PLS 217R (lecture): Introduction to Hydroponics and Controlled Environment Agriculture
3 Credits

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

Day/Time: In person - Tuesdays & Thursdays 3:00 – 4:15 pm
Or Distance Learning online

Description of Course
Hydroponics and controlled environment agriculture: an historical perspective; basic plant physiology and anatomy; general cultural practices; plant protection (insects and diseases); traditional and organic hydroponic production systems; pollination, fertilization and bee management; plant nutrition and disorders; irrigation systems and nutrients; transplant production; greenhouse site selection, structures and control systems; fruit harvest; food handling and safety; marketing and economics of a hydroponic business.

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 stacyl@email.arizona.edu
Office Hours/“Open Door Policy” By appointment
Web information:
Course: http://ceac.arizona.edu/pls-217-introduction-hydroponics-and-cea
Current semester info available through D2L.

Course Format and Teaching Methods
This is a lecture-based course taught either in person or on-line using D2L. The course includes readings, Powerpoint presentations, videos, 8 assignments, 14 on-line discussions, and 3 exams. Course materials, including the course manual (textbook), will be available on D2L, and students may read from there or print at their own expense. The course will conducted the same whether students are using distance learning or taking the class in person, except that distance learning students will take exams online and will see the CEAC facilities tour through video rather than in person, and view lecture through online videos. Students are expected to read the assigned chapters and complete assignments before coming to class, or before doing the assignments.
Course Objectives and 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) Demonstrate mastery of plant cultivation, harvesting, pest management, and food safety techniques for growing hydroponic tomatoes.
4) Explain the considerations involved with different types of greenhouses and structural components, control systems, and site selection in order to grow a successful crop.
5) Demonstrate understanding of 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 Controlled Environment Agriculture)
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.

Relationship of Course to ABET Learning Outcomes:

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

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

Students are expected to come to class (if in person) and complete readings and assignments according to the lecture schedule. They are expected to participate in weekly on-line discussions as outlined in information given during class. 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:** Students who miss class due to illness or emergency are required to bring documentation from their health-care provider or other relevant, professional third parties. Failure to submit third-party documentation will result in unexcused absences. Contact the instructor (phone, email, in person) **within 24 hours** of the missed class in order to get credit for assignments missed, if they are done within 48 hours.

- **Due to prescheduled UA- approved 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. You must still turn in assignments on the due dates and participate in discussions for that week, even if you are 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 and are still responsible for on-line discussions for that week. **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.

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.

Course Communication

Course communication will occur through the instructor’s and students’ University of Arizona email accounts and D2L.

Required Texts or Readings

PLS 217 Class Notes: Intro to Hydroponics and CEA is required and available on D2L and online at http://ceac.arizona.edu/pls-217-introduction-hydroponics-and-cea. Handouts and videos will be posted on D2L.

Required or Special Materials

Students will need a computer with Internet access in order to access and use D2L.

Information on how to use D2L

1. Go to http://d2l.arizona.edu/ to access D2L
2. Enter your netID login and password
3. Go to “My Academic Courses”
   a. Click on the down arrow beside the current semester.
   b. Click on your course name.
   c. You should now be at your D2L Course Home Page.

If you have difficulty with D2L, please read the D2L Tip Sheet at
http://eebweb.arizona.edu/faculty/dornhaus/courses/d2l%20tip%20sheet%20students.pdf.
Problems using D2L can also be reported using this Web link http://help.d2l.arizona.edu/node/153.
Additionally you can contact UITS 24/7 at: http://uits.arizona.edu/departments/the247 or directly at -
(520) 626-TECH (8324)

Assignments and Examinations: Schedule/Due Dates
Readings should be completed before the lecture for the topic. Assignments will be posted on
D2L. Students may download the assignment file, add their responses, and re-save. Assignments
must be uploaded and turned in through D2L before class starts on the due date posted on the class
schedule.

There will be 14 on line discussions in which students must participate on a weekly basis in order
to earn points. Participation for the previous week must be completed by the due date listed on the
lecture schedule.

The first 2 exams will be held on days listed in the lecture schedule. The Final Exam will be held
on according to the University Exam Schedule as listed at
http://www.registrar.arizona.edu/schedules/finals.htm

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

Grading Scale and Policies
All points, as listed below, will count toward the final grade.

<table>
<thead>
<tr>
<th>Assignments</th>
<th>Points</th>
<th>Percentage</th>
<th>Grade</th>
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<tbody>
<tr>
<td>8 short exercises (20 points each)</td>
<td>160</td>
<td>537-600</td>
<td>A</td>
</tr>
<tr>
<td>14 on-line discussions (10 points each)</td>
<td>140</td>
<td>477-536</td>
<td>B</td>
</tr>
<tr>
<td>3 1-hr exams (100 points each)</td>
<td>300</td>
<td>417-476</td>
<td>C</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>357-416</td>
<td>D</td>
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<tr>
<td></td>
<td></td>
<td>Below 357</td>
<td>E</td>
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</tbody>
</table>

Late work policy: Assignments MUST be turned in before the start of class on the day it is due.
A grade of “0” will be assigned if the work is turned in after the due date/time.

Testing policy: All tests will cover readings, handouts, videos, and lecture material. 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.

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 http://www.honors.arizona.edu/faculty-and-advisors/contracts

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, 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.

