

BMB471: ADVANCED BIOCHEMISTRY LABORATORY SYLLABUS
2021 Edition

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Instructors

Faculty & Staff	Email	Office	Phone	Zoom Office Hours**
Min-Hao Kuo*	kuom@msu.edu	401A Biochemistry	(517) 355-0163	Monday 3-4 pm
R. Michael Garavito	garavito@msu.edu	513 Biochemistry	(517) 355-9724	Monday 3-4 pm
Allan TerBush	terbusha@msu.edu	113 Biochemistry	(517) 355-3971	Monday 10-12 am

*course coordinator

**We are certainly open to setting individual zoom appointments upon request.

Teaching Assistants	Email
Anooj Arkatkar	arkatkar@msu.edu
Ryan Phillips	phill794@msu.edu
Abby Schuch	schuchab@msu.edu
Kellie Walker	walke745@msu.edu

Books Used in Biochemistry and Molecular Biology 471

Texts

Required to be purchased by student:

- Advanced Biochemistry Laboratory, 2020 ed. (this lab manual)
- Advanced Biochemistry Laboratory Supplement, 2020 ed. (Part of this lab manual)
- 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.

Recommended to purchase:

- 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:

- Cooper, T.G., *The Tools of Biochemistry*, 1st ed., Wiley-Interscience, 1977.
- Various authors, textbooks and other reference material on laboratory techniques.

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:
 - o quantitative laboratory skills.
 - o the ability to keep a clear and complete lab notebook.
 - o the ability to analyze and interpret laboratory data.
 - o 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

The course consists of one lecture, one 50-minute pre-lab/Q&A period, and one 5-hour laboratory period per week. The lectures will be pre-recorded and posted 1 week ahead of its scheduled week. Monday pre-lab/Q&A sessions will be held via Zoom at 12:40 pm EST and are **mandatory**. You can find a link to the zoom meeting posted in D2L. Bi-weekly quizzes will be given in D2L and opened at 1:10 pm EST. You will have 20 minutes to complete each quiz.

The course will have a semi-open lab format; students may leave and return to the lab rooms at any time. The labs (113, 116, & 117 Biochemistry) will be open Tuesday through Friday from 12:30 to 5:30 p.m., and students may work only on their scheduled lab day.

For parts of Unit A and all of Unit D, students will work in groups of two. Each student will work individually in Units B, C, and E. When working in pairs, 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.**

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

Lab Period	Date	Experimental Work	Due Dates	Bi-weekly Quiz
1	Jan. 11-15	Reading and review of course material		
2	Jan. 18-22	Online week: group and experiment signup, watch Unit A or B lectures		
3	Jan. 25-29	Unit A - purity of light & wavelength accuracy or Unit B - buffer preparation (titration curve); pH measurements		Quiz 1
4	Feb. 1-5	Unit A - absorbance accuracy & linearity, recorder use or Unit B - effects of salt & dilution on pH of a buffer		
5	Feb. 8-12	Unit A - purity of light & wavelength accuracy or Unit B - buffer preparation (titration curve); pH measurements	Feb. 9-12: Notebooks* Unit A or Unit B**	
6	Feb. 15-19	Unit A - absorbance accuracy & linearity, recorder use or Unit B - effects of salt & dilution on pH of a buffer		
7	Feb. 22-26	Unit C – AAT enzyme assays and Lowry protein assay	Feb. 23-26: Notebooks* Unit A or Unit B**	Quiz 2
8	Mar. 1-5	Labs Canceled	Mar. 2-5: Notebooks* Unit C	
9	Mar. 8-12	Unit D – large-scale $(\text{NH}_4)_2\text{SO}_4$ precipitation, and AAT assays	Mar. 12: Report I*** Units A-C	Quiz 3
10	Mar. 15-19	Unit D - CM-sephadex column chromatography - AAT and Lowry protein assay of AAT fractions		
11	Mar. 22-26	Unit D - SDS-PAGE of AAT fractions Unit E - buffer/ethanol preparation, γ ADH assay testing	Mar. 23-26: Notebooks* D2-D4	Quiz 4
12	Mar. 29 - Apr. 2	Unit E - $[\gamma\text{ADH}]$, $[\text{NAD}^+]$, γADH stability	Mar. 30 - Apr. 2: Notebooks* D5-E0	
13	Apr. 5-9	Unit E - approximate K_m & V_{max} , stability	Apr. 5: Report II*** Unit D Apr. 6-9: Notebooks* E2-E4	Quiz 5
14	Apr.12-16	Unit E - precise K_m & V_{max} and inhibition, stability		
15	Apr. 19-21	Lab check-out	Apr. 19: Notebooks* E4-E5, E7 Apr. 23: Report III*** Unit E	Quiz 6

