Plant Biotechnology 424-524 (3 credits)

This course covers the methods, applications, and implementation of plant biotechnology in agriculture. The topics covered include technical as well as regulatory and policy aspects of aspects of plant biotechnology.

It will be assumed that the students at the senior undergraduate/graduate student level will have a course background in basic genetics, plant physiology/biology, and biochemistry (UA suggested equivalents Chem 241 A/B, Chem 242 a/b and Bioc 462 a/b or Bioc 460). The Fall semester Plant Biochemistry class (PLS/MCB/ECOL/CHEM/BIOC 448A/548A) is highly recommended. There are no specific prerequisites. The intent is to build on background knowledge by discussing engineering strategies that use genetics and biochemistry knowledge to select or create plant biotechnology traits. This course will discuss some of the societal issues of plant biotechnology that is science based, that is those that can be framed as science questions. These discussions include regulatory processes, safety concerns and intellectual property. No prior background will be required for this component of the course. This is not a course on non- science based questions and controversies of plant biotechnology.

This class is presented on-line with D2L and all lectures and materials can be viewed on-demand.

Office hours

Virtual office hours are made upon request during Mon-Friday 8 am-4 pm. Email to set up an appointment. No in-person office hours are available due to the present health emergency.

Contact information for Instructor

Email: emherman@email.arizona.edu

Instructor Bio

Eliot M Herman, Dr. Herman is a Professor in the School of Plant Sciences and a member of the Bio5 Institute. Prior to employment at the University of Arizona he was a scientist working with the USDA/ARS for 24 years where his research focused on engineering seeds to improve composition. His research has focused on understanding how protein and oil metabolites are regulated and accumulated and addressing the problem of food allergy. He discovered the protein that is major soybean allergen and produced the first biotech knockout of a major allergen by silencing this allergen for which he was awarded the top USDA annual award in 2004 by the Secretary of Agriculture. As a federal employee Dr. Herman served on a wide variety of other biotechnology related assignments including serving as NSF program director at the inception of

the plant genome programs, as Science Fellow in the US Embassy in Sweden working on plant biotechnology issues in the Nordic and Baltic nations, on the EPA oversight committee that examined the aftermath of the Starlink Bt maize episode especially the question of whether there was an allergenic reaction by consumers. Dr. Herman has served as an evaluation committee member for NIST program that was directed at providing federal support for emerging biotechnology start-ups. Dr. Herman has been a visiting scientist at the Weizmann Institute in Israel and Tokyo Metropolitan University in Japan. Dr. Herman is a fellow of the AAAS and a Pioneer member of the American Assoc for Plant Biology. Dr. Herman was one of the original full members of the Donald Danforth Plant Science Center in St. Louis during 2002-12, prior to relocating to University of Arizona.

My google scholar list of publications.
https://scholar.google.com/citations?user=kLnBn38AAAAJ&hl=en

Grading

All students- Four Equal weight exams; (25% final grade each). The tests will be a combination in short answer format. Test questions will be derived from in-class materials and presentations. The university scale will be employed for grading purposes. Dependent on performance, I reserve the right to scale up the scores of individual examinations or the class as a whole. Exams may not be missed except for medical emergencies (Doctor's note required), or for circumstances leading to a University approved absence form. In these cases, make-up exams will be provided. Incomplete grades will only be given under exceptional circumstances, and these require a written agreement between the student and the instructor, specifying the work to be completed and the timeframe.

Graduate Students only. As a 500 level course the parallel graduate level course is considered to be different. (20% of final grade- each test is also 20%, I reserve the possibility to use different questions on graduate student exams although I have not often done this). A short essay of an agreed topic in plant biotechnology will be required which will be set no later than February 15 2021 giving 60 days to complete the assignment. The essay is to be 3 pages single-spaced 12 pt text. No figures required, but can be used if desired not counting instead of text. References are needed but are not inclusive in the 3 pages. If you use references please use numbers in text (1), (2), to minimize text use for references. The overall style to be used is a brief introduction section outlining the issue, followed by a section with whatever arguments you wish to make divided into any sections as you think appropriate. The purpose of this essay is to engage in the type of arguments used in the broader perspective and integration that is critical to graduate student exams and is useful to prepare for a graduate exam. Please be creative. The purpose of this exercise it to foster critical analysis needed for qualifying exams. This essay is DUE ON APRIL 15, 2020 (tax day).

