



BE 350: Advanced Hydroponic Crop Production
3 Credits
Spring

Location: Campus Agriculture Center
Controlled Environment Agriculture Center (CEAC)
1951 E. Roger Rd, Tucson, AZ 85719
CEA Building, Classroom 117

Day/Time: Tuesdays and Thursdays 1:00pm - 2:15pm

Description of Course

This is an advanced level course, building on the basic principles covered in BE 217: Introduction to Hydroponics. Students will gain experience in nutrient formulation, fertigation management, and plant health monitoring; design, operation, and cultivation of crops in various types of hydroponic systems and environments (ex. Nutrient Film Technique, Deep Water Culture, aeroponics, aquaponics, gourmet mushrooms, vertical farming, supplemental and sole source lighting); and understanding of the principles and challenges in developing organic hydroponic systems. Students will read and analyze primary literature involving hydroponic systems and develop the ability to troubleshoot and solve grower problems.

Course Prerequisites or Co-requisites

BE 217: Introduction to Hydroponics. BE 350 LAB is a co-requisite for Sustainable Plant Systems majors with a CEA subplan. BE 350 LAB is not required, but is highly recommended for all others.

Instructor and Contact Information

Name	Dr. Stacy Tollefson
Office Location	CEA Building Room 103
Telephone number	520-626-9953/ 520-250-4156 Cell
E-mail address	stacyl@email.arizona.edu
Office Hours/“Open Door Policy”	By appointment
Web information:	
Course:	TBD
Current semester info available through D2L.	

Course Format and Teaching Methods

This is an advanced level course, building on the basic principles covered in BE 217: Introduction to Hydroponics. Class attendance is mandatory. Class time will consist of: 1) lectures from the primary instructor and guest speakers who are experienced in the field of hydroponics and CEA, 2) collaborative activities, and 3) discussions. There is no text book, but reading materials and videos to watch will be posted on D2L. Students are expected to read or watch any assigned material before it scheduled to be discussed in class.

There will be one mandatory field trip to a commercial hydroponic growing facility such as Wholesum Harvest or Nature Sweet, which will take place on a Friday or Saturday TBD.

Course Objectives

This course builds on the basic principles of hydroponics in controlled environments which were covered in BE 217. Students will gain experience in nutrient formulation and fertigation management including how to manage nutrients in recirculating systems; understanding of design, operation, and cultivation of crops in various types of hydroponic systems and environments (Ex. Nutrient Film technique, Deep Water Culture, aeroponics, aquaponics, gourmet mushrooms, vertical farming, supplemental and sole source lighting); and understanding of the principles and challenges in developing organic hydroponic systems. Students will read and analyze primary literature involving hydroponic systems and develop the ability to troubleshoot and solve grower problems.

Expected Learning Outcomes

By the end of the course, students will be able to demonstrate the ability to do the following:

1. Calculate and adjust nutrient formulae, manage fertigation, and identify nutrient deficiencies through data and observation.
2. Describe nutrient requirements, environmental conditions, and cultural practices for growing vining crops, leafy greens, strawberries, and mushrooms using hydroponics and controlled environments.
3. Describe operation, design, financial parameters, and current trends of different hydroponic growing systems/controlled environments and the pros and cons of using each production system.
4. Describe principles and challenges when using organic hydroponic methods.
5. Critically read, review, and analyze research papers of studies in hydroponics.
6. Synthesize and apply principles of hydroponic/CEA growing to troubleshoot and solve grower problems.

This course aligns to all five Student Learning Outcomes for the Sustainable Plant Sciences Major:

This course will provide the students with opportunities to:

- 1) Integrate and apply the general principles of Sustainable Plant Systems to specific plant production systems (Hydroponics and CEA).
- 2) Demonstrate an understanding of the history, current conditions, and future challenges associated with plant sciences and production systems on a local and global scale.
- 3) Apply the basic principles of plant biology and soil science to plant production systems.
- 4) Think critically as demonstrated by evaluating information from multiple perspectives, drawing reasonable conclusions, and defending them rationally.
- 5) Communicate effectively principles and technical terms associated with plant production systems both orally and in writing.

