

**PLB/BMB 856: Plant Molecular and Omic Biology  
Syllabus - Spring 2025**

**Instructors:**

Hideki Takahashi    [htakaha@msu.edu](mailto:htakaha@msu.edu)    (course coordinator)  
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**Brief Description of Course:**

The intention of the course is to provide a survey of plant molecular biology, molecular genetics, genomics and cell biology, emphasizing recent research advancement and technology development in these disciplinary areas.

**Prerequisite:**

Advanced undergraduate or equivalent college-level courses in molecular genetics, molecular biology and/or biochemistry. Please contact the course coordinator (Hideki Takahashi, [htakaha@msu.edu](mailto:htakaha@msu.edu)) if you have any doubts about the suitability of your preparation.

**Credits:** 3-0

**Class Session:** 3:00-4:20 PM on every Tuesday/Thursday  
Room 247, Plant Biology Building

**Course Materials:** D2L (<https://d2l.msu.edu/d2l/login/>)  
**SS25-PLB-BMB-856-001 - Plant Molecular and Omic Biology**  
Use your MSU NetID and password (case-sensitive) to log in.

**Uploading Assignment:** OneDrive folder **SS25-PLB-BMB-856 Your Name**  
Use your MSU NetID and password (case-sensitive) to log in.

**Course Grade:**

The course grade is based on two exams (40% of grade total; split between the midterm and the final), writing of a research proposal (35% of grade total), and homework assignments (25% of grade total).

**Class Format/Daily Preparation:**

Sessions of the class typically will consist of lectures by the instructors combined with a discussion of reading materials. For each unit of the course, 2 to 4 key articles will be posted as pdf files at the D2L web site, by the previous Friday. **Please read these articles before joining class sessions.** These articles are designated for thorough understanding and in-depth discussion of lecture topics.

Students should prepare by making sure that they can answer the following key questions:

- What was the goal of the research, including the problem being addressed?
- Which figure(s) or table(s) presents the most critical data in the study? Why?
- What were the strengths and weaknesses of the paper?
- What would *you* do next?

The instructors will provide lecture notes by or soon after lecture time through D2L. These notes will provide copies of some of the figures and tables that may be mentioned from the articles other than the assigned reading materials.

### Homework:

Short homework assignments are scheduled 6 times during the semester. Homework will be made available through D2L. Upload your response to your shared OneDrive folder by due dates indicated in the course D2L calendar.

### Exams:

The two exams will have an open-book, take-home format.

- Notes, books, articles, and online information may be consulted, but students are expected to complete their exams independently, without discussion with others until after all exams are turned in.
- The exams will be made available on D2L as indicated below.
- Upload your complete exam response to your shared OneDrive folder.

	Available on D2L	Due in OneDrive
<b>Midterm Exam</b>	February 27 <sup>th</sup> , 5:00 PM	<b>February 28<sup>th</sup>, 11:59 PM</b>
<b>Final Exam</b>	April 29 <sup>th</sup> , 5:00 PM	<b>April 30<sup>th</sup>, 11:59 PM</b>

### Research Project Proposal:

The assignment is to write an original research project proposal on a specific topic in plant molecular biology, molecular genetics and genomics.

- **The proposal should include the molecular genetics and genomics aspects of the problems you choose to address** (as opposed to being focused only on the biochemistry, quantitative genetics, molecular breeding or physiology aspects of the problem). It should be related to a topic pertinent to the course. However, it does not have to be on a topic specifically covered in class.
- You should focus on a basic biology problem, though you may extend it with a perspective on translational possibilities. For instance, you could write a proposal in relation to mechanisms of plant disease resistance; molecular genetics of plant development; molecular and physiological responses to the environment (e.g., light, temperature, water, UV); etc.
- The proposal should be original and creative. Students may not use a paper written for another course, nor conceptualized by someone else.

- You are encouraged to start researching your topic as soon as the course begins, including discussions with course instructors before or after class times.
- Your proposal should be written using a 11-12 point standard 'with serif' font (Times New Roman 12 point is a good choice) and single line spacing, numbering all pages.
- The general format of the proposal should be as follows:
  - A. Project Summary** (1 page max.). State the broad, long-term objectives of the proposed line of research and the hypothesis. Describe concisely and realistically what the specific research described in the proposal is intended to accomplish. Specific aims should be listed as a short list (typically 3 specific aims total).
  - B. Background and Significance** (2 pages max.). Summarize what is known about the chosen area of research critically evaluating the existing knowledge and specifically identifying the gaps the project is intended to fill. State concisely the importance of the research and relate the specific aims to the broad, long-term objectives of the project. Please cite key references in this and the next section, preferably in a “first author, date” style.
  - C. Experimental Design** (4 pages max.). Outline the experimental design and procedures to be used to accomplish the specific aims of the project. Include discussion on how you will interpret the data. Discuss the potential difficulties and limitation of the proposed procedures and present alternative approaches to achieve the aims where appropriate. On a separate page (not included in the 4 pages max count), give a tentative sequence or timetable for the investigation.
  - D. References.** List the literature cited in the text, including titles and full list of authors.
  - E. Graduate and Past Research Projects** (1 paragraph). Briefly summarize the research you are conducting for your graduate degree.
- Upload all documents to your shared OneDrive folder.
- Timeline:
  - 1) **February 4<sup>th</sup>** – One-page project summary (*first draft*)
  - 2) **February 11<sup>th</sup> and 12<sup>th</sup>** – Individual discussion

Each student will be given the opportunity (15 minutes) to meet with the instructors and discuss their ideas for the project proposal. The instructors will give feedback on your one-page project summary.
  - 3) **February 25<sup>th</sup>** – One-page project summary (*second draft*)
  - 4) **April 22<sup>nd</sup>** – Full proposal
- The instructors will give comments on your proposal, including the draft version of the project summary. These comments include advice and suggestions about proposal writing, in general.