Grading Scale and Policies

424 and 524 courses are treated separately for grading purposes. That is, curves and averages will be determined for each separately. The marking scheme is also different and is as follows:

Marking Scheme	**424**	**524**
4 tests	100%	80%
1 paper	n/a	20%

Course grades will be assigned based on percentages:

A = 90 –100%
B = 80 – 89%
C = 70 – 79%
D = 60 – 69%
F = 0- 59%

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal respectively.

Honors Credit

Students wishing to contract this course for Honors Credit should email me to set up an appointment to discuss the terms of the contact. Information on Honors Contracts can be found at http://www.honors.arizona.edu/faculty-and-advisors/contracts.

Schedule

An outline of the lecture course is provided under syllabus. Please note the topics are provisional, and I reserve the right to alter this schedule as we progress through the semester. The webpages will be updated regularly to reflect any changes. Release date is shown, because this is an on-line class the date reflects access to the recorded lecture and materials. Once released the materials will remain available for the remainder of the semester. We may after consultation with the class schedule one or more Zoom live interactive sessions that could offset or alter this prospective schedule. Please note I have built into this schedule three live Zoom sessions to discuss the semester's materials. When this course was offered as in-person students could ask questions and discuss in real time and I have previously had review sessions. To recapture this I would offer and I think it might be useful for us to all meet and discuss this materials. I will be requesting your feedback on this plan. This class is in-person 11-12:15 and I would propose that we use the normal class time on its TT for this discussion session. A different time(s) may be proposed if there is sufficient objection to this time. A query will be circulated well in advance for student feedback.

Syllabus Schedule

Release Date	Topic	Instructor *	Reading
January 14	Go over syllabus Plants Food And Man Plant Biotech and the advance of agriculture Global Food	EMH	**All reading assignments will be posted in advance of lectures on D2L.**
January 19	Omics- Genome to Proteome to Metabolome- The underlying biology of life to implement biotechnology	EMH	.
January 21	Mutation/Insertion Traits Gamma Gardens and insertion libraries	EMH	
January 26	TILLING large scale genomics and tissue culture	EMH	
January 28	Plant Tissue Culture Methods and Application to produce clonal plants and bioactive substances	EMH	
February 2	Plant Transformation Crown Gall to Agro Insertion sites, stability	EMH	
February 4	Vectors, Directed modification of genomes, gene expression, suppression, RNAi, Gene Editing. Constructs and regulation/ test	EMH	
February 9	Flex- Either a discussion session via Zoom or a lecture TBD	EMH	

February 11	Test #1	EMH	
February 16	Viruses	EMH	
February 18	Risk/Regulation/Policy Geneflow, APHIS, BL1-5IP/Owning Life/Policy. International experience	EMH	
Feb 23	Risk/Regulation/Policy Geneflow, APHIS, BL1-5IP/Owning Life/Policy. International experience	EMH	
Feb 30	Herbicide Resistance	EMH	
March 2	Insect Resistance		
March 4	Zoom review discussion or lecture TBD	EMH	
March 11	Test# 2	EMH	
March 14	Transfats seed oils	EMH	
March 16	Biopharma	EMH	
March 18	Food Allergy and Biotech Crops	EMH	
March 23	Carotenoids (Golden Rice) and Biofortification	Monica Schmidt	
March 25	Flex either a Zoom discussion to review or	EMH	

	a lecture TBD		
March 30	Test #3	EMH	
April 1	Toxic food plants and biotech to mitigate/remove toxins	Monica Schmidt	
April 6	Postharvest traits Browning acrylamide	EMH	
April 8	Biomaterials/Biofuels	EMH	
April 13	Environmental stress	EMH	
April 15	Crops in danger- disease and mitigation	EMH	
April 20	Heavy metals and Agriculture	EMH	
April 22	New ag building food systems here on Earth and in Space- synergy of technologies	EMH	
April 27	Wrap-up/food sustainability or Review of semester- mostly likely a Zoom session scheduled We will discuss later.	EMH	
May 4	Test #4		

