance. A student who will miss class due to participation in an official University activity must notify the instructor well in advance of the activity to assure that the absence is excused.
5. For more information: www.millersville.edu/registrar/faculty/attendance_policy.php

Delay and Cancellation Delay Policy: <https://www.millersville.edu/delays.php>

University Inclusion Statement: <https://www.millersville.edu/dsj/inclusionstatement/>

Preferred Name FAQs: <https://www.millersville.edu/dsj/inclusionstatement/preferred-name-faqs.php>

Privacy Rights under FERPA: <https://www.millersville.edu/registrar/ferpaforstudents.php>

Land Acknowledgement:

We would like to recognize the Native peoples of the lower Susquehanna River basin, those known and those unknown to us, who have stewarded the land, upon which Millersville University sits, for thousands of years. We acknowledge that the land on which we gather, study, and work is the ancestral land of the Conestogas, Susquehannocks, Shawnee, and others. One group, the Shenks Ferry people, had a village adjacent to the campus. We pay our respects to the traditional occupants and caretakers of this land.

Title IX Statement

Title IX Reporting Requirements and the Faculty member: Millersville University is committed to maintaining a safe education environment for all students. In compliance with Title IX of the Education Amendments of 1972 and guidance from the Office for Civil Rights, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are

communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. **Faculty members are obligated to report sexual violence or any other abuse of a students who was, or is, a child (under 18 years of age) when the abuse allegedly occurred to the person.**

Information about Title IX, resources and reporting can be found at: <https://www.millersville.edu/titleix/>

Counseling Reminder

Students sometimes face mental health or drug/alcohol challenges in their academic careers that interfere with their academic performance and goals. Millersville University is a caring community and resources are available to assist students who are dealing with problems. The Counseling Center (717-871-7821) is an important resource for both mental health and substance abuse issues. Additional resources include: Health Services (717-871-5250), Center for Health Education and Promotion (717-871-4141), Campus Ministries, and Learning Services (717-871-5554).

Americans with Disabilities Act

Millersville University is committed to equality of opportunity and freedom from discrimination for all students, employees, applicants for admission or employment, and all participants in public University-sponsored activities. In keeping with this commitment, and in accordance with the Americans with Disabilities Act (ADA) the University will make every effort to provide equality of opportunity and freedom from discrimination for all members of the University community and visitors to the University, regardless of any disability an individual may have. Accordingly, the University has taken positive steps to make University facilities accessible to individuals with disabilities and has established procedures to provide reasonable accommodations to allow individuals with disabilities to participate in University programs. The University administration and management are obligated to report any allegation of discrimination to the appropriate office as defined in this policy.

Please let me know how I may make accommodations in the classroom setting that will enhance and support your learning.

Tentative Course Schedule (subject to change)

Date	Topic	Lab
8/26	Introduction to Biochemistry and Cellular Respiration; Molecular Forces of Attraction	Solns, Dilns, and Spec
8/28	Water and Acid-Base Chemistry	
9/2	Acid-Base Chemistry; Carbohydrates	Buffers: pH & pKa
9/4	Complex Carbohydrates; Nucleotides	
9/9	Nucleic Acid Formation and Structure	Carbohydrates and RNA Folding
9/11	Nucleic Acid Function	
9/16	Classes of Lipids	Properties of Amino Acids
9/18	EXAM 1	
9/23	Amino Acids, Peptide Bond and Protein Structure	Native Gel
9/25	Protein Structure	
9/30	Protein Separations	Protein Chromatography
10/2	Protein Folding	
10/7	Protein-Ligand Interactions	Protein Assays (I); Protein Workshop
10/9	Binding: Hb and Mb	
10/14	FALL BREAK	Protein Assays (II)
10/16	EXAM 2	
10/21	Enzymes And Enzyme Thermodynamics	Inspired by Enzymes Project
10/23	Enzyme Mechanisms	
10/28	Enzyme Kinetics	Enzyme Kinetics
10/30	Enzyme Inhibition	
11/4	Intro to Metabolism, Regulation	Western (I); Project Work Week
11/6	Bioenergetics	
11/11	EXAM 3	Western (II); Project Work Week
11/13	Glycolysis	
11/18	Fates of Pyruvate	Glycolysis Workshop
11/20	Pyruvate Dehydrogenase	
11/25	Citric Acid Cycle	NO LAB
11/27	THANKSGIVING BREAK	
12/2	Electron Transport Chain	Respiration and Check out
12/4	ATP Synthase	
	Final Exam: Tues 12/9, 2:45 – 4:45 pm	
	Final Project Viewing: 12/7-9, 10 am – 2 pm	