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# PLS 477/577 — Applied Plant Biodiversity

In person, 3 units

Fall 2024: T/Th 9:30-10:45

### Course description

Landscapes, whether natural or built, are rich with plant life. Plants are widely appreciated, e.g., for their edible materials, fuel, fiber, carbon sequestration, shade, visual appeal, and wildlife support. Diverse plant species, and plant lineages, fill these needs and blanket landscapes. In this course, we will weave together ***knowledge*** about global and regional plant biodiversity with transferable ***skills*** in analyzing biodiversity. We will reflect on this content in multiple ***contexts***, including wildlife habitat, climate change, and social justice issues, e.g., biological intellectual property rights. The resulting synthesis will prepare students for careers in horticulture, conservation, land management, wildlife management, natural history museums, and/or basic scientific research involving multiple species of plants.

### Course prerequisites

College-level introductory biology, e.g., ECOL 182R (recommended), PLS 240, or MCB 181R. Additional courses on plants will be helpful (e.g., RAM 370), but are not necessary.

### Instructor and Contact Information

Michelle (Shelley) McMahon, Ph.D.

School of Plant Sciences, Department of Ecology and Evolutionary Biology.

Marley 441G; 621-7243; mcmahonm@arizona.edu; Office hours: TBA.

Individual meetings are very welcome and can be scheduled by email or through an online scheduler (see d2l for details), and can be conducted by Zoom or in person.

Web information: d2l course site.

### Course Format and Teaching Method

This course is lecture-based and in-person with active learning components. Each week, lectures provide review, content, and context for out-of-class activities (homework) and for in-class activities, include working with plant materials to reinforce lecture content, querying national databases, or engaging in collaborative projects. To bolster understanding of career opportunities and the role of biodiversity in our society, occasional guest lecturers are drawn from our rich community of professionals, e.g., resource managers for local National Parks or independent contractors involved in rare plant research.

Course Objectives

Throughout the course, we will:

1. Study essential concepts in plant morphology, as well as relevant aspects of plant development, physiology, and ecology.
2. Study fundamental processes of evolution, including diversification, in the context of current plant biodiversity.
3. Study distinguishing characteristics of plant families that are most relevant to built, managed, and natural landscapes in the southwest US and beyond.
4. Connect plant biodiversity to timely topics such as climate change, ecosystem sustainability, and food supply resilience.

Expected Learning Outcomes

Upon completing the course, you will be able to:

1. Distinguish members of more than 25 major plant families and discuss them in larger contexts, including evolution, ecology, and economics.
2. Apply traditional keys and other tools for plant identification, assess accuracy through cross-validation, and explain the biological significance of the results.
3. Discuss various career options in plant biodiversity.
4. Critically evaluate the impact of plant biodiversity, and biodiversity expertise, in a changing world.

Students enrolled in 577 will additionally:

1. Assemble scholarly articles, summarize current research, and communicate effectively about a topic in biodiversity.
2. Create and evaluate professional-grade museum collections.

### Course Communications

Online communication will be conducted through d2l, Zoom, and by email as needed. Email is the primary method to reach the instructor; be sure to put “PLS 477” or “577” in the subject. Messages will be returned within 2 business days. My aim is to acknowledge submission of learning activities (homework, in-class worksheets, etc.) within two business days, to grade quizzes within three business days, and to return exams within a week.

### Texts

Required

* *Botany in a Day: The Patterns Method of Plant Identification*. 2013. Thomas J. Elpel. HOPS Press. Note: this is not an advanced text! However, it concisely presents morphology and characteristics of the plant families that we will be investigating (and many more); currently, it costs less than $20.

Additional texts

* *Vascular Plants of Arizona*. Vascular Plants of Arizona Editorial Committee. 1992+. Journal of the Arizona-Nevada Academy of Science and Canotia. All issues are available online.
* *Plant Identification Terminology: An Illustrated Glossary*, 2nd Ed. 2001. J.G. Harris & M.W. Harris. Copies are available for short-term loan and in-class work, or students may purchase.
* *Flora of North America*. Flora of North America Editorial Committee. Numerous volumes are available online http://www.efloras.org; all published volumes are available in hard copy for use in the Herbarium.
* Additional readings will be available on the course site.

### Special Materials

You will need standard materials for taking notes, including completing worksheets and making labeled drawings. You may want to bring a laptop or tablet for in-class activities involving accessing the internet. You may check out or purchase a handlens at cost from the instructor. Plant presses will be available for loan by the UA Herbarium, if needed. All borrowed material must be returned prior to the start of finals. Microscopes will be available during classes held in the Herbarium.

