College of Natural Science
MICHIGAN STATE UNIVERSITY

Departments: Biochemistry and Molecular Biology, Plant Biology and the Molecular Plant Sciences Program

Biotechnology and Plant Biochemistry Spring 2026 Syllabus

BMB/PLB and MPS 864
Credit Hours Total Credits: 3 Lecture/Recitation/Discussion Hours: 3
Course meeting days and time: Tuesdays and Thursdays 1:00-2:20
Course location: MPS 3220
Course website address: d2l.msu.edu/d2l/home/2582751
Course Modality: In person

Instructors

Instructor Information

Instructor(s)
Björn Hamberger (he/him/his) Experts in various relevant fields (industry, IP/Technology Office, computational biology) will give guest lectures and will be available for discussion of respective technology or career questions.
Office: MPS 3230, or by Zoom Personal meeting ID 585 243 9276 https://msu.zoom.us/j/5852439276
Office hours: *Ad hoc*, when needed. Please contact Dr. Hamberger for arrangements.
Phone: 517-944-1296
E-mail: hamberge@msu.edu

Instructor Introduction:

Plant Synthetic Biology approaches offer sustainable production and complementing difficult chemical synthesis or extraction from the often rare, native plant species. Research in the Hamberger lab focuses on pathway discovery of specialized metabolism in plants. Specifically, our team is interested in natural compounds of the terpene class with a broad range of applications, including agrichemicals, cosmetics and therapeutics. With the biobricks (enzymes) in hand, biotechnological production through metabolic engineered chassis systems is a typical approach. Yet, what happens if you assemble parts into new modules or pathways? Can specialized metabolism be hijacked to respond to the needs of a post-'fossil fuel' era?
Relevant for this course, our team has experience with Intellectual Property management from the academic perspective, which has enabled several industrial collaborations.

For details, please see Hamberger Lab:
https://directory.natsci.msu.edu/Directory/Profiles/Person/100353
Publications: https://www.ncbi.nlm.nih.gov/myncbi/1b5IZBIHgv25v/bibliography/public/

Course Information

Course Description, Objectives and General Course Information

BMB/PLB and MPS 864 is an interdisciplinary course for graduate students with interest in biotechnology applications using Plant Biology, Biochemistry or Synthetic Biology. Despite building on cases from plant biotechnology, this course explicitly invites students with broad interests outside the field of photosynthetic systems. You will be encouraged to think about, and actively develop concepts and ideas that may have the potential for commercialization.

Perspectives of public perception, investor and scientist will be discussed and shape the course. Examples will highlight plant metabolic pathways that impact human health and nutrition, as well as sustainability in the production of therapeutics, food and biomaterials. Case studies will cover expression hosts, strategies and pitfalls such as emerging resistances. Examples are chosen to explain basic metabolic engineering principles, including synthetic biology approaches to generate, analyze, and optimize transgenic platforms. Some cases will examine regulatory and commercial issues related to genetically modified organisms (GMOs) and the 'share-your-parts' philosophy, as promoted by the international genetically modified machine (iGEM) initiative. To actively participate in the course, you need to have a basic understanding of molecular biology, genomics, or biochemistry. You are expected to read background and original research papers as assigned, and you should be comfortable giving a summary and express your opinion.

You will be guided to develop a 3-page brochure presenting a scientific idea for your biotechnology-based product or process with a recognized need or a new opportunity. You will need to lay out the idea, present reasonable milestones, be aware of potential technical, commercial, or societal hurdles, and articulate how the proposed technology would address the need or opportunity. The course will provide you with tools, i.e., relevant concepts (technology readiness level, societal acceptance, outreach, IP aspects) will be discussed, and a list of topics will be developed together with the students during the course. The instructors will provide guidance and feedback on an individual base as you develop your project. Individual feedback will also be given for both take home assignments.

During the final sessions of the semester, you will present your idea/spin-out in a 10-min pitch. Feedback will include the perspective of Angel Investors. This may involve the MSU Innovation Center.

The course includes a responsible conduct of research module (RCR). BMB 864 is complementary to the NIH T32 training program 'Plant Biotechnology, Health and Sustainability' and the RCR activities can count towards your training requirement.

