BMB471: ADVANCED BIOCHEMISTRY LABORATORY SYLLABUS

SS26 Edition

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Instructors

Table I: Faculty Instructor information

Faculty	Email	Office
Dr. Min-Hao Kuo*	kuom@msu.edu	401 BCH
Dr. Maks Chruszcz	chruszcz@msu.edu	107 BCH
Dr. Stacy Hovde	deweesst@msu.edu	409 BCH
Dr. Allan TerBush	terbusha@msu.edu	116A BCH

*Course coordinator

Table II: Teaching Assistant (TA) information

Teaching Assistant	Email
Kayla Bello	bellokay@msu.edu
Ava Erickson	erick321@msu.edu
Cole Evans	evansco7@msu.edu
Mailan Nguyen	nguy1149@msu.edu

Books Used in Biochemistry and Molecular Biology 471

Texts

Required texts:

- Advanced Biochemistry Laboratory, 2025 ed.
- Advanced Biochemistry Laboratory Supplement, 2025 ed.

Recommended texts:

- Segel, I.H., *Biochemical Calculations*, 2nd ed., J. Wiley & Sons, Inc., 1976.
- Day, R.A., *How to Write and Publish a Scientific Paper*, 6th or 7th ed. Oryx Press, 2006.
- Boyer, R.F., *Modern Experimental Biochemistry*, 3rd ed., Addison Wesley Pub. Co., 2000.
- Voet, D. and Voet, J.G., *Biochemistry*, 2nd edition, J. Wiley & Sons, N.Y., N.Y., 1995.
  Available in the Teaching Labs and Room 105 Biochemistry:

Handbooks

- *Handbook of Chemistry & Physics*, CRC Press (various editions, a new edition is published each year)
- *The Merck Index*, Merck & Co. (various editions)
- Dawson, R.M., Elliott, D.C., Elliott, W.H., and Jones, K.M., *Data for Biochemical Research*, 3rd ed., Clarendon Press, Oxford, 1986.
- Sax, N.I., *Dangerous Properties of Industrial Materials*, 4th or 5th ed., Van Nostrand Reinhold Co., 1975 (4th), 1979 (5th)
- Rayburn, S.R., *The Foundations of Laboratory Safety*, Springer-Verlag, 1990.

Objectives

The subject areas for the course are weak acids and bases, spectrophotometry, protein purification, and enzyme activity assays. The objectives for the course are for students to:

- Develop the ability to design logical experiments given specific experimental objectives but only general procedures, perform these experiments successfully and independently, properly interpret the data, and clearly present the data in writing.
- Learn foundational biochemical laboratory methodology and techniques.
- Further develop:
    - quantitative laboratory skills.
    - the ability to keep a clear and complete lab notebook.
    - the ability to analyze and interpret laboratory data.
    - skill in writing scientific laboratory reports.
- Understand the concepts on which the laboratory experiments are based and related concepts (largely covered in lecture and homework problems).

Organization of Course

Lectures: Monday, 12:40 - 1:30 pm, 101 Biochemistry.
Laboratory Periods: Tuesday - Friday (Sections 1-4): 12:40 - 5:40 pm
Quizzes: Monday, 1:30 - 9 pm, dates shown in the course schedule

Lectures: In-person lectures will be held Mondays from 12:40 - 1:30 pm EST in Room BCH 101. Lectures will provide scientific and technical content for the corresponding lab period. Lectures are a mandatory part of the course and slides will be posted to D2L

Laboratory Periods: Lab sections are Tuesday – Friday (sections 1-4, respectively) from 12:40 - 5:40 pm in BCH 113 or 117. Laboratory experiment videos will be posted online. Students are encouraged to view these videos before attending lab and performing the experiments. Some data obtained from experiments will be distributed via D2L modules. Students may work only on their scheduled lab day, unless coordinated ahead of time with Dr. TerBush with a valid reason.

Dress code: While in the lab, students must wear lab appropriate attire. This includes safety glasses (unless informed chemical splash goggles are required; will be informed ahead of time), close-toed shoes, full-length shirts (no bare mid-drifts), and long pants (no torn pantlegs). Put simply, no skin may be exposed beneath the waist. Students with improper attire will be required to leave and come back with proper clothing.

