

# Course Syllabus: BMB 801 – Introduction to Molecular Biology

## Fall Semester 2024

### Course Information

Weather permitting, our first day of class (8/26/24) will be outside, meeting in the garden area in back of the Biochemistry Building from 9:10-10:00 am EST. We will have coffee and bagels starting at 8:45 a.m. Starting on Wednesday 8/28/24, we will be meeting in 1420 BPS (across from Sparty's) from 9:10-10:00 am EST. All classes will be also on Zoom so that remote students can follow, and recordings will be available for streaming after class. Recitations with your TA will be held on Wednesdays from 5:00-6:00 p.m.

Special review sessions by the instructors may also be arranged periodically depending upon student requests. Course documents and archived material are available on D2L.

### Zoom Meeting Information

The meeting ID for the MWF lectures is:

**Topic: BMB 801 fall 2024**

**<https://msu.zoom.us/j/98861762501>**

**Meeting ID: 988 6176 2501**

**Passcode: 801bmb**

Zoom software is supported by MSU and is free to students (<https://zoom.us/download>).

### Contact Information for Course Instructors

Dr. Bill Henry	lectures 1-19	henryrw@msu.edu
Dr. David Arnosti (Course Coordinator)	lectures 21-26, 28-42	arnosti@msu.edu
Bailey Kleven (Teaching Assistant)	lecture 27	klevenba@msu.edu
Dr. Stephanie Hickey (Guest Lecturer)	lecture 20	hickeys6@msu.edu

We like to use first names for students and instructors; as graduate students you are now peer scientists-in-information and first name interactions are common in the lab, at meetings, and other venues. You may indicate your preferred name (and pronouns, if desired) on your nametag the first day of class to help people address you correctly, e.g. "Bill", "Bailey", "David (he/his)".

### Course Description & Overview

Welcome to Biochemistry & Molecular Biology 801! The focus of this course is on cellular information management - DNA metabolism and gene expression. We will emphasize "What" we know and "How" we know it for a series of related topics. We also hope that you will come to appreciate "Why" these topics were pursued in the first place by some of the leading scientists who forged critical breakthroughs. Through reading, writing and discussing this material, you will gain experience that will help you prepare for second-year qualifying exams, a common feature of graduate programs.

### Required Textbook & Course Materials

No course textbook is *required*. Relevant topics will be covered in the instructors' notes and slide

presentations available on D2L. For a “deeper dive” in some selected topics, the non-profit Science Communication Laboratory has developed a whole series of video presentations from leading researchers, talking about their favorite (in some cases, Nobel-Prize-Winning) topics. Find them online here: <https://www.ibiology.org/about/>. In addition to informative videos, you can take a free online course to help you build your mentoring network!

### Recommended Texts & Other Course Materials

Most course information for this course is derived from the primary literature. For additional background, we recommend *Molecular Biology of the Gene* (Watson, Baker, Bell, Gann, Levine & Losick) *Molecular Biology of the Cell* (Alberts, Johnson, Lewis, Raff, Roberts & Walter) or Lewin’s *Genes* (Krebs, Goldstein & Kilpatrick). We will provide lecture notes, outside papers, old exams, and class recordings online via D2L. Course lecture notes will be available online for students to read before class. We will aim to have notes available at least a week in advance, so that students can read material before class – an important step for classroom discussion.

To access course material:

- \* Sign on to “D2L” <https://d2l.msu.edu/d2l/loginh/>
- \* Log on with your account name before the @ (e.g. arnosti) + password  
(the course is titled: FS24-BMB-801-001 Molecular Biology)
- \* Features
  1. Course Syllabus
  2. Course Announcements
  3. Background information on molecular biological techniques
  4. Lecture Notes (PDF format)

*Note:* For further studies of the primary literature, obtain your own copies of papers. As an MSU student, you can access most journals that are behind paywalls by going through the MSU library and entering the journal name: <https://libguides.lib.msu.edu/eresources/ejournals>

### Study Groups

Although you will doubtlessly find it useful to review concepts on your own, we strongly encourage all students to also participate in student-organized study groups to discuss more general themes and approaches. We will facilitate introductions to your peers throughout the semester to help you get to know and study with your classmates.

