

**BMB471: ADVANCED BIOCHEMISTRY LABORATORY SYLLABUS**  
SS24 Edition

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## Books Used in Biochemistry and Molecular Biology 471

### Texts

Required texts:

- Advanced Biochemistry Laboratory, 2024 ed.
- Advanced Biochemistry Laboratory Supplement, 2024 ed.

Recommended texts:

- Segel, I.H., *Biochemical Calculations*, 2<sup>nd</sup> ed., J. Wiley & Sons, Inc., 1976.
- Day, R.A., *How to Write and Publish a Scientific Paper*, 6<sup>th</sup> or 7<sup>th</sup> ed. Oryx Press, 2006.
- Boyer, R.F., *Modern Experimental Biochemistry*, 3<sup>rd</sup> ed., Addison Wesley Pub. Co., 2000.
- Voet, D. and Voet, J.G., *Biochemistry*, 2<sup>nd</sup> 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*, 3<sup>rd</sup> ed., Clarendon Press, Oxford, 1986.
- Sax, N.I., *Dangerous Properties of Industrial Materials*, 4<sup>th</sup> or 5<sup>th</sup> ed., Van Nostrand Reinhold Co., 1975 (4<sup>th</sup>), 1979 (5<sup>th</sup>)
- 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**

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. Garavito: Thursday 4 – 5 pm (BCH513A)
- Dr. Hovde: Friday 11am – 12 pm (BCH113)
- Dr. Chruszcz: Friday 3 – 4 pm (BCH107A)

### **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 <sup>1</sup>	Bi-weekly Quiz <sup>2</sup>
Jan. 8-12	Lab introduction; check-in; safety tour <b>Unit A</b> - spectrophotometry			
Jan. 15-19	<b>Monday Lecture cancelled - MKL Day (Unit B recored lecture)</b> <b>Unit B</b> - buffer preparation (titration); pH measurements	Jan. 16 - 19: Notebooks <sup>3</sup> Unit A	Problem Set B-1	Quiz 1
Jan. 22-26	<b>Unit B</b> - effects of salt & dilution on pH of a buffer		Problem Set B-2	
Jan. 29 - Feb. 2	<b>Unit C</b> - AAT enzyme assays and Lowry protein assay	Jan. 30 - Feb 2: Notebooks <sup>3</sup> Unit B	Problem Set C	Quiz 2
Feb. 5-9	<b>Unit D</b> - AAT heat denaturation and AAT assays	Feb. 6-9: Notebooks Unit C	Problem Set D-1	
Feb. 12-16	<b>Lecture &amp; Lab canceled</b> Open lab office hours (Wednesday - Friday; 12:40-3 pm)			
Feb. 19-23	<b>Unit D</b> - (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> precipitation & AAT assays	Feb. 23: Report I <sup>4</sup> Units A-C	Problem Set D-2	
Feb. 26 - Mar. 1	<b>Lecture &amp; Labs canceled - Spring Break</b>			
Mar. 4-8	<b>Unit D</b> - CM-sephadex column chromatography & AAT assays	Mar. 5-8: Notebooks D1-D2	Problem Set D-3	Quiz 3
Mar. 11-15	<b>Unit D</b> - AAT and Lowry protein assay of AAT fractions & SDS-PAGE of AAT fractions		Problem Set D-5	
Mar. 18-22	<b>Unit E</b> - buffer/ethanol preparation, $\gamma$ ADH assay testing	Mar. 19-22: Notebooks D3-D5	Problem Set E-0	Quiz 4
Mar. 25-29	<b>Unit E</b> - [ $\gamma$ ADH], [ $\text{NAD}^+$ ], $\gamma$ ADH stability			
Apr. 1-5	<b>Unit E</b> - approximate $K_m$ & $V_{max}$ , stability	Apr. 2-5: Notebooks E0-E3		Quiz 5
Apr. 8-12	<b>Unit E</b> - precise valid range, stability		Problem Set E-5	
Apr. 15-19	<b>Unit E</b> - precise $K_m$ & $V_{max}$ and inhibition, stability	Apr. 15: Report II Unit D	Problem Set E-6	
Apr. 22-26	Finals Week	Apr. 22: Notebooks <sup>5</sup> E3-E6		Quiz 6

1. LON-CAPA Problem Sets (PS) are due **Mondays at 11:30 pm EST**. Each problem set opens 1 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 12:30 pm EST. – Late reports will receive a 25% deduction for each 24-hour period after the deadline**

5. Final lab notebooks (E3-E6) are due **Monday, Apr. 22 at 12:30 pm EST**.

### Course reading assignments for Monday lectures.

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

### Grading

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

Laboratory notebooks	45%
Reports	20%
Quizzes	25%
LON-CAPA problem sets	10%

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.

## Late Penalties and other Course Policies

1. 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.
2. **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.
3. **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 11:30 pm EST on Mondays listed on the course schedule
  - No late Problem Sets will be accepted.
4. **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.
5. **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.
6. **RCPD VISAs**: If you have an RCPD VISA that details accommodations relevant to BMB470, please email it to Dr. TerBush at the beginning of the semester. Accommodations cannot be applied retroactively.
7. **Unexcused absences** will result in no ability to make up missed experiments or completing the post-lab analysis.
8. Students with **3 or more unexcused absences** from laboratory periods will be assigned a failing grade (0.0) in the course.
9. **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.
10. **Challenging grades**. If you believe an assignment was graded incorrectly, you have 2 weeks 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 2 weeks will not be considered

## **COVID-19 Safety precautions**

The COVID-19 virus is extremely contagious and is believed to spread mainly from person-to-person contact. Due to the continued presence of the novel coronavirus, various policies have been implemented for in-person learning. 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:

**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

**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 contact the MSU COVID-19 Triage line (1-888-958-2678) and follow the instructions for how to proceed.

**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) or do not wear your face covering appropriately (i.e., over your mouth and nose) 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.



## 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.**
  - o **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 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](#).