



BE 217 LECTURE: Introduction to Hydroponics and Controlled Environment Agriculture
3 Credits
Fall 2019

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

Day/Time: Tuesdays & Thursdays 3:00 – 4:15pm

Description of Course

Controlled environment agriculture is the science and technology of producing crops such that the grower controls the plant’s aerial and root zones in order to optimize growth, yields, and quality while minimizing the use of resources. This course teaches the scientific and technological principles of hydroponics and CEA including different types of systems, appropriate crops and cultivation methods, plant anatomy and physiology, transplant production, pest management, plant nutrition, monitoring plant health, fertigation management, environmental parameters, greenhouse structures and climate control, and lighting. The course covers current trends in CEA such as urban rooftop greenhouses, indoor growing, vertical farming/plant factories, lunar/space applications, and aquaponics, as well as marketing and food safety certification.

Course Prerequisites or Co-requisites

No prerequisites

Instructor and Contact Information

Name	Dr. Stacy Tollefson
Office Location	CEA Building Room 103
Telephone number	520-626-9953
E-mail address	stacytolleffson@yahoo.com
Office Hours/“Open Door Policy”	By appointment

Web information:

Course: <https://ceac.arizona.edu/students/ua-courses/pls-217>

Current semester info available through D2L.

Course Format and Teaching Methods

The course combines lecture, videos, tours of facilities, and guest speakers so give students a well-rounded view of Hydroponics and CEA and its applications in the real world. D2L will be used to post the Powerpoints, videos, and classnotes textbook chapters. Students are not required to purchase the classnotes textbook, but may print it out on their own if they so choose. Students are expected to

read the assigned chapters and watch the assigned videos **before** coming to class on the day they are covered.

Course Objectives

The objective of this course is to introduce students to the field hydroponics and controlled environment agriculture as a technological science and as a growing industry. Student will learn about current trends in the industry and types of systems and the scientific principles and techniques involved in hydroponic crop production.

Expected Learning Outcomes

The course objective is for students to gain a theoretical and practical understanding of the science and techniques of hydroponic crop production and controlled environment agriculture.

The expected learning outcomes are for students to be able to:

- 1) Describe the advantages/disadvantages of controlled environment agriculture and hydroponic crop production in the agricultural production of various food crops.
- 2) Demonstrate an understanding of basic principles of plant biology, entomology, plant nutrition and disorders, irrigation and fertilization, and environmental conditions necessary for growing greenhouse hydroponic vegetable crops.
- 3) Understand plant cultivation, harvesting, pest management, and food safety techniques for growing hydroponic tomatoes.
- 4) Understand the considerations involved with different types of greenhouses and structural components, control systems, and site selection in order to grow a successful crop.
- 5) Understand the knowledge base, food safety issues, marketing, and financial considerations needed to start a hydroponic crop production business.

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) [High]
- 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 identify and select tools and equipment to perform specific operations.
- 3) Students will be able to work cooperatively with others.

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

- 1) Can apply mathematics, science, and engineering principles to solve problems.

- 2) Can use the techniques, skills, and modern engineering tools necessary for engineering practices.
- 3) Has the broad education necessary to understand the impact of engineering solutions in global, economic, environmental, and societal context.
- 4) Has a knowledge of relevant contemporary issues.
- 5) Can communicate effectively.

Absence and Class Participation Policy

Students are expected to come to class and complete readings according to the lecture schedule. If students are absent due to illness, dean's excuse, or other absence approved by the instructor, students will have 48 hours to make up the assignment.

If regular lecture times are missed:

Due to personal illness/accident: Contact the instructor (phone, email, in person) within 24 hours of the missed class in order to get full credit for assignments turned in within 48 hours of due date

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>

Due to prescheduled event: Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>. **YOU MUST contact instructor prior to AND as soon as you know the dates you will be gone.**

Due to religious belief, observance, or practice: 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>. Students will still be responsible for lecture material by reviewing chapters and materials posted on D2L. Homework assignments are still due on the due date. **POLICY:** Students MUST give the instructor a list of these events within the first 7 days of the semester AND make arrangements, to make up assignments late if needed.

Exams will only be re-scheduled for Doctor's excused illnesses, Dean's Excuses, and religious events that pre-approved by the instructor.

Dropping the course once it has begun:

If you decide to drop the class once it has begun (once you have been assigned a rep of plants, i.e., after the first class meeting), please notify the instructor.

Please see University withdrawal procedures: <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal>

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

PLS 217 Class Notes: Intro to Hydroponics and CEA is required and available on D2L and online at

<https://ceac.arizona.edu/students/ua-courses/pls-217> Handouts will be distributed in class and/or on D2L. Powerpoints will be posted on D2L.

Required or Special Materials

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

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 should complete those readings before the lecture for the topic.

The first 2 exams will be held on days listed in the lecture schedule and will generally not be comprehensive, unless the instructor explains which topics will overlap. The Final Exam will be held on Wednesday December 18, 2019 from 3:30-5:30pm in the regular classroom (CEAC Rm 117) and will generally not be comprehensive, unless the instructor explains which topics will overlap.