### Course Objectives & Expectations

The long-term mission of this course is to enable students to actively participate in the modern scientific enterprise. We will accomplish this goal by (1) enhancing your scientific knowledge base and (2) highlighting intellectual approaches to the scientific process. After completion of this course, students should be able to understand biological processes at a molecular level and communicate these details to an audience in a clear and concise manner. We additionally expect that students will begin to apply these principles to novel situations reflective of the scientific exploration process. The material presented in this course is expected to provide a solid foundation for success with comprehensive preliminary exams, expected in the near future for many of you.

## Grading

Grades will be based on written assignments, done in small groups, as well as one oral and one written exam. The written assignments, in essence short grant proposals, will be crafted in teams with collaboration among team members encouraged. These assignments will follow the general format for a NIH R01 grant submission, but in a much briefer format (5 page max). Details of the written assignments will be provided at a later date. The topic(s) for the individual written and oral exams will be derived from material discussed in the class, as well as the content covered in the written assignments. We will test the student's knowledge of relevant material, as well as ability to interpret and design experiments. The purpose of using these diverse types of assessment is to solidify thinking about applying knowledge of processes and approaches, and to provide practice for the second year qualifying exam.

## Technical Assistance

If you need technical assistance at any time during the course you can:

- \* Visit the MSU Help site at <http://help.msu.edu>
  - \* Visit the Desire2Learn Help Site at <http://help.d2l.msu.edu>
  - \* Call the MSU IT Service Desk at (517)432-6200, (844)678-6200, or e-mail at [ithelp@msu.edu](mailto:ithelp@msu.edu)
  - \* Request assistance navigating and requesting instructional design help:  
<https://tech.msu.edu/service-catalog/teaching/instructional-design-development/>
  - \* Browser/mobile support for D2L can be found at:  
[https://documentation.brightspace.com/EN/brightspace/requirements/all/browser\\_support.htm](https://documentation.brightspace.com/EN/brightspace/requirements/all/browser_support.htm)
  - \* Guide for internet speed: <https://broadbandnow.com/guides/how-much-internet-speed-do-i-need>.
- For most courses, 25 Mbps should work. If there is no mandatory video component, then students may be able to interact with the course with a slower connection. However, some course activities may require access to "high speed" internet.

## Additional Policies

1. Attendance & Absences. We will record the classes (not any breakout sessions, however) so that all students can access the presentations and discussions through D2L. We strongly encourage students to attend all class sessions. It works best for most people. If for any reason you are not able to attend a class, we understand! No need to provide a doctor's certificate in case of illness. You are responsible for your own intellectual progress in this course, and we are confident that you know how to best manage your time.
2. COVID and infectious diseases in general. You should feel free to wear masks when indoors to reduce the spread of infections. If you feel ill, please do not come to class; that's what Zoom is good for. If your instructor is ill, but not too ill, the class will be held on Zoom!
3. Academic Integrity/Cheating Policy. Your written exercises will represent the efforts of your team; as with all scholarly documents, plagiarism is not acceptable (<https://msu.edu/unit/ombud./academic-integrity/plagiarism-policy.html>). If you have concerns about the integrity of any work in the class, you can discuss with any of the instructors, or TA, or anonymously by contacting the MSU ombudsperson (<https://ombud.msu.edu>). **For any written assignment, if you use ChatGPT or other AI-based text generator in any way, whether to organize material, prepare an outline, or for grammar checks, specify in a section at the end of your work which tool you used, and how you**

**used it.** Note that AI-generated text may contain complete fabrications (“the moon is made of green cheese”) complete with fake references to back up the assertion. We expect that the final product reflects your own work, not just a copy-and-paste of generated text.

4. Accommodations for Persons with Disabilities - The instructors are here to serve you, and make this course a stepping stone in your professional development. Whether or not you have an officially recognized disability, we will seek to find accommodations for any obstacle to your success. Disabilities may be seen or unseen; the Graduate Student Accessibility and Support Network is a student-run organization that provides help to students across the university. <https://msu.campuslabs.com/engage/organization/gsasn>. In addition, MSU has an office to help students with disabilities <https://www.rcpd.msu.edu/>.
5. Learning Continuity Statement - If something arises that will interfere with attending on an ongoing basis, please let the instructors know, and we will work to find a solution. In case a student cannot complete the course for medical or other reasons, it is possible to obtain a deferral, allowing completion at a later date.
6. Course Continuity Statement – Bill Henry will supervise the first part of the course, and David Arnosti the latter portion. We will both be present for the first class, and in case of instructor illness will cover for each other. Our TA Bailey Kleven will present weekly recitations, and will provide backup for the instructors. Communications about the course should be directed at the TA and/or the lead instructor for that portion of the course.