Prerequisite:

The following is recommended background: Interest in biotechnology applications using Plant Biology, Biochemistry or Synthetic Biology, basic knowledge in molecular biology, genomics, or biochemistry as demonstrated by having completed at least one of the following, or equivalent graduate level classes: BMB801 molecular genetics or BMB961 genomics or BMB865 plant molecular biology. Enrolled in a graduate program related to biomolecular sciences, plant molecular sciences, biochemistry, Cell & Molecular Biology, Microbiology & Molecular Genetics or Genetics & Genome Sciences Program. Students from Chemical Engineering and Chemistry are welcome but will need to ask for an override.

Course Overview and Grading:

The format of this course is in person, or alternatively online via Zoom, in adherence with MSU regulations. If those regulations are changed, course participants and instructors will discuss how to make appropriate adjustments. This course is a mixture of lectures, providing background to the individual topics and discussions of assigned research papers.

The progress will be evaluated and course objectives will be met in equal weight distributed over a mid-term (25%, February 26 or March 10) and final (25%, April 21) 24-hour take-home assignment (opinion-based essays) as well as a 3-page brochure and a 10-minute pitch (25%, April 28 and April 30) detailing a scientific idea for your biotechnology-based product or process with a recognized need or a new opportunity. Additional recognitions are awarded for the projects attracting highest capital investments and for the investors with the best sense for innovation.

Scheduling of the take-home assignments can be arranged within a week, if needed and requested by the student, but essays must have been submitted a day before the class meets for discussion. All essays will be returned with commentary. No re-writing will be needed, but follow-up questions raised by the student will be accommodated and discussed during office time if needed.

Ethics policy regarding take-home examinations: Take home exams are fully open book and open notes. Take home exams will also permit the use of online resources. The use of AI, e.g., chat-GPT is not prohibited but will need appropriate indication in the documents, checking of facts and of references and resources given. Exam material may require online resources and an internet connection. As such, these exams require students to abide by academic and scientific ethical standards. All answers for take-home exams must be solely based on the effort of the individual student. All consulting and collaboration with other members of the class, former students, or scientific colleagues more generally, needs to be clearly marked and referenced. If a student wishes to paraphrase from a published scientific work, the article needs to be properly cited, and the relevant text should be clearly marked for quoted information.

Course Outline/Schedule

BMB/PLB/MPS 864 Spring 2026 Biotechnology and Plant Biochemistry

Class begin SS26: 15-Jan
Instructor: Hamberger
Course meeting days and time: Tuesdays and Thursdays 1:00-2:20
Course location: MPS 3220, if required by MSU regulations Zoom, https://msu.zoom.us/j/5852439276

Course roadmap 2026

Week	***Date***	***Instructor***	***Topic***
Week 1	13-Jan	Hamberger	No class
	15-Jan	Hamberger	Course Introduction, Goals and Expectations; business aspects. How much work to ace this class?
Week 2	20-Jan	Hamberger	SynBio: Societal acceptance; Outreach and communication; examples iGEM. NSF 'greater impacts'.
	22-Jan	Hamberger	Hands-on workshop: Research tools to scan Markets, Companies and IP. Your impact statement may start here.
Week 3	27-Jan	Hamberger	IP, inventions and industrial commercialization: the scientist's perspective. Examples Streptomycin and lab notebooks; Warfarin discovery.
	29-Jan	Hamberger	The Avenacin pathway to antimicrobials in oat: developments during the last 15 years.
Week 4	3-Feb	Hamberger	Phenylpropanoids Background, the core pathway to lignin, soluble and wall bound phenolics and flavonoids
	5-Feb	Hamberger	The science of targeting the shikimate pathway. Bowman vs. Monsanto; glyphosate Case study: Engineering glyphosate resistance. Naturally occurring resistance in weeds.
Week 5	10-Feb	Hamberger	RCR - Critical reading: the Seralini affair, integrity in science
	12-Feb	Hamberger	Flavonoid and anthocyanin engineering
Week 6	17-Feb	Hamberger	Brochure brainstorming. Pre-mortem analysis and discussion.
	19-Feb	Hamberger	Ohno's Dilemma tested: Gene duplication and Evolution
Week 7	24-Feb	Andersen	Engineering the microbiome, emerging technologies. Take home assignment I
	26-Feb	Hamberger	Terpenoids Background, Take home assignment I (option date 1)
Week 8	3-Mar		Spring Break
	5-Feb		Spring Break
Week 9	10-Mar	Hamberger	SynBio tools: Reporters and Biosensors (Take home assignment, option date 2)
	12-Mar	Hamberger	Take-home assignment I, discussions
Week 10	17-Mar	Barry	Alkaloids Background, tropinone alkaloids from the Solanaceae
	19-Mar	Hamberger	Brewing Bad: Biosynthesis of kratom opioids and regulatory considerations. Case study for alkaloid drug production.
Week 11	24-Mar	Hamberger	Brochure/Biotech project discussion and feedback
	26-Mar	Hamberger	RCR - Biodiversity and Biopirates
Week 12	31-Mar	Hamberger	Is this food good? Golden rice, papaya, arctic apple, mushrooms

