

CHEM 326: Biochemistry I
Spring 2025
MWF 10-10:50
Brossman 102

Instructor: Melissa A. Mullen Davis Pronouns: she/her/hers
e-mail: melissa.mullendavis@millersville.edu
Office: Caputo 218 Office Phone: 717-871-7439
Office Hours: Mon 11-1, Wed 2-4, Fri 9-10, and by appointment.

Labs: Mon 1:00 – 3:50 pm (D) Tues 9:00 – 11:50 am (A) Tues 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)
- iClicker App Access, available free through Achieve
- E-text "Fundamentals of Biochemistry" by Jakubowski and Flatt (linked on D2L)
 - For those who prefer a hardcopy textbook, the following options 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).



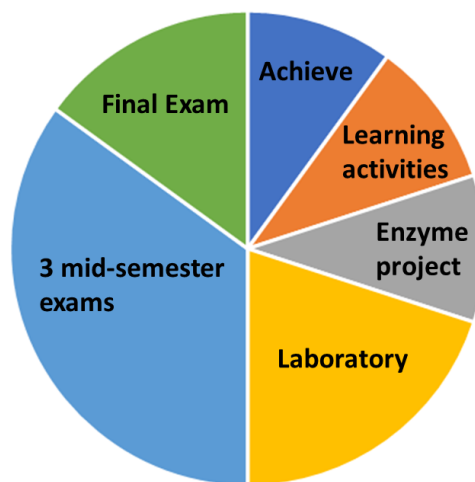
Course Objectives:

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.

Engagement and Learning Activities (15%):

In addition to online homework, we will also have a variety of assigned "Learning Activities," in-class iClicker questions, or quizzes designed to help you practice and gain mastery of course material. 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.

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. Deadlines are included on the course schedule at the end of the syllabus. 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	~10-20 pts depending on the experiment
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 assignments (D2L data and quizzes) should be submitted to D2L by **11:59 pm** three days following your experiment.

Monday Lab	Assignment due	Thurs 11:59 pm
Tuesday Labs	Assignment due	Fri 11:59 pm

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.

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, Inclusion, and Anti-Racism 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.

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

Millersville University and its faculty are committed to maintaining a safe and productive educational environment for all students. In order to meet this commitment and to comply with Title IX of the Education Amendments of 1972 and guidance from the Office for Civil Rights, Title IX requires University faculty members to report incidents of sexual discrimination, including sexual violence, shared by students to the University's Title IX Coordinator. Accordingly, if a student shares information about any incidents of sexual discrimination or sexual violence during a classroom discussion, in a writing assignment for a class, or in other contexts, faculty must report that information to the Title IX Coordinator. This information will only be shared with the Title IX Coordinator, who is the individual on campus designated to respond to reports of discrimination or sexual violence. While the Title IX Coordinator is not a confidential source of support, they will address matters reported to them with sensitivity and will keep your information as private as possible. Additionally, faculty members are obligated to support sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred, to the person designated in the University's Protection of Minors policy.

Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth 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
1/22	Introduction to Biochemistry and Respiration	No Lab
1/24	Water; Molecular Forces of Attraction	
1/27	Acid-Base Chemistry	Solns, Dilns, and Spec
1/29	Acid-Base Chemistry; Nucleotides	
1/31	Nucleic Acid Structure	
2/3	Nucleic Acids Function; Central Dogma	Buffers: pH & pKa
2/5	Carbohydrates	
2/7	Carbohydrates	
2/10	Glycobiology	Carbohydrates and RNA Folding
2/12	Lipids	
2/14	Lipids and Membranes	
2/17	EXAM 1	Properties of Amino Acids
2/19	Amino Acids	
2/21	Peptide Bonds	
2/24	Protein Separations	Protein Chromatography
2/26	Protein Separations	
2/28	Protein Structure	
3/3	Protein Structure	Native Gel
3/5	Protein Folding	
3/7	Protein-Ligand Interactions	
	SPRING BREAK: NO CLASS	NO LAB
3/17	Binding: Hb and Mb	Protein Assays (I)
3/19	Binding: Hb and Mb	
3/21	EXAM 2	Inspired by Enzymes Project; Enzyme Choice Assign
3/24	Enzymes!	
3/26	Enzyme Thermodynamics	
3/28	Enzyme Mechanisms	
3/31	Enzyme Kinetics	Protein Assays (II); Enz Structure Assign
4/2	Enzyme Kinetics	
4/4	Enzyme Inhibition	Enzyme Kinetics
4/7	Intro to Metabolism, Regulation	
4/9	Bioenergetics	
4/11	Bioenergetics	Western (I); Enzyme Mech Assign
4/14	EXAM 3	
4/16	Glycolysis	
4/18	Glycolysis	Western (II); Enz Kinetics Assign
4/21	Fates of Pyruvate	
4/23	Pyruvate Dehydrogenase	
4/25	Citric Acid Cycle	Respiration and Check out
4/28	Citric Acid Cycle	
4/30	Membranes and Membrane Transport	
5/2	Electron Transport Chain	Final Project Due
5/5	ATP Synthase	
	Final Exam: Thurs 5/8, 8 - 10 am	