*Lab notebooks must be submitted by 5:30 pm EST on the day of your lab period to be graded.

**Unit A or B notebooks are due depending on which unit each student has completed over the previous two weeks

***submit reports to their corresponding D2L assignment

REPORTS ARE DUE BY 12:00 pm EST. - LATE REPORTS RECEIVE NO CREDIT

Pre-lab problem sets

Short 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. The assignments are due **before the scheduled start of the following week's lecture (12:40 p.m.)** on Mondays. The schedule for distribution and due dates of the problems is as follows:

Post Date	Due Date	Material Covered
Jan. 18	Feb. 8	Unit A – Day 1*
Jan. 25	Feb. 15	Unit A – Day 2*
Jan. 18	Feb. 8	Unit B – Day 1*
Jan. 25	Feb. 15	Unit B – Day 2*
Feb. 15	Feb. 22	Unit C – Enzyme and protein assays
Mar. 1	Mar. 8	Unit D – Day 2 ((NH ₄) ₂ SO ₄ fractionation)
Mar. 8	Mar. 15	Unit D – Day 3 (CM-sephadex, Lowry)
Mar. 15	Mar. 22	Unit D – Day 4 (SDS-PAGE, γADH buffers)
Mar. 15	Mar. 22	Unit E – Day 1 ([γADH], [NAD ⁺], γADH stability)
Mar. 29	Apr. 5	Unit E – Day 2 (Approximate K _m & V _{max})
Apr. 5	Apr. 12	Unit E – Day 4 (Precise K _m & V _{max} , Inhibition)

*Pre-lab problem sets will be due according to the unit each student is working on for Weeks 1-4

Discussion section schedule and readings

(Lecture videos posted 1 week ahead of time, Zoom meetings 12:40 - 1:30 pm EST)

Date	Subject	Reading
Jan. 11	Spectrophotometry, including Beer's and Lambert's laws	1. Experimental Biochemistry Supplement, Chapter 1 & 3. 2. Segel, I.H. <i>Biochemical Calculations</i> , 2 nd ed., pp. 324 - 333
Jan. 18	Spectrophotometry (continued)	
Feb. 1	Buffers, activity, and related subjects	1. Experimental Biochemistry Supplement, Chapter 2. 2. Segel, I.H., <i>Biochemical Calculations</i> , 2 nd ed. pp. 1-83.
Feb. 8	Buffers (continued)	
Feb. 15	Assay of enzymes & protein	1. Experimental Biochemistry Supplement, Chapter 4. 2. Segel, I.H., <i>Bioch. Calcs.</i> , 2 nd ed. pp. 208-214, 291-92, 333-46.
Feb. 22	Protein purification	1. Experimental Biochemistry Supplement, Chapter 7. 2. Segel, I.H., <i>Bioch. Calcs.</i> , 2 nd ed. pp. 287-290
Mar. 1 Mar. 15, 22	Protein purification Chromatography SDS-PAGE	1. Experimental Biochemistry Supplement, Chapter 5. 1. Experimental Biochemistry Supplement, Chapter 6.
Mar. 29, Apr. 5 Apr. 12, 19	Chemical and Enzyme Kinetics	1. Experimental Biochemistry Supplement, Chapter 8. 2. Segel, I.H., <i>Biochemical Calculations</i> , 2 nd 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 bi-weekly 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.