Week	*Date*	*Instructor*	*Topic*
	2-Apr	Hamberger	Clustering: Genomic organization of pathways; Regulation: Dhurrin Metabolon.
Week 13	7-Apr	Hamberger	Lockdown: biological containment from Synthetic Biological Perspective.
	9-Apr	Hamberger	Tools for Specialized Metabolism, bioparts and synthetic promoters e.g. Patrick Shikh
Week 14	14-Apr	Hamberger	Guest Speaker: Dr. Garret Miller (Manus Bio, Boston, now UoM, Flint), PBHS alumni
	16-Apr	Hamberger	Guest Speaker: Dr. Emily Lanier (Virginia Tech, Tech Transfer Office and Commercialization), PBHS alumni
Week 15	21-Apr	Hamberger	Selectable module, Take home assignment II
	23-Apr	Hamberger	Take-home assignment II, discussions
Week 16	28-Apr	Hamberger	Make your pitch! And discussions, feedback for the brochure (where applicable, also from the MSU tech trans office).
	30-Apr	Hamberger	Make your pitch! And discussions, feedback for the brochure (where applicable, also from the MSU tech trans office).

Examples of previously selected favorite modules:

Molecular warfare: Gene drive

Is this food good? BT toxin -- benefits and risks; GMO vs. organic; emerging insect resistance

Cyanogenic glucosides and the plant defense mustard bomb

SynBio hosts - Is there an ideal chassis organism?
GMO or not? The sweet potato genome with transgenic material, focus Tilling and Crispr.
Birth of a new discipline, Rod Croteau and molecular biology of early terpene biosynthetic pathways in mint
Emerging themes from Student Projects: Hot topic of the season (past examples: CRISPR IP fight; deep eutactic solvents; nano-clays in agriculture; commercial bryotechnology (engineered moss)).
Writing helpful paper/proposal/project reviews -- Considerations and ethics of the review process.
Revisions needed? Writing a fair opinion. Responding to reviewer's comments.

Other Course Policies

Important Dates to Remember:

Course/Acad. year Event	**Date**
Classes begin	12-Jan
Lecture 1, introduction	15-Jan
24-hour take-home assignment I	26-Feb
Optional date, assignment I	10-Mar
Brief opinion presentations, discussions	12-Mar
Spring Break	28-Feb to 8-Mar
24-hour take-home assignment II	21-Apr

Brief opinion presentations, discussions	23-Apr
Classes end	26-Apr
Final pitches	28-Apr and 30-Apr

Required Course Materials:

No specific textbook is assigned. Lecture material will come from reviews and primary literature manuscripts assigned throughout the semester. These will be available online through D2L. For general background you are likely to find a biochemistry textbook useful, for example “Principles of Biochemistry by D.L. Nelson and M. M. Cox, W.H. Freeman and Company”. In addition, there are some books specific to plant biochemistry that you may want to consult for background on specific topics. The following are available through MSU:

