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

Instructors:

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Sarah Lebeis	lebeissa@msu.edu	
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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) 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/loginh/)
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**
Midterm Exam	February 27th, 5:00 PM	**February 28th, 11:59 PM**
Final Exam	April 29th, 5:00 PM	**April 30th, 11:59 PM**

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 4th** – One-page project summary (*first draft*)
  2) **February 11th** and **12th** – 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 25th** – One-page project summary (*second draft*)
  4) **April 22nd** – 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 8th and 10th) 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.

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