Assignment Format

Homework assignments and due dates are listed on the Schedule of Lectures. Assignments must be printed and handed in at the start of the class period in which they are due.

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 3pm, as listed at <http://www.registrar.arizona.edu/schedules/finals.htm> which is Wednesday December 18, 3:30 -5:30pm in the CEAC Classroom.

Grading Scale and Policies

FINAL GRADE = 400pts Total

LECTURE GRADE	Pts
Homework (8@ 10 pts each)	80
Presentation	20
Exam 1	100
Exam 2	100
Final Exam	100
TOTAL	400

Grading Scale

A = 358 - 400 pts
B = 318 - 357 pts
C = 278 - 317 pts
D = 238 - 277 pts
E < 238 pts

Late work policy: Assignments **MUST** be turned in at the beginning of class on the date due. 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). 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 will be written / oral**. For prescheduled out-of-town events, **the written test must be taken 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.

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

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.

Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

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.

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.

PLS 217: Intro to Hydroponics and CEA
SCHEDULE OF LECTURES
FALL 2019

INSTRUCTOR: Dr. Tollefson

(Schedule subject to change)

DATE	LECTURE	DUE DATES
27 Aug.	<ul style="list-style-type: none"> • Course expectations, syllabus • Tour of CEAC facilities • Video: From Seed to Harvest 	
29 Aug.	<ul style="list-style-type: none"> • Principles of hydroponics: definition, types of media, types of systems, basics of fertilizers 	
03 Sept.	<ul style="list-style-type: none"> • Plant propagation: Chapter 6 	HW 1: Industry Examples
05 Sept.	<ul style="list-style-type: none"> • Planted Greenhouse 	
10 Sept.	<ul style="list-style-type: none"> • No class (CEA Biosphere 2 Conference) 	
12 Sept.	<ul style="list-style-type: none"> • Went over HW1 • Plant propagation (cont'd) 	
17 Sept.	<ul style="list-style-type: none"> • Types of systems: Aggregate, liquid, aquaponics 	
19 Sept.	<ul style="list-style-type: none"> • Types of systems: Aggregate, liquid, aquaponics (cont'd) 	
24 Sept.	<ul style="list-style-type: none"> • Pollination, fertilization, and bee management: Chapter 7 	HW 2: Automation
26 Sept.	<ul style="list-style-type: none"> • The plant: Anatomy and Physiology: Chapter 2 	
01 Oct.	<ul style="list-style-type: none"> • Guest Speaker Dr. Merle Jensen: History and Development of Hydroponic & CEA Crop Production Tomatoes: “the balanced plant”: Chapter 3 	HW 3
03 Oct.	<ul style="list-style-type: none"> • The plant: Anatomy and Physiology: Chapter 2 (cont'd) 	
08 Oct.	<ul style="list-style-type: none"> • 1ST ONE HOUR EXAM (100pts) 	
10 Oct.	<ul style="list-style-type: none"> • “The balanced plant” Vegetative vs Reproductive • Integrated Pest Management (IPM), monitoring: Chapter 4 	HW 4
15 Oct.	<ul style="list-style-type: none"> • Insects and Disease ID and Control: Chapter 4 (cont'd) 	
17 Oct.	<ul style="list-style-type: none"> • Hydroponic nutrient solutions: Chapter 9 & 10 Plant nutrients, source water, water chemistry 	HW5
22 Oct.	<ul style="list-style-type: none"> • Hydroponic nutrient solutions: Chapter 9 & 10 • Hydroponic fertilizers/recipes 	
24 Oct.	<ul style="list-style-type: none"> • Fertigation systems and management: Chapter 10 	
29 Oct.	<ul style="list-style-type: none"> • Nutrient and physiological disorders: Chapters 9 & 10 	HW 6
31 Oct.	<ul style="list-style-type: none"> • Monitoring plant health: “Reading the plant” 	
05 Nov.	<ul style="list-style-type: none"> • 2nd ONE HOUR EXAM (100pts) 	
07 Nov.	<ul style="list-style-type: none"> • Guest speaker Mr. Myles Lewis, Arizona Vegetable Company: Hydroponics and CEA in other countries 	
12 Nov.	<ul style="list-style-type: none"> • <i>Assign Presentation: Present a CEA operation not covered in class.</i> • Greenhouse site selection 	
14 Nov.	<ul style="list-style-type: none"> • Greenhouse structures, started Env conds. 	

19 Nov.	<ul style="list-style-type: none"> • Guest Speaker Dr. Merle Jensen: Marketing “High tech, high touch” 	
21 Nov.	<ul style="list-style-type: none"> • Environmental conditions, setpoints, cooling 	
26 Nov.	<ul style="list-style-type: none"> • Student presentations 	
28 Nov.	THANKSGIVING BREAK – No Class	
03 Dec.	<ul style="list-style-type: none"> • Greenhouse heating, control systems for heating and cooling 	
05 Dec.	<ul style="list-style-type: none"> • Certifications – food safety, certified pesticide-free, organic 	HW 7
10 Dec.	<ul style="list-style-type: none"> • Troubleshooting activity, Brix 	HW 8
18 Dec. Wednesday	FINAL EXAM (100 pts) CEAC classroom RM 117, 3:30-5:30pm	