Each student will work individually in Units A, B, C, and E. For Unit D, students will work in pairs. When working as a group, partners only collaborate on the experimental (data acquisition) portions of the labs. All notebook preparation, data analysis/post-lab notebook entries, and lab reports are to be done individually. Unit E is considered a practical examination for the course. **Students are expected to perform experimental work each lab period. Except in cases of excused absence, students who do not participate in data collection during the lab period are not entitled to the data collected by others.**

Quizzes: Six short quizzes will be administered between 1:30 and 9 pm EST on Mondays as noted in the course schedule. These quizzes will be taken remotely and be open note. Have a calculator and transparent ruler available for when you take the bi-weekly quizzes. Once a quiz is begun, you will have 20-30 minutes to complete it. After the time limit expires, no further answers will be allowed.

Some of the main course goals are for you to be able to analyze and interpret laboratory data for meaningful biochemical conclusions. Therefore, the quizzes will focus on your understanding of the quantitative and conceptual aspects of the experimental work, the material covered in lectures, the assigned readings, and pre-lab problem sets. Problems of the type encountered in the experimental work and in the pre-lab problems may be on the quizzes. You should also expect some short-answer questions focusing on the theory of your experiments and the molecular interactions involved in them.

Office Hours

Office hours are a great way to interact directly with instructors to clarify questions and concerns you may have about the course material. This semester, we will host in-person office hours. We have some standing weekly times that are open for students to drop into. You can find the times for each instructor listed below. If the times listed there do not work for you, please feel free to email any of the instructors to set up an individual appointment either in person or via zoom video conferencing software. This software is compatible with most internet browsers, and if you are unfamiliar with Zoom, please visit https://msu.zoom.us for technical help. Please allow 24 hours for a reply.

- Dr. TerBush: Monday 10 am – 12 pm (BCH116A)
- Dr. Kuo: Monday 4 – 5 pm (BCH401A)
- Dr. Chruszcz: Friday 10 – 11 am (BCH107A)
- Dr. Hovde: Friday 11 am – 12 pm (BCH116)

Computer Resources

The Teaching Lab has computers with internet access that may be used during scheduled laboratory hours. We will be using the Desire2Learn (D2L) system for posting announcements and course materials as well as LON-CAPA for pre-lab problem sets (according to the schedule posted on Page 5), and submission of your laboratory reports. It is recommended that students have access to 25 Mbps download speed for watching video content from D2L.

Course Schedule & Due Dates

Date	Experimental Work	Due Dates	LON-CAPA[1]	Bi-weekly Quiz[2]
Jan. 12-16	Lab introduction; check-in; safety tour **Unit A** - spectrophotometry			
Jan. 19-23	**Monday Lecuture cancelled - MLK Day** **Unit B** - buffer preparation (titration); pH measurements	Jan 20-24: Notebooks[3] Unit A	Problem Set B-1	
Jan. 26-30	**Unit B** - effects of salt & dilution on pH of a buffer		Problem Set B-2	Quiz 1
Feb. 2-6	**Unit C** - AAT enzyme assays and Lowry protein assay	Feb. 3-6: Notebooks[3] Unit B	Problem Set C	
Feb. 9-13	**Lecture & Lab canceled** Open lab office hours (Wednesday - Friday; 12:40-3 pm)	Feb. 10-13: Notebooks Unit C		
Feb. 16-20	**Unit D** - AAT heat denaturation and AAT assays		Problem Set D-1	Quiz 2
Feb. 23-27	**Unit D** - $(NH_4)_2SO_4$ precipitation & AAT assays	Feb. 27: Report I[4] Units A-C	Problem Set D-2	
Mar. 2-6	**Lecture & Labs canceled - Spring Break**			
Mar. 9-13	**Unit D** - CM-sephadex column chromatography & AAT assays	Mar. 10-13: Notebooks D1-D2	Problem Set D-3	Quiz 3
Mar. 16-20	**Unit D** - Lowry protein assay & SDS-PAGE of AAT fractions			
Mar. 23-27	**Unit E** - buffer/ethanol preparation, yADH stability	Mar. 24-27: Notebooks D3-D5	Problem Set E-0	Quiz 4
Mar. 30 - Apr. 3	**Unit E** - approximate K_m & V_{max}, stability			
Apr. 6-10	**Unit E** - precise valid range, stability	Apr. 7-10: Notebooks E0-E2	Problem Set E-3	Quiz 5
Apr. 13-17	**Unit E** - precise K_m & V_{max} and inhibition, stability	Apr. 17: Report II Unit D	Problem Set E-4	
Apr. 20-24	Check-out	Apr. 21-24: Notebooks[5] E1, E3-E4		Quiz 6