Lecture Materials

All materials will be posted on D2l.

Videos

There will be some videos of varying length assigned for viewing from Youtube or selected web sites such as PBS, Nat Geo and such. These are to provide some background context of the world of agriculture. All are freely accessible without any registration on you-tube or equivalent web site. These will be used my discussions as reference points. The videos are all enjoyable to watch and are at a general audience level.

Course Updates

Any course updates will be posted on D2l and discussed in class. In some instances the entire class will be emailed with important information, please make sure your email of record is accurate.

Assigned Readings:

Primary Text – None **Some source material is available in:**

Plant Biotechnology and Agriculture- ed. A. Altman and Paul Hasegawa. Academic Press, 2012. Many of the individual chapters were written by the leaders in the individual plant biotechnology fields. **Slightly dated, available in the library.**

Nina Federoff, a member of National Academy, and worked in the US State Department as an Asst Secretary, Mendel in the kitchen, 2006, John Henry Press (paperback, kindle)

Robert Paalberg, forward by Normal Borlaug and Jimmy Carter, 2008, Starved For Science. This is an important book that discussions the consequences for people in need of the collision of science and politics of biotechnology. This book is an important reminder that the technology development and policy debates occur a world away from those who most need the assistance.

Robert Paarlberg, Food Politics, 2nd Edition, 2013, Oxford Univ Press (paperback, kindle)

Dan Charles, Lords of harvest, 2001, Basic books, (paperback, kindle)- This is one of the best historical descriptions of the development of transgenic plant technology.

Thomas Kuhn, The structure of scientific revolutions. 50th anniversary edition. (paperback, kindle)– This is the classic reference of the philosophy of science. It qualifies as a **"great book"** and one that any person interested in science should have read. A theme of this course is whether plant biotechnology is an evolution or revolution of agriculture and this will be discussed many times and often in the context of Kuhn's concept.

Denis Murphy, Plant Breeding and Biotechnology 2007 A very detailed book, also a little dated being > 10 years old.

Jonathan Gressel Genetic Glass Ceilings 2008 , again dated but is a great description of the limits of extent genetic information in improving plants and what can/should be done by engineering and what should be done by breeding.

Pamela Ronald and Raoul Adamchak, 2012, Tomorrow's Table, Organic Farming, Genetics, and the Future of Food. (paperback, kindle)-Dr. Ronald is a UC Davis professor and National Academy member who works on the biotechnology of rice. She is married to an organic farmer, Raoul Adamchak. The interactions and synergy of these two worlds is a unique contribution.

Research articles

Articles will be posted in association each week as background reading. These will often be short review articles from Trends, Current opinion etc. As a 400/500 level class students should be familiar with the style and content of the literature. All will elaborate further on presented materials.

Additional articles (suggested)

In association with each lecture several other articles, reviews, original literature, and in some instances patents, regulatory approvals, or news articles will be posted. These are intended to supplement and enrich the lectures. One to several articles will be posted on D2l for each lecture. These are FYI, interesting accessible films that place the class into a broader context.

Research Journals (Resources)

Nature Biotechnology

Plant Biotechnology Journal

Transgenic Research

BMC Biotechnology

New Biotechnology

Trends in Biotechnology

Other resources include papers/reviews published in: Plant Physiology, Plant Journal, Plant Cell, J Experimental Botany, Science, Nature, Current Opinion, Annual Reviews, PNAS.