Online discussions are intended to make you think more deeply about the courses content and think of related issues and questions outside of what is covered in class. It is expected that students may disagree with thoughts or opinions expressed by classmates, and it is fine to disagree, but to disparage others views is unacceptable. All comments should be kept civil and thoughtful. It is expected that only appropriate language be used (ex. No swearing or slang) and proper spelling language (Ex. No text-spell such as using “u” for you.)

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, email, 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](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](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](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](http://catalog.arizona.edu/policies).

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

**Confidentiality of Student Records**


**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.

**Scheduled Topics/Activities**

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<tr>
<th>DATE</th>
<th>LECTURE</th>
<th>DUE</th>
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<tr>
<td>23 Aug.</td>
<td>Chapter 1: Historical Perspectives of Hydroponics</td>
<td>HW1</td>
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<tr>
<td>28 Aug.</td>
<td>From Seed to Harvest video</td>
<td>Discussion 1</td>
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<tr>
<td>30 Aug.</td>
<td>Chapter 2: The plant: Anatomy, physiology, &amp; tomatoes</td>
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<tr>
<td>04 Sept.</td>
<td>Chapter 2: The plant: Peppers, cucumbers, eggplant, lettuce, herbs, &amp; medicinals</td>
<td>Discussion 2, HW 2</td>
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<tr>
<td>06 Sept.</td>
<td>Chapter 3: How to grow tomatoes</td>
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<tr>
<td>11 Sept.</td>
<td>Chapter 3: How to grow tomatoes, “The balanced plant”</td>
<td>Discussion 3</td>
</tr>
<tr>
<td>13 Sept.</td>
<td>Chapter 3: How to grow to cucumbers, peppers, other vining crops</td>
<td>Tour greenhouses (on-site)</td>
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<tr>
<td>18 Sept.</td>
<td>How to grow lettuce</td>
<td>Discussion 4, Tour greenhouses (on-site)</td>
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<td>20 Sept.</td>
<td>Chapter 4: Plant protection: Insects &amp; IPM</td>
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<tr>
<td>25 Sept.</td>
<td>Chapter 4: Plant protection: Insects &amp; IPM</td>
<td>Discussion 5, HW 3</td>
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<tr>
<td>27 Sept.</td>
<td>1ST ONE HOUR EXAM (100pts) (Chapters 1-6)</td>
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<tr>
<td>02 Oct.</td>
<td>Chapter 7: Pollination, fertilization, &amp; bee management</td>
<td>Discussion 6</td>
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<tr>
<td>04 Oct.</td>
<td>Chapter 8: Cluster Maintenance, Fruit Harvest, Grading, Storage</td>
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<tr>
<td>09 Oct.</td>
<td>Troubleshooting activity</td>
<td>Discussion 7, HW 4</td>
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<tr>
<td>11 Oct.</td>
<td>Chapter 9/10: Plant nutrients, water chemistry, &amp; nutrient solutions</td>
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<tr>
<td>16 Oct.</td>
<td>Chapter 9/10: Plant nutrients, water chemistry, &amp; nutrient solutions (cont’d)</td>
<td>Discussion 8</td>
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<tr>
<td>18 Oct.</td>
<td>Chapter 10: Fertigation systems and management</td>
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<tr>
<td>23 Oct.</td>
<td>Chapter 9: Nutritional deficiencies, physiological, and pollination issues; Monitoring Growth</td>
<td>Discussion 9, HW 5</td>
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<tr>
<td>25 Oct.</td>
<td>2ND ONE HOUR EXAM (100pts) (Chapters 7-10, Exercises &amp; lab info)</td>
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<tr>
<td>30 Oct.</td>
<td>Chapter 11: Greenhouse site selection</td>
<td>Discussion 10</td>
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<tr>
<td>02 Nov.</td>
<td>Chapter 12: Greenhouse structures</td>
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<tr>
<td>06 Nov.</td>
<td>Chapter 13: Greenhouse control systems. Light, RH, CO2, Cooling</td>
<td>Discussion 11</td>
</tr>
<tr>
<td>08 Nov.</td>
<td>Chapter 13: Greenhouse control systems. Heating</td>
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<tr>
<td>13 Nov.</td>
<td>Chapter 14: Greening the Greenhouse</td>
<td>Discussion 12, HW 6</td>
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<tr>
<td>DATE</td>
<td>LECTURE</td>
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<tr>
<td>15 Nov.</td>
<td>Urban production systems: Indoor/Rooftop</td>
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<tr>
<td>20 Nov.</td>
<td>Indoor Growing: Lighting/Climate Control/IPM</td>
<td>Discussion 13, HW 7</td>
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<tr>
<td>22 Nov.</td>
<td>THANKSGIVING BREAK – No Class</td>
<td>Data for term paper will be emailed to students.</td>
</tr>
<tr>
<td>27 Nov</td>
<td>Chapter 16: Food safety and storage</td>
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<tr>
<td>29 Nov.</td>
<td>Chapter 16: GHP/GAP Food Safety Certification</td>
<td>Discussion 14</td>
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<tr>
<td>04 Dec.</td>
<td>Chapter 15: Marketing and economics</td>
<td>HW 8</td>
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<tr>
<td></td>
<td><strong>FINAL EXAM (100 pts)</strong></td>
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<td></td>
<td>CEAC classroom RM 117</td>
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<tr>
<td></td>
<td>(Chapters 11-16, Exercises, and lab info)</td>
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</tbody>
</table>