1. LON-CAPA Problem Sets (PS) are due **Tuesdays at 12:30 pm EST**. Each problem set opens on the Monday the week before the due date.
2. Quizzes will be given through the D2L course page and open at 1:30 pm the Monday of the week listed on the course schedule and remain available through 9 pm.
3. Lab notebooks are due and submitted to their corresponding D2L assignment dropbox by **12:30 pm EST** on the day of your lab section in the weeks noted above.
4. Reports must be submitted to their corresponding D2L assignment dropbox

REPORTS ARE DUE BY 11:59 pm EST. – **Late reports will receive a 25% deduction for each 24-hour period after the deadline**

Course reading assignments for Monday lectures.

Table III: Reading assignments

Date	Subject	Reading
Jan. 12	Spectrophotometry, including Beer's and Lambert's laws	1. Experimental Biochemistry Supplement, Chapter 1 & 3. 2. Segel, I.H. *Biochemical Calculations*, 2nd ed., pp. 324 - 333
Jan. 19 & 26	Buffers, activity, and related subjects	1. Experimental Biochemistry Supplement, Chapter 2. 2. Segel, I.H., *Biochemical Calculations*, 2nd ed. pp. 1-83.
Feb. 2	Assay of enzymes & protein	1. Experimental Biochemistry Supplement, Chapter 4. 2. Segel, I.H., *Bioch. Calcs.*, 2nd ed. pp. 208-214, 291-92, 333-46.
Feb. 16	Protein purification	1. Experimental Biochemistry Supplement, Chapter 7. 2. Segel, I.H., *Bioch. Calcs.*, 2nd ed. pp. 287-290
Feb. 16 Mar. 9 Mar. 16	Protein purification Chromatography SDS-PAGE	1. Experimental Biochemistry Supplement, Chapter 5. 1. Experimental Biochemistry Supplement, Chapter 6.
Mar. 23 - Apr. 20	Chemical and Enzyme Kinetics	1. Experimental Biochemistry Supplement, Chapter 8. 2. Segel, I.H., *Biochemical Calculations*, 2nd ed., pp. 208-212 (top), 214-219, 221 (bottom)-236 plus problem 4.9 on page 237, 246-250, 252.

Bi-weekly quizzes

Some of the main course goals are for you to be able to analyze and interpret laboratory data for meaningful biochemical conclusions. Therefore, the quizzes will focus on your understanding of the quantitative and conceptual aspects of the experimental work, the material covered in lectures, the assigned readings, and pre-lab problem sets. Problems of the type encountered in the experimental work and in the pre-lab problems may be on the quizzes. You should also expect some short-answer questions focusing on the theory of your experiments and the molecular interactions involved in them.

Before you begin the quiz, be sure that you have a stable internet signal. Issues with the WI-FI signal is not grounds for a quiz retake or other accommodations. If your internet at home is suspect, going to a library or other location may be necessary.

Grading

Final grades will be based on a weighted grading scale as described below:

Table IV: Assignment category weighting in final gradebook

Grade Category	% weight
Laboratory notebooks	40%
Reports	25%
Quizzes	25%
LON-CAPA problem sets	10%

Table V: Final grade cutoffs

Grade	% cutoff
4.0	90
3.5	82
3.0	75
2.5	70
2.0	65
1.5	60
1.0	50

Grade cutoffs subject to minor adjustments in the downward direction. A passing grade will be awarded to any student who completes and submits all Problem Sets, Lab Reports and Notebooks on time, participates in all laboratory sessions (except for excused absences), and earns at least 50% of the points.