This course aligns to three of the Student Learning Outcomes for the Agriculture Technology Management Major:

- 1) Fulfills knowledge for topic area of Controlled Environment Agriculture.
- 2) Students will be able to work cooperatively with others.

This course aligns to four of the Student Learning Outcomes for the Biosystems Engineering Major:

- 1) Can apply mathematics, science, and engineering principles to solve problems.
- 2) Has the broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal context.
- 3) Has a knowledge of relevant contemporary issues.
- 4) Can communicate effectively.

Absence and Class Participation Policy

Students are expected to come to class and complete readings according to the lecture schedule. Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures and discussion section meetings. Absences may affect a student's final course grade. If you anticipate being absent, are unexpectedly absent, or are unable to participate in class online activities, please contact me as soon as possible. Please contact me BEFORE a foreseeable absence or as soon as possible after the absence in order to discuss an agreeable time period for you to turn in any missed material or assignments. To request a disability-related accommodation to this attendance policy, please contact the Disability Resource Center at (520) 621-3268 or drc-info@email.arizona.edu. If you are experiencing unexpected barriers to your success in your courses, the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office is located in the Robert L. Nugent Building, room 100, or call 520-621-7057.

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>

Makeup Policy for Students Who Register Late

Students who register after the first class meeting must make up all assignments and online discussions within 3 days of first day of attendance, or time agreed upon by instructor.

Required Texts or Readings

There is no textbook required for this course. Readings and assignments will be posted on D2L and may be printed by the students if they so choose.

Required or Special Materials

Students will need a computer with Internet access so that they can access D2L and a printer.

Required Extracurricular Activities

There will be one mandatory field trip to a commercial hydroponic growing facility such as Wholesum Harvest or Nature Sweet, which will take place on a Friday or Saturday TBD.

Assignments and Examinations: Schedule/Due Dates

Readings will be posted to D2L at least a week prior to when those topics are presented in lecture. Students need to complete those readings before the lecture for the topic. There will be 10 Assignments and 1 research project, due as shown in the Lecture Schedule. There are two exams and a final exam. The first two exams will be held on days listed in the lecture schedule and will NOT be comprehensive. The Final Exam will be held on the date/time posted in the UA schedule of final examinations for T/Th classes meeting at 1pm. The Final Exam will not be comprehensive. Each exam covers only information covered

since the last exam (see course schedule for detail).

Assignment Format

Assignments will be posted and turned in on D2L. The project guidelines will be posted on D2L, the Powerpoint Presentation/paper will be turned in on D2L but also presented during class.

Final Examination

The Final Exam will be held on the day/time designated in the UA schedule of final examinations for T/Th classes meeting at 1pm. See Schedule for date and time. The Final Exam will take place in the CEAC Classroom Rm 117. The date and time of the final exam or project, along with links to the Final Exam Regulations, <https://www.registrar.arizona.edu/courses/final-examination-regulations-and-information>, and Final Exam Schedule, <http://www.registrar.arizona.edu/schedules/finals.htm>

Grading Scale and Policies

FINAL GRADE =

LECTURE GRADE	Pts
Homework (20 assignments)	200
Exam 1	100
Exam 2	100
Final Exam	100
TOTAL	500

Grading Scale

A = 448 – 500 pts
B = 398 - 448 pts
C = 348 - 397 pts
D = 298 - 347 pts
E < 298 pts

Late work policy: Assignments **MUST** be turned on on D2L by the date due/time. A grade of “0” will be assigned if the work is turned in after the due date/time, unless otherwise agreed upon by the instructor.

Testing policy: All tests will cover readings, videos, and lecture material (video and/or Powerpoints), all of which will be posted in D2L. Make-ups will only be given in case of a documented medical emergency or out-of-town events associated with a degree program (ex. Ag Ed FFA Conf. etc.) with Dean’s Excuse. For unforeseen medical emergencies (w/ Dr’s excuse), **make-ups may be written / oral**. For prescheduled out-of-town events, the instructor may agree to give the test prior to leaving.