Bring a calculator and transparent ruler to bi-weekly quizzes.

Grading

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

Laboratory notebooks	40%
Laboratory reports	30%
Bi-weekly quizzes	20%
Prelab problem sets	10%
Total	100%

Students earning 90% or more of the total points will receive a grade of 4.0. The dividing line between 2.5 and 2.0 grades will be approximately 70% of the total points. The range between 90% and 70% will be divided into approximately equal parts for assigning grades of 3.5, 3.0, and 2.5. The dividing line between 1.0 and 0.0 grades will be about 50%. 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.

Note: Reports are **due by 12:00 p.m.** on the day listed in the schedule. **Reports submitted after the due time/date will not receive any credit.** Electronic templates will be provided for you to make your reports from. Submit your electronic reports to their corresponding D2L assignment dropbox **by 12:00 p.m.** on the day listed in the schedule.

Note: Notebooks are **due at 5:30 pm EST on the day of your lab section** (except the last grading; see schedule) the week listed in the schedule. Late notebooks will incur a 25% per 24-hour period penalty (including weekends) and may have a delay in when feedback and grades are published. Notebooks submitted more than 3 days late will receive no credit. They will be corrected with feedback provided.

Challenging Grades

From the time grades are posted, students have **2 weeks to challenge their grades** by contacting a faculty on the teaching team with a list of items from the grading rubric they believe were graded incorrectly and noting where in the assignment they satisfactorily covered that content.

COVID-19 Safety precautions

The novel coronavirus, which causes the disease COVID-19, has been declared a worldwide pandemic. The COVID-19 virus is extremely contagious and is believed to spread mainly from person-to-person contact. The COVID-19 pandemic represents an unprecedented public health crisis that has impacted every facet of life, including the classroom environment. As a result, significant changes in how we conduct in-person classes must be made. This section of the syllabus discusses the policies and procedures we will use in class.

This class abides by all principles, guidelines, and requirements detailed in the [MSU Community Compact](#). Specifically, all participants in the class will adhere to the following:

Face coverings. Face coverings must be worn by everyone (including all faculty, staff, students, vendors, and visitors) indoors and outdoors while on property owned or governed by MSU and while participating in MSU-related or MSU-sponsored activities. Thus, unless you are unable to tolerate a face covering for medical reasons you must wear a face covering inside and outside of class. **This face covering must cover your mouth and nose.**

Physical distancing. We will be practicing physical distancing in the classroom. Thus, all students should maintain at least six feet distance between themselves and others (excluding those with whom they live). This applies to all aspects of the classroom setting, including seating arrangements, informal conversations, and dialogue between faculty and students.

Personal Hygiene. All students must maintain proper hygiene and health practices, including:

- Washing hands frequently with soap and water or, if soap is unavailable, using hand sanitizer with at least 60% alcohol
- Routinely cleaning and sanitizing living spaces and/or workspace
- Using the bend of the elbow or shoulder to shield a cough or sneeze
- Refraining from shaking hands

Adherence to Signage and Instructions. Students will (a) look for instructional signs posted by MSU or public health authorities, (b) observe instructions from MSU or public health authorities that are emailed to my “msu.edu” account, and (c) follow those instructions.

Self-Monitoring. Students will self-monitor for flu-like symptoms (for example, cough, shortness of breath, difficulty breathing, fever, sore throat or loss of taste or smell). If a student experiences any flu-like symptoms, they will stay home and contact a health care provider to determine what steps should be taken.

Exposure to COVID-19. If a student is exposed to someone who is ill or has tested positive for the COVID-19 virus, they will stay home, contact a health care provider and follow all public health recommendations.