Late Penalties and other Course Policies

1. Students are responsible for checking the documents that are uploaded to D2L assignment dropboxes. Export your Word documents to a PDF and submit those. Students may submit assignments as many times as needed. We will grade the last file submitted to the assignment dropbox.
2. The **late penalty** for Notebooks and Lab Reports is 25% of the points for the assignment for each 24-hour period past the deadline (including weekends). Assignments turned in more than 4 days late will receive no credit but will be assessed and annotated for student feedback.
    a. Additionally, objects (data tables, graphs, chart tracings, etc) placed into incorrect sections of the notebooks will result in no credit given for the affected objects.
3. **Biweekly quizzes** are taken through D2L, while Pre-lab Problem Sets are accessed through LON-CAPA.
    - Quizzes will be given on Mondays of the weeks listed on the course schedule. They will be open from 1:30 – 9 pm EST. No late quizzes will be accepted, except by special arrangement coordinated with Dr. TerBush before the quiz.
    - Have a calculator and transparent ruler available for when you take the bi-weekly quizzes. Once a quiz is begun, you will have 20-30 minutes to complete it. After the time limit expires, no further answers will be allowed.
4. **Pre-lab Problem Sets** will be available through LON-CAPA. The problems will test your understanding of the experiments and prepare you for pre-lab and post-lab calculations/data analysis for experiments performed the following week.
    - are due by 12:30 pm EST on Tuesdays listed on the course schedule
    - No late Problem Sets will be accepted.
5. **Absence from a Laboratory Session** must be documented in writing and, if possible, in advance. Medical excuses will be accepted up to 3 days after the missed class period. Other excuses must be authorized in advance by Dr. TerBush.

6. **Request for assignment extensions** must reflect some documentable situation that prevented you for completing your assignment. To request such an extension, email Dr. TerBush with a description and documentation of your situation (no need for sensitive details) before the assignment is due. Proactivity on such circumstances is appreciated.
7. **RCPD accommodation letters**: If you have an RCPD accommodation letter that details accommodations relevant to BMB471, please email it to Dr. TerBush at the beginning of the semester. Accommodations cannot be applied retroactively.
8. **Unexcused absences** will result in no ability to make up missed experiments or completing the post-lab analysis.
9. Students with **3 or more unexcused absences** from laboratory periods will be assigned a failing grade (0.0) in the course.
10. **Requesting official course data**: Students are responsible for performing experiments to acquire data needed for post-lab notebook analysis. However, if a student fails to acquire usable data, that student may request official data by emailing Dr. TerBush, so the notebook assignment may be completed. A deduction will be applied to the notebook assignment.
11. **Challenging grades.** If you believe an assignment was graded incorrectly, you have 1 week from the time grades and feedback are published to email Dr. TerBush to challenge the grade. You must include a listing of the criteria that you believe were graded incorrectly and a description of where in the assignment you earned those points. Grade challenges after 1 week will not be considered

Laboratory Safety

For the welfare of fellow students, and for your own well-being, each student is expected to follow a set of accepted laboratory precautions. To ensure that each student understands these guidelines, students are expected to sign a consent form. The form will be provided on the first day of class. In the lab:

- **Protective eyewear must be worn at all times (safety glasses or face shields). No exceptions to this policy will be made.**
    - **A few times throughout the semester, you will need chemical splash goggles when working with a strong acid or base. You will be informed of these lab periods ahead of time.**
- Proper clothing (full-length pants, close-toed shoes, full-length shirts (no bare mid-drifts)) must be worn to lab. Put simply, no skin may be exposed beneath the waist. Students with improper attire will be asked to leave and come back with proper clothing.
- Gloves must be worn when working with hazardous chemicals (Units B and D). We will supply suitable gloves for this purpose.
- Do not eat, drink, or apply cosmetics at any time while in the laboratory. **Do not place food wrappers, beverage cups, or other food-related waste in the trash cans in the lab.**
- Do not sit on the lab benches.
- Use chemicals with high vapor pressure only in the hood.
- Handle and dispose of hazardous chemicals properly. Disposal containers are provided.

- When chemicals are spilled, they should be wiped or swept up or both as soon as possible. If the spillage is large, immediately notify an instructor. Sponges and brushes are provided and should be used to keep your work area clean.
- Be aware of objects that can burn or give electrical shocks.
- In general, be alert to possible hazards from chemicals, glassware, electrical connections, and flammable solvents. Read labels and observe suggested precautions.
- Sweep up broken glassware as soon as possible and deposit it in the labeled container set aside for this purpose.
- Never work in the lab alone.
- All solutions that you prepare must be labeled with date, your last name, and the type and concentration of the reagent. Unmarked solutions will be disposed.
- Wipe your lab bench with a damp sponge at the end of each lab period.
- Be familiar with location and use of safety items — location of safety showers, eyewash stations, fire blankets, fire extinguishers, medical kit. Review the lab floor plan and evacuation routes on page 11 before coming to the first lab period.

