Instructor: Dr. Andrew Kulmatiski  
Andrew.kulmatiski@usu.edu  
NR 224

Office hours: Wednesday after class and by appointment.

Course website: look up course on CANVAS (https://usu.instructure.com/courses/352192)

Course Objectives: I want you to be able to apply ecophysiology concepts and data to new systems and communicate these concepts succinctly.

Format: One 4-hour class each week (1-5 pm, BNR 112B). Most class periods will begin with a lecture (~45 minutes) and discussion of a reading from the primary literature (20-40 minutes). The remainder of the class will be dedicated to using instruments, manipulating data and in-class exercises.

Course Description: How plants access resources and interact with their abiotic and biotic environment is fundamental to life on earth. Seemingly small differences in plant physiology can determine where a plant grows, how abundant it is and its role in an ecosystem (e.g., productivity or palatability). In this course, we will explore

Student Evaluation: Assessment of student performance will be based on a midterm exam (15%), a final exam (20%), your ability to lead a discussion on a paper from the primary literature (20%), class participation (5%), data analysis / lab reports (10%) and a proposal or class project (30%).

Exams: I recognize that not all topics will be relevant to all students, so exams will allow students to select questions to answer from a list of options allowing students to focus on their area of interest. I will provide a study sheet one week prior to exams. Exam questions will be derived solely from that list so there will be no surprises – just an opportunity to make sure you understand the material covered in class.

Discussions: See ‘How to lead a discussion’ at the end of the syllabus. Each student will be responsible for selecting a topic/paper of interest and leading a discussion on that topic/paper. Each student must run their suggested paper(s) by me two weeks before presenting the paper in class. One week prior to your presentation you must submit a concise one-page summary of the paper that includes an outline of how you will lead a discussion on the paper (10 pts). Please note that leading a discussion requires more than simply reading the paper. Unless you are already intimately familiar with a topic, you should expect to read several related papers so you can provide some background / relevance and alternatives to the paper.

Class participation: We will be discussing papers during each class. Discussions are not productive if you are not there either physically or mentally. We will all get more out of discussions if you are well prepared, so please read the paper and come prepared to discuss it.

Data analyses / lab reports: There will essentially be an answer (e.g., 5 mmol m^2 sec^{-1}) for each in-class project. Submit the answer for points. If you come to class and work on the project for the day, you will get the points.
Proposal: As graduate students you are all responsible for producing a research proposal. This is an opportunity to refine that proposal and receive feedback. The proposal should be hypothesis driven and broadly related to plant physiological ecology. It should briefly outline the nature of the problem addressed, the hypothesis tested then provide a brief description of the approaches to be used in the research. The proposal should be 3-5 pages single spaced (not including references) but formatting is flexible if the proposal is to be used for other purposes (e.g., NSF). This proposal will be due the day of 8 April. A revision of the proposal will be due the day of the final. Each will be worth 20% of your grade.

Project: Some of the techniques and data used in this class will be very relevant to some of the students and it may be appropriate for some of you to work up data to either refine your expertise or to develop existing data analyses for use in a publication (e.g., I can provide unpublished data that offers students opportunities to analyze data for use in a publication). If this sounds appealing talk to me early in the course so we can get you started. Students can work in groups but I will expect that data will be analyzed and summarized in a format similar to a Note in Ecology.

Grading will be based on a 90–100% = A, 80–89% = B, etc. scale. For each day that the write-up associated with an assignment is late, you lose 5% of your grade on that assignment.

Readings: Much of the work in this class will be reading. There is one required textbook: Plant Physiological Ecology, by Lambers, Chapin and Pons. There will also be readings from scientific journals and books. PDFs of readings are/will be posted on CANVAS. Students are expected to read assignments before class and contribute during lectures and discussions. Assignments, exams etc. will be placed in your mailboxes.

Accommodations for disabilities: Students with physical, sensory, emotional or medical impairments may be eligible for reasonable accommodations in accordance with the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973. All accommodations are coordinated through the Disabilities Resource Center (DRC) in Room 101 of the University Inn, 797-2444 voice, 797-0740 TTY, or toll free at 1-800-259-2966. Please contact the DRC as early in the semester as possible. Alternate format materials (Braille, large print or digital) are available with advance notice.

Academic integrity: Each student has the right and duty to pursue his or her academic experience free of dishonesty. The Honor System is designed to establish the higher level of conduct expected and required of all USU students. Infractions (cheating, falsification, and plagiarism) and their associated penalties are described in the USU Academic Policies and Procedures Manual (www.usu.edu/policies).