Additional Information that is derived from the University not all of which applies to on-line courses such as this. Please note the University's response to the pandemic undergoes periodic changes and impacting Faculty, Staff, and Students. While much of this information is more pertinent to on-campus and in-class I will pass on any relevant information as I receive it. Above all please be safe.

The University of Arizona Code of Academic Integrity applies to PLS 424-524. All students should abide by this Code.

As a courtesy to others, please switch off your phones during the class period. Electronic devices can be used for course work only during class hours.

Employees, Students and Visitors Must Use Face Coverings as Follows:

CLASSROOMS – You are required to wear a face covering in all classrooms and other group instructional settings.

INDOORS – You are required to wear a face covering in all University Buildings, unless you are alone in a single occupancy office.

OUTDOORS – You are required to wear a face covering while in any University of Arizona outdoor space where continuous physical distancing of at least 6 feet is difficult or impossible to maintain.

Please be aware that those not in compliance could now be facing disciplinary actions involving Human Resources.

Life challenges: If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office can be reached at 520-621-2057 or DOS-deanofstudents@email.arizona.edu.

Physical and mental-health challenges: If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care. For

medical appointments, call (520-621-9202. For After Hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.

Equipment and software requirements: For this class you will need regular access to reliable internet signal.

Classroom Behavior Policy
To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., for in classroom, texting, chatting, reading a newspaper, making phone calls, web surfing, etc.) (for on line: be respectful of input from instructors and student during the discussion sections).

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

Threatening Behavior Policy
The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student- affairs/threatening-behavior-students.

Accessibility and Accommodations
Our goal in this classroom is that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact the Disability Resource Center (520-621- 3268) to establish reasonable accommodations. For additional information on the Disability Resource Center and reasonable accommodations, please visit http://drc.arizona.edu.

If you have reasonable accommodations, please plan to meet with me by appointment or during office hours to discuss accommodations and how my course requirements and activities may impact your ability to fully participate.

rev. 7/20/20

Code of Academic Integrity
Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of **independent effort** unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/academic- integrity/students/academic-integrity.

The University Libraries have some excellent tips for avoiding plagiarism, available at http://www.library.arizona.edu/help/tutorials/plagiarism/index.html.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions.

Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

Dr. Herman holds the copyright in the lectures and course materials. Copyright includes student notes or summaries that reproduce these lectures or materials. These course materials are made available only for personal use by students, and students may not distribute or reproduce the materials for commercial purposes without Dr. Herman express written consent. Violation of this copyright may result in course sanctions and violate the Code of Academic Integrity.

UA Nondiscrimination and Anti-harassment Policy
The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Additional Resources for Students
UA Academic policies and procedures are available at http://catalog.arizona.edu/policies

Student Assistance and Advocacy information is available at
http://deanofstudents.arizona.edu/student-assistance/students/student-assistance

Confidentiality of Student Records http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act- 1974-ferpa?topic=ferpa

Subject to Change Statement
Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

Policies, Codes, and Conduct Statements:

General UA Codes and Conduct Information: http://deanofstudents.arizona.edu/policiesandcodes.

Behavior inappropriate for the classroom: http://deanofstudents.arizona.edu/examplesofdisruptivebehavior

Threats of physical harm to any member of the University community: http://web.arizona.edu/~policy/threatening.pdf

UA Code of Academic Integrity: http://deanofstudents.arizona.edu/codeofacademicintegrity

Special Needs and Accommodations Statement:

Students who need special accommodations or services should contact the Disability Resources Center, 1224 East Lowell Street, Tucson, AZ 85721, (520) 621-3268, FAX (520) 621-9423, email: uadrc@email.arizona.edu, http://drc.arizona.edu/. You must register and request that the Center or DRC send me official notification of your accommodations needs as soon as possible. Please plan to meet with me by appointment to discuss accommodations and how my course requirements and activities may impact your ability to fully participate. ***The need for accommodations must be documented by the appropriate office.***