Compliance and reporting. Those who come to MSU facilities must commit to the personal responsibility necessary for us to remain as safe as possible, including following the specific guidelines outlined in this syllabus and provided by MSU more broadly (see below). There may be times when action will be necessary to reinforce expectations. **If you do not wear appropriate face coverings (see MSU’s guidelines), do not wear your face covering appropriately (i.e., over your mouth and nose), or do not adhere to physical distancing guidelines (i.e., six feet apart), you will be asked to correct the situation or leave the facility.** In addition, MSU will utilize the processes already in place to respond to any issues of noncompliance with standards established for the

health and safety of our community. For classroom disruptions or issues, the responses and processes that have been used previously remain the first line of action. If necessary, the student conduct system will be the avenue used to adjudicate student disciplinary situations.

Additional information. See <https://msu.edu/together-we-will/keeping-spartans-safe/> for details about these new policies and procedures and see <https://ehs.msu.edu/assets/docs/fact-sheets/cloth-face-covering-fact-sheet.pdf> for more details about the cloth face coverings guidelines

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 (must be chemical splash goggles or face shields). No exceptions to this policy will be made.**
- 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.**
- Mouth pipetting is not permitted.
- 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.
- Do not use open flames near flammable chemicals.
- 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 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.

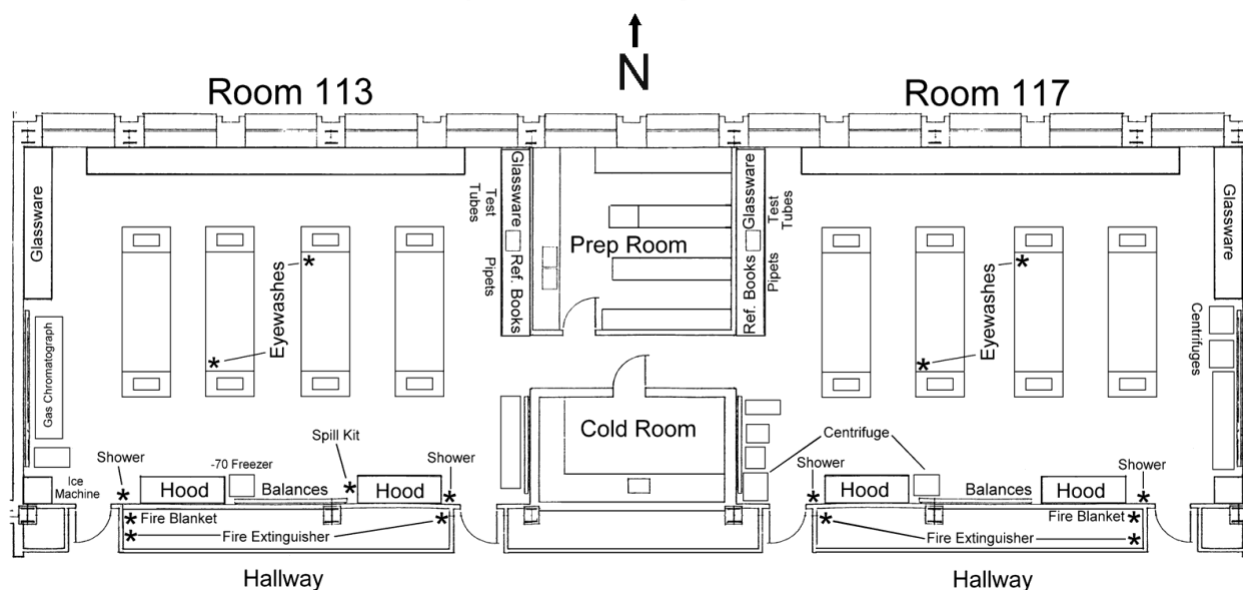
Plagiarism of any kind will not be tolerated. Penalties for plagiarism will range from **a severe point deduction to a score of zero** for the assignment, and as such will be regarded as a **"penalty grade"**. In accordance with university policy, a report will be forwarded to the academic dean, which 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.

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](#).

Teaching Labs Floor Plan

Biochemistry Teaching Labs - Floor Plan



Emergency Evacuation Instructions

In Case of an Emergency

Fire: Exit room and go left (East) to EXIT and move away from building

Tornado: Exit room and go left (East) and downstairs to middle of building