General Laboratory Rules

- Used glassware from the glassware cabinets must be rinsed with tap water and placed on the designated cart after all tape has been removed. Ink writing on this glassware need not be removed. Glassware from the shared bench drawers must be rinsed with tap water, then rinsed several times with de-ionized water and returned to the shared drawer.
- Items stored in the cold room or freezer boxes should be removed and disposed when they are no longer needed.
- The instructors will make every effort to keep equipment in good working order. It is your responsibility to read and understand instructions for the use of equipment. Do not turn on an instrument until you have done this. Do not hesitate to ask questions of your instructor after you have read the instructions. If any equipment malfunction is noted, report this immediately to an instructor.
- **Be considerate of others.** Clean up after yourself after using any piece of equipment. All equipment, especially balances, should be left ready for immediate use by another student.

In Case of an Accident

- Report all injuries, even minor ones, to an instructor immediately.
- In case of even minor laboratory accidents, you should go to Olin Health Center for treatment. Your instructor will provide an accident report form; a copy of this form must be taken to the Center.
- For any chemicals splashed in the eye, hold the eye open and flush immediately with cold water by using the eye wash. Flush for at least 5 minutes and call for help from an instructor.
- For chemicals spilled on the skin or splashed into the mouth, again, flush with large amounts of cold water for 5 or more minutes. Call for an instructor.
- For severe bleeding, apply pressure and call for help from an instructor.
- For burns, flush with cold water and contact an instructor.

- Note: Injury to students in the laboratory is not covered by University insurance. Students must provide their own insurance coverage.

Academic Integrity

- Academic integrity is central to the educational process and is expected throughout this course. We will teach you accepted standards of intellectual honesty with respect to the performance of experiments, the processing of data, and the reporting of results. We expect you to follow these standards. Particularly be aware of when you must work independently. Credit will not be given to work obtained through collaboration when independent effort is required. Students should be familiar with the student handbook, which governs all student behavior.
- Please see the following additional expectations below:
    - ***Each student is to work completely independently in the processing of their data, as well as in the writing of the reports.*** Students are welcome to discuss their data with each other, with instructors, or with others to achieve a full understanding of them before processing them. The exception to open discussion: ***In the units where a coworker collects some of your data, you may not discuss the processing of the data or the preparation of the report with your coworker in any way.*** Discussions about the data and experiment with anyone else are still encouraged.
    - ***Plagiarism of any kind will not be tolerated***. Penalties for plagiarism will range from ***a severe point deduction to a score of zero*** for the assignment, and as such will be regarded as a ***"penalty grade"***. In accordance with university policy, a report will be forwarded to the academic dean, which will become a part of the student's academic record. In addition, ***falsification or fabrication of any laboratory data*** will result in a failing grade in the class and a report will be forwarded to the academic dean.

Policy on Artificial Intelligence (AI) Use in Writing Assignments.

- BMB471 students are encouraged to develop critical thinking and effective writing skills by thoughtfully engaging with notebook assignments and reports. Responsible use of Artificial Intelligence (AI) tools (e.g., chatbots, large language models) is encouraged to support this learning process. Specifically, AI may be used collaboratively to brainstorm ideas, explore scientific concepts, gather background information, structure arguments, and provide feedback to refine your drafts. However, your final submission must reflect your own analytical thinking, synthesis of ideas, and original expression. AI-generated content should be treated as a collaborative starting point, to be critically evaluated and built upon by you, not a final product. Assignments that rely heavily on unmodified AI-generated text or involve minimal student input undermine the educational objectives of this course and are considered breaches of academic integrity. Any use of AI that breaches the code of academic honesty policy and may result in a failing grade for a portion or the entire assignment. Please consult with the instructor if you have questions about appropriately using AI in this course.

Student Rights and Responsibilities

As students, you have a range of support and information options available to discuss actions or activities related to their academic, personal or professional lives at MSU. These rights and resources are detailed on the ombudsperson's website.