1. Buchanan BB, Gruissem W, Jones RL (2015) Biochemistry & Molecular Biology of Plants. American Society of Plant Physiologists, Rockville. Second addition.

https://ebookcentral-proquest-com.proxy1.cl.msu.edu/lib/michstate-ebooks/detail.action?docID=7103740&query=Biochemistry%2520and%2520Molecular%2520Biology%2520of%2520Plants#

2. Heldt H-W (2011) Plant Biochemistry. Fourth Edition. Elsevier Academic Press, Burlington MA.

http://www.sciencedirect.com.proxy1.cl.msu.edu/science/book/9780123849861

Required Technologies, if using online access to the course:

- The course, depending on MSU regulations, may require access to "high speed" internet and a webcam.
- Information about how students can access internet connections, including companies offering students free or reduced cost internet, information on VPN and Eduroam: https://remote.msu.edu/learning/internet.html
- Please notify the course coordinator within a day by phone or email should students encounter difficulties--including outages--during synchronous sessions, or the final pitch to discuss how to accommodate the student’s needs best.

MSU Community Compact regarding, and during outbreaks:

BMB/PLB/MPS 864 is, according to current MSU regulations, held in person, of if needed virtually (online). Should regulations change the following guidelines will be followed in case the course is changed to hybrid, or in person format.

Course platforms/Structure:

This course will be delivered in person, or if regulations require synchronous ***online*** (Zoom) through the course management system and you will need your MSU NetID to login to the course from the ***D2L homepage*** **(*http://d2l.msu.edu*).**

In ***D2L***, you will access course materials, and additional resources. Activities may consist of readings, discussion forums, email, and other online activities.

Any adjustment of the course structure to online, hybrid class will follow possible changes of MSU regulations.

Technical Assistance:

Information helpful for the use of required software, including D2L: Include information on how to navigate necessary software, expectations, instructions on how to access course material, and where to find technical and online course development assistance. For example: If you need technical assistance at any time during the course or to report a problem 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
- Request assistance navigating and requesting instructional design help: https://tech.msu.edu/service-catalog/teaching/instructional-design-development/

Guide for internet speed: https://broadbandnow.com/guides/how-much-internet-speed-do-i-need. For most courses, 25 Mbps should work.

Additional Optional Information

Disability Access:

Students must inform the instructor of any accommodations needed. Information related to disability access is available on the Resource Center for Persons with Disabilities (RCPD) website. Students: to make an appointment with a specialist, call: (517) 353-9642 Or TTY: (517) 355-1293 or visit the RCPD website.

Americans with Disabilities Act Accommodations:

"Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at rcpd.msu.edu. Once your eligibility for an accommodation has been determined, you will be issued a verified individual services accommodation ("VISA") form. Please present this form to me at the start of the term and/or two weeks prior to the accommodation date (test, project, etc.). Requests received after this date will be honored whenever possible."

MSU Community Compact regarding COVID-19:

This section was gladly removed and will be updated with adherence to MSU regulations if required.

Learning Continuity Statement:

What students should do should they become unable to in person/virtually attend class for an extended period of time.

Communication with the instructor via phone, or email regarding prolonged absences, and assignments, homework, and groupwork caused by prolonged absences.

Course Continuity Statement:

All instruction for this course is in person. Should the instructor be required to be absent for an extended period of time, this will be communicated to the class within 24 hours. The secondary instructor will provide continuity regarding feedback and grading expectations and assessment modifications (if any) surrounding prolonged absences.

College of Natural Science
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yllabus Signature Page

Instructor: Björn Hamberger

Course: BMB/PRL/MPS 864

Semester: Spring Semester 2026

I _____ acknowledge that I received and even read a copy of the course syllabus for the class mentioned above. For this I am aware that I can and should inform the instructor that I earned ice cream from the MSU dairy store for the next meeting. I will let the instructor know if I have any dietary restrictions.

I understand the course requirements and the policies entailed in this document. I further understand that my participation and conduct in this course is a key contributor to my success and the success of this course.

I pledge to come to class prepared and to always conduct myself respectfully.

_____
Print Full Name

_____ _____
Signature Date