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. Incomplete grades must be verified with a written agreement between the instructor and student. This agreement will specify the work to be done and a timetable of completion.

Dispute of Grade Policy: Students may discuss/dispute a given grade with the instructor as long as it is within one week of the grade being returned to the student. The instructor reserves the right to maintain the grade as it was originally assigned.

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 contract. Information on Honors Contracts can be found at <https://www.honors.arizona.edu/honors-contracts>.

Scheduled Topics/Activities

See table at the end of this document.

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., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.). Cell phones should remain OFF during lecture, unless approved by instructor to being used as calculators. Laptops, ipads, and tablets are allowed during lecture for the purpose of taking notes only (no internet, email, facebook, games, etc). Phones, laptop, and other personal electronics are NOT allowed during exams.

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

At the University of Arizona we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, <https://drc.arizona.edu/>) to establish reasonable accommodations. Please plan to meet with me by appointment or during office hours to discuss needed accommodations.

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. The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>.

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.

**BE 350: ADVANCED HYDROPONIC CROP PRODUCTION: SCHEDULE OF LECTURES
Spring 2020**

INSTRUCTOR: Dr. Tollefson

(Schedule subject to change)

Week	DATE	LECTURE	DUE
1	Jan 16 TH	Course expectations	
2	Jan 21 T	Nutrient formulae, how to make and refill tanks	
	Jan 23 TH	How to calculate recipes	
3	Jan 28 T	How to calculate recipes	HW 1: Tank refills
	Jan 30 TH	Fertigation system parameters/management. How to manage nutrition in recirculating systems. Case study: SU Rooftop GH	
4	Feb 4 TU	pH, alkalinity, EC, effect of organic matter, flow rate.	HW 2: Recipe calculations
	Feb 6 TH	Alkalinity workshop.	HW 3: Alkalinity Activity
5	Feb 11 T	Dosatron/Mini-Dos workshop - Stephen Poe	HW 4: Recirc Management of recipes
	Feb 13 TH	Commercial scale tomato growing – Jose Torres, Wholesum Harvest	Field trip to Commercial Facility, Friday, 8am - noon
6	Feb 18 T	Lettuce	HW 5: Wholesum Harvest Reflection
	Feb 20 TH	1ST ONE HOUR EXAM (100pts)	
7	Feb 25 T	Food Safety Certification	
	Feb 27 TH		
8	Mar 3 T	Attend Short Course	
	Mar 5 TH	Attend Short Course	HW 6: Journal Article Review
9	Mar 10 T	<u>NO CLASS – SPRING BREAK</u>	
	Mar 12 TH	<u>NO CLASS – SPRING BREAK</u>	
10	Mar 17 T	<u>NO CLASS –</u>	
	Mar 19 TH	Pepper, Eggplant, Cucumber, Hops Strawberries, other berries	HW 7: Short Course Summaries
11	Mar 24 T	Aquaponics	
	Mar 26 TH	Aquaponics (cont'd)	
12	Mar 31 T	Organic growing methods (cont'd)	
	Apr 2 TH	Organic Certification, organic growing methods	HW 8: Aquaponics/Organic Hydroponic Controversy
13	Apr 7 T	2nd ONE HOUR EXAM (100pts)	
	Apr 9 TH	Vertical Farming/Indoor growing – environmental considerations	

14	Apr 14 T	Lighting – supplemental and sole source, growth and morphology effects on plants	HW 9: Journal Article Review
	Apr 16 TH	Troubleshooting Activity	
15	Apr 21 T	Mushroom Production	
	Apr 23 TH	Mushroom Production (cont'd)	HW 10: Mushroom Production
16	Apr 28 T	Mushroom Production (cont'd)	
	Apr 30 TH	Hemp Production	
17	May 5 T	Hemp Propagation Activity	
	T May 12	FINAL EXAM (100 pts) 1:00-3:00pm CEAC classroom RM 117	