First day quiz – single word or short phrase answers, please.
What is the concentration of CO₂ in the atmosphere?
Which is the reduced form of C, CH₄ or CO₂?
Why would a plant want to release protons or organic acids into the soil?
Why do C₃ and C₄ plants have different δ¹³C values and what are they?
Why is N important to plants – be specific?
What is nitrification?
What is the Keeling curve?
How much carbon is fixed in a tropical forest? Temperate forest? Tundra? Open ocean?
What is stomatal control?
## Course Schedule and Readings

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<th>Date</th>
<th>Topic</th>
<th>‘lab’</th>
<th>Readings</th>
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<tr>
<td>7-Jan</td>
<td>Intro / Energy Flows</td>
<td>Goldilocks dilemma</td>
<td>[1, 2]</td>
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<td>14-Jan</td>
<td>Abiotic – Biometeorology – leaf E budget</td>
<td>Campbell dataloggers, Soil water sensors, Porometer,</td>
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<td>1,3 (2)</td>
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<td>4-Feb</td>
<td>Abiotic – Primary minerals, weathering, nutrient uptake</td>
<td>Water potential (WP4), Hydrus</td>
<td>[7] [8] [9]</td>
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<td>18-Feb</td>
<td>Life stages and roots</td>
<td>root measures</td>
<td>[12] [13]</td>
<td>8</td>
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<tr>
<td>25-Feb</td>
<td>Roots, review</td>
<td></td>
<td>[14]</td>
<td>9a</td>
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<td>4-Mar</td>
<td>midterm</td>
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<td>11-Mar</td>
<td>Spring Break</td>
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<tr>
<td>25-Mar</td>
<td>Ecology- Competition</td>
<td>AMF, Pyroseq (multivariate stats)</td>
<td>[15] [16]</td>
<td>9e</td>
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<td>1-Apr</td>
<td>Ecology- symbionts, pathogens, psf</td>
<td>LiCor,</td>
<td>[17] [18]</td>
<td>9b</td>
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<td>8-Apr</td>
<td>Ecology- Ecosystem ecology</td>
<td>Budgeting (Dendrometers, allometry, litter, soil resp., ICP)</td>
<td>[19] [20]</td>
<td>9c,d</td>
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<td>15-Apr</td>
<td>Global change</td>
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<td>[21] [22]</td>
<td>10</td>
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<td>22-Apr</td>
<td>Final</td>
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## How to Lead a Discussion

*What can you do to lead a fun discussion?*

- Although discussions may often appear to lack guidance, a good discussion leader will have:
  - Enthusiasm
  - A solid understanding of the history of a field
  - And be prepared to guide the discussion with a *series of questions that lead to a desired endpoint*.

- No power point or other “presentation” is allowed. There will be no materials for you to use for the discussion except the white board.

*What do you need to do beforehand?*

- Come prepared to present information on papers other than the ones you assign.
- Come with a list of important questions
- Think about the big picture and where you think the discussion should end. What information should everyone walk away with? I think there’s nothing more unsatisfying than feeling like the discussion didn’t get anywhere.

*How do you select a paper?*

There are several approaches to take: classics in the field, review papers, significant papers, or really modern applications. This is something to think about carefully because you have to get the class up to speed.
I would suggest NO MORE than 2 papers depending on their length and difficulty. It might be that 1 paper is sufficient. You should realize that the more you assign the less likely that everyone will be read it really carefully. In addition, your fellow students might not like you so much! Look at the length of the papers that you are considering. Some of the best discussion papers maybe 4 pages in Nature or Proceedings of the National Academy – as opposed to 20 page review articles or monographs. And, the 4 page paper might leave a lot more room for interesting discussion than the 20 page review article. However, as the leader of the discussion, you might want to read the 20 pager to give the class additional information during the discussion.

I have papers that I’ve picked for a number of topics. I will give the person who is assigned each topic this list of papers as a starting point. I’m happy if you want to use all the papers I’ve suggested. It is up to you. You will be leading the discussion and you should be interested in and comfortable with the papers you’ve chosen.

However, I will request that you run your potential papers by me. I would like to do some screening, because in the past, I’ve had some not so interesting papers assigned, and if we can stop this ahead of time, that would be great. The papers that I’m unlikely to want to see are data papers because these papers are unlikely to be good discussion papers. The broader the paper is to the issues, the better it will be for discussion.

How can you tell if your paper is likely to make for a good discussion? When you are doing your lit search what should you look for to see if the paper is likely to be a good – besides looking at the abstract.

The first thing that I look for is the number of times that the paper has been cited. Of course, if it is a 2012 paper, this is going to be less than if it’s a 2009 paper. However, even papers that are couple of years old could have 30 or more citations. Some have 100s. The more times it’s cited, the more likely that the paper is a classic or controversial. These are usually good papers to pick.

Another thing I do is see who has the most papers coming out on this topic. It might be good to pick a paper from someone who is at the top of the field because they are likely to have other papers on the topics, pushing the envelope with their work and their work is probably important for the class to know about.

Another thing to consider is the journal where the work was published. If the journal is region focused, organism focused or subject focused the paper is less likely to appeal to a broad audience – like we have in this class.

What journals typically have significant or novel papers? Or classics?
Nature, Science, New Phytologists, Ecological Applications

What journals typically have good up-to-date reviews?
Trends in Ecology and Evolution, Ecology Letters

What journals are likely to have articles with a Plant Ecophysiology focus?
Oecologia, Ecohydrology, Tree Physiology, Plant, Cell and Environment
What journals are likely to have articles to have really good theoretical support as well as data?

Journal of Ecology, Oecologia, Oikos, American Naturalist