## Lecture Schedule

Lecture #	Date	Instructor	Topic
Lecture 1	Aug 26	Both	Course Introduction, organization and networking
Lecture 2	Aug 28	Henry	DNA Structure & Genome Structure
Lecture 3	Aug 30	Henry	DNA Analysis & Methods
Lecture 4	Sept 4	Henry	Centromeres & Telomeres
Lecture 5	Sept 6	Henry	DNA Topology
Lecture 6	Sept 9	Henry	DNA Topoisomerases
Lecture 7	Sept 11	Henry	Chromatin Remodeling I (ATP-dependent)
Lecture 8	Sept 13	Henry	Chromatin Remodeling II (Covalent Modification)
Lecture 9	Sept 16	Henry	DNA Modification I – Restriction & Ligation
Lecture 10	Sept 18	Henry	DNA Modification II - CRISPR
Lecture 11	Sept 20	Henry	Midterm Exam (Lectures 1-10)
Lecture 12	Sept 23	Henry	DNA Replication I (Introduction & Overview)
Lecture 13	Sept 25	Henry	DNA Replication II (Origin Function)
Lecture 14	Sept 27	Henry	DNA Replication III (DNA Pol Function)
Lecture 15	Sept 30	Henry	DNA Replication IV (Licensing)
Lecture 16	Oct 2	Henry	DNA Repair I (Base Excision Repair)
Lecture 17	Oct 4	Henry	DNA Repair II (Nucleotide Excision Repair)
Lecture 18	Oct 7	Henry	DNA Repair III (Double strand break Repair)
Lecture 19	Oct 9	Henry	Mitochondrial DNA Replication
Lecture 20	Oct 11	Hickey	RNA-seq and global gene expression analysis techniques
Lecture 21	Oct 14	Arnosti	Reverse transcriptase and retroviruses
Lecture 22	Oct 16	Arnosti	Recombination I
Lecture 23	Oct 18	Arnosti	Recombination II
Lecture 24	Oct 23	Arnosti	Overview of transcription and methods I
Lecture 25	Oct 25	Arnosti	Overview of transcription and methods II
Lecture 26	Oct 28	Arnosti	RNA polymerases, bacterial initiation
Lecture 27	Oct 30	Kleven	The lac operon: a half-century of innovation
Lecture 28	Nov 1	Arnosti	Termination and attenuation
Lecture 29	Nov 4	Arnosti	Transcription: eukaryotes and archaea
Lecture 30	Nov 6	Arnosti	Eukaryotic RNA polymerases and basal factors
Lecture 31	Nov 8	Arnosti	Transcriptional activation and repression I
Lecture 32	Nov 11	Arnosti	Transcriptional activation and repression II
Lecture 33	Nov 13	Arnosti	Genome-wide and developmental regulation
Lecture 34	Nov 15	Arnosti	Capping and polyadenylation
Lecture 35	Nov 18	Arnosti	mRNA splicing I
Lecture 36	Nov 20	Arnosti	mRNA splicing II (class will be on Zoom)
Lecture 37	Nov 22	Arnosti	mRNA turnover
Lecture 38	Nov 25	Arnosti	miRNA, piRNA, and RNA interference
Lecture 39	Nov 27	Arnosti	Translation
Lecture 40	Dec 2	Arnosti	The ribosome; structure and function
Lecture 41	Dec 4	Arnosti	Alternative translational codes
Lecture 42	Dec 6	Arnosti	'omic analysis of translation

*Final Exam Week: Dec. 9-13; individual oral exams will be scheduled throughout the week in room 208 Biochemistry.*

## Midterm and Final

The midterm will be an in-class short-answer written exam. The final exam will be a ~30 minute oral exam, scheduled during finals week, in person in room 208 Biochemistry, or on Zoom.