**Lab activity:**

Unit 6 consists of two lectures on proteomics (April 8<sup>th</sup> and 10<sup>th</sup>) followed by two weeks of lab activity and data analysis on this topic. This activity will offer you the opportunity to carry out a proteomics experiment with a real biological sample and is designed to provide you with practical, hands-on experience in completing a bottom-up proteomics experiment including prepping the protein sample, submitting to MSU's proteomics core facility, and analyzing and interpreting the resulting data. Students will work in groups of two and be given a unique sample from the Lundquist lab group. All work is anticipated to fall within the regular class period hours.

**Artificial Intelligence (AI):**

Using artificial intelligence (AI) is permitted in specific contexts. Students may use AI as a tool to explore information and prepare for the course-related assignments, such as the homework, exams and research project proposals. However, the text to be submitted for these course-related assignments must be written by yourself. Developing critical thinking and writing skills are essential for your academic success. AI tools can be helpful, but they are not always accurate. Students should critically evaluate the AI-generated information, acknowledging the benefit and limitations.

**Other Recommended Activities:**

Throughout the semester, several seminar series will be hosting scientists who will present lectures on pertinent topics. Some may be mentioned in class, and posted on the D2L site or provided by email. We encourage you to mention seminars in class so that other students may learn of them.

If you are a BMB student in the Molecular Plant Sciences (MPS) Program and would like to obtain more information on topics in molecular genetics and genomics that are not covered in PLB 856, you may consider attending lectures in BMB 801 "Molecular Biology". The course is offered in Fall semesters. Please contact the course instructors David Arnosti (arnosti@msu.edu) and Bill Henry (henryrw@msu.edu) for details or advice.

**Course Assessment:**

Michigan State University and the instructors take seriously the opinion of students in the evaluation of the effectiveness of instruction, and MSU has implemented the Student Perceptions of Learning Survey (SPLS) to gather student feedback. You will receive an e-mail sometime during the last two weeks of class asking you to fill out the SPLS online form at your convenience. You will have the option to decline to participate in the course evaluation—we hope, however, that you will be willing to give us your frank and constructive feedback so that we may instruct students better in the future.

## Course Schedule:

Lecture	Date	Instructor	Topics	Exam & Homework	
1	January 14, 2025	Takahashi	<b>Unit 1. Forward &amp; Reverse Genetics</b> Model Organism / Natural Diversity Plant Transformation / Genome Editing Genetic Screening		
2	January 16, 2025	Takahashi			
3	January 21, 2025	Takahashi			
4	January 23, 2025	Takahashi			
				Unit 1 Homework: Due January 24	
5	January 28, 2025	Takahashi	<b>Unit 2. Transcriptional Regulation</b> Transcriptomics Gene Expression Gene Regulatory Network		
6	January 30, 2025	Takahashi			
7	February 4, 2025	Takahashi			Project Summary (first draft): Due February 4
8	February 6, 2025	Takahashi			
				Unit 2 Homework: Due February 7	
	February 11, 2025	Takahashi, Lebeis	Individual discussion about your research proposal		
	February 12, 2025	Takahashi, Lebeis			
9	February 18, 2025	Takahashi	<b>Unit 3. Post-transcriptional Regulation</b> siRNA / VIGS miRNA Translation		
10	February 20, 2025	Takahashi			
11	February 25, 2025	Takahashi			Project Summary (second draft): Due February 25
12	February 27, 2025	Takahashi			
				Midterm Exam: Due February 28	
	March 4, 2025		Spring Break		
	March 6, 2025				
				Unit 3 Homework: Due March 10	
13	March 11, 2025	Takahashi	<b>Unit 4. Small Molecules</b> Hormone Signaling Chemical Genomics Metabolomics Evolution of Metabolism		
14	March 13, 2025	Takahashi			
15	March 18, 2025	Takahashi			
16	March 20, 2025	Takahashi			
17	March 25, 2025	Takahashi			
				Unit 4 Homework: Due March 26	
18	March 27, 2025	Lebeis	<b>Unit 5. Plant-Microbe Interaction</b> Plant Immune Response Microbiome Analysis		
19	April 1, 2025	Lebeis			
20	April 3, 2025	Lebeis			
				Unit 5 Homework: Due April 4	
21	April 8, 2025	Lundquist	<b>Unit 6. Proteomics</b> Bottom-up Proteomics Post-translational Modification (including 2 weeks of lab activity and data analysis)		
22	April 10, 2025	Lundquist			
23	April 15, 2025	Lundquist			
24	April 17, 2025	Lundquist			
25	April 22, 2025	Lundquist			Full proposal (final draft): Due April 22
26	April 24, 2025	Lundquist			
				Unit 6 Homework: Due April 25	
				<b>Final Exam: Due April 30</b>	