## Written Assignments:

1. The topical questions are short answer, paragraph-length exercises.
2. The mini-grant assignments are 3-5 page ONE SPECIFIC AIM proposals that loosely follow the flow of an NIH grant proposal, but will be much more concise. They are not intended to take enormous amounts of time and effort, but rather to give you a flavor for the types of thinking and writing that you will use later in your second-year qualifying exam proposals. We will create small groups (3-4 students) for each assignment; you will work together on the project. The proposals will be commented on and returned to you for modification, full credit given for revising the proposal and returning it.

Due Dates for Written Assignments – upload to D2L before class

1. Chromatin Remodeling – due Sept 16
2. mini-NIH Proposal 1 (DNA Replication) - due Oct 4
3. Mitochondrial DNA Replication – due Oct 11
4. Recombination - due Oct 23
5. Transcription – due November 6
6. mRNA splicing – due November 25
7. mini-NIH Proposal 2 (Gene expression) - due December 6

## Grading

Students should turn in all five of the short-answer written assignments, which will be recorded as “completed”. The two mini-NIH proposals will be complete after the group reads the written comments and revises the proposal accordingly. Exceptional performance in proposal writing will be recognized with additional bonus points. Assuming these assignments are complete, the graded midterm and oral exam will determine final grade for the course, each counting equally in the total. Students with a good grasp of the course concepts will receive a 3.0 or higher, which is counted as “passing” for graduate programs that require BMB 801 as part of the core curriculum.

# Biochemistry and Molecular Biology

## COMMUNITY STANDARDS



Biochemistry and Molecular Biology (BMB) is committed to fostering the education of students and postdocs in a welcoming and supportive environment.

All members of the BMB community are expected to treat each other in a respectful, professional manner. We are all responsible for holding to those standards both on and off campus (e.g. at conferences, meetings or field work). In addition to following University policies, we ask all members of BMB to support and adhere to our community norms of respectful and responsible conduct.

### EXPECTED CONDUCT

BMB has established the following standards of conduct:

- Act ethically and with integrity
- Be fair and respectful to others
- Be welcoming and inclusive of all people
- Manage, supervise, instruct and advise responsibly
- Protect, preserve and responsibly use University resources and property
- Promote physical and mental health & safety
- Promote a culture of compliance with legal requirements
- Preserve academic freedom
- Ethically conduct research, teaching and community engagement
- Acknowledge conflicts of interest
- Carefully manage public, private and confidential information

### UNACCEPTABLE BEHAVIOR

BMB will ask Michigan State University authorities to take action in case of:

- Sexual harassment, sexual assault, stalking and relationship violence
- Bullying behavior
- Discrimination
- Retaliation
- Unethical research, including falsification of data or information
- Scholastic dishonesty
- Unauthorized use, including misuse of, facilities, equipment or services
- Theft, property damage or vandalism
- Violation of University rules
- Violation of local, state or federal laws

### MSU SANCTIONS FOR UNACCEPTABLE BEHAVIOR

Sanctions will be commensurate with the nature and severity of the offense. Consideration will be taken of persistence of violations and the impact of the offense on other people. Sanctions may include:

- Warning
- Probation
- Restitution
- Reassignment of work activities
- Paid or unpaid leave of absence
- Termination of employment

## REPORTING MISCONDUCT AND MORE INFORMATION

MSU's Office of Institutional Equity (OIE):

The OIE serves to uphold and advance our shared values through oversight and application of civil rights policies.

The Anti-Discrimination Response and Investigations team supports, responds to, and investigates reports related to discrimination and harassment based on race, ethnicity, color, national origin, sex, disability, religion, age, gender, gender identity, sexual identity, height, marital status, political persuasion, sexual orientation, veteran status, or weight.

The Relationship Violence and Sexual Misconduct Response and Investigations team supports, responds to, and investigates relationship violence and sexual misconduct, including dating violence, gender-based harassment, sexual assault, and stalking.

<https://civilrights.msu.edu/response-and-investigations/index.html>

The College of Natural Science Diversity, Equity and Inclusion website lists comprehensive resources relating to Relationship Violence and Sexual Misconduct, Discrimination, and Conflict Resolution.

<https://natsci.msu.edu/diversity-equity-and-inclusion/reporting/>

# MICHIGAN STATE UNIVERSITY