### Assignments and Examinations

#### Learning activities

Each week you will have one or two low-stakes assignments. Examples include worksheets, readings, or engaging with visiting professionals, and will often include working with dried or fresh plant material. Each activity is designed to build skills, enhance your retention of the lecture material, expand your understanding of the impact of plant biodiversity, and/or facilitate connections between concepts in the course material. Points are awarded for successful and timely completion, and keys are posted to allow self-evaluation as appropriate.

#### Quizzes

Ten short quizzes will be used to assess comprehension and retention. Quizzes can be retaken once. See Schedule (below and on d2l) for dates. Quizzes on d2l will be available for at least two days, with time limits once opened.

#### Exams

Three midterms will be held during class time, providing you with an opportunity to demonstrate mastery of the material. A final exam will be conducted during the final exam period. Half of the final will be material that was presented after the last midterm, and half of the final will be comprehensive, covering the entire semester. Note that I expect written answers to be your own ideas, in your own words, to demonstrate accuracy and understanding. Answers that are identical or very close to another student’s response will result in zero points for both students. Answers that are identical or very close to those generated by publicly available large language models (e.g., ChatGPT, Windows Copilot) will result in zero points.

#### Research project

As an opportunity to explore your own ideas in this domain, you will conduct a semester-long research project on an aspect of plant biodiversity, tailored to your specific interests (e.g., conservation, horticulture, comparative molecular biology, medicinal plants, wildlife management). Group projects may be allowed, with instructor permission. See “Research Project” for details, including interim and final deadlines, which are designed to help you build towards success and create a project about which you can be proud.

#### Graduate student assignments

If you are enrolled in 577, you will have two additional activities:

1. Create a plant collection of 10 native or naturalized specimens, collected and preserved according to professional standards and identified correctly to species, subspecies, or variety, as appropriate.
2. Create and deliver a 20-30 minute lecture on a topic selected from a list made available at the start of the semester.

### Final Examination

The final will be in person; see the course schedule and the UArizona policy and schedule for final exams

https://registrar.arizona.edu/faculty-staff-resources/room-class-scheduling/schedule-classes/final-exams

### Grading Scale and Policies

Maximum points earned within each activity category:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Activity | Points (each) | Number | Subtotals (477) | Subtotals (577) |
| Quizzes | 20 | 10 | 200 | 200 |
| Learning activities | 10 | 20 | 200 | 200 |
| Midterm Exams | 100 | 3 | 300 | 300 |
| Final Exam | 200 | 1 | 200 | 200 |
| Research Project | 100 | 1 | 100 | 100 |
| Plant Collection | 50 | 1 | 0 | 50 |
| Lecture | 100 | 1 | 0 | 100 |
| Totals |  |  | 1000 | 1150 |

Grades are awarded based on the percentage of total points earned:

|  |  |  |  |
| --- | --- | --- | --- |
| Letter grade | Percentage | Points (477) | Points (577) |
| A | 90.0 - 100.0% | 900 - 1000 | 1035 - 1150 |
| B | 80.0 - 89.9% | 800 - 899 | 920 - 1034 |
| C | 70.0 - 79.9% | 700 - 799 | 805 - 919 |
| D | 60.0 - 69.9% | 600 - 699 | 690 - 804 |
| E | 0 - 59.9% | 0 - 599 | 0 - 689 |

The University policy regarding grades and grading systems is available at http://catalog.arizona.edu/policy/grades-and-grading-system

#### Co-convened course

This course is co-convened. If you are enrolled in 577, you will complete the activities of the 477 course and will have two additional assignments (creating a small plant collection, creating and delivering a short lecture).

#### Incomplete (I) or Withdrawal (W):

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.

### Scheduled Topics/Activities

The following table provides the general schedule for the Fall semester. Quizzes are usually online, on our course site. Exams are in class. Due dates for all other learning activities, including interim and final products for the Research Project, are on the d2l calendar and within the d2l learning modules. Career discussions may be rescheduled, pending availability of professionals as guests.

|  |  |  |  |
| --- | --- | --- | --- |
| **Wk** | **Lecture topics** | **Families and Guests** | **Quizzes & Exams** |
|  | **Module 1: Introduction to plant biodiversity** | | |
| **1** | Botany, biodiversity, and vegetation — *why are plants important?* |  | Quiz 1 |
| **2** | Informatics and natural history collections — *how do we learn about plants?* | *Career discussion: museums and biodiversity informatics.* | Quiz 2 |
|  | **Module 2: Conifers and other land plants** | | |
| **3** | Conifers, ferns, and mosses — *how did plants change the planet?* | Pteridaceae, Pinaceae | Quiz 3 |
| **4** | Seeds, flowers, and angiosperms — *how did flowers change animal life?* | Major clades of Angiosperms | Exam 1 (Th 9/19) |
|  | **Module 3: Legumes and other rosids** | | |
| **5** | Life cycles, toxins, polyploidy, and food plants — *what’s a fruit, anyway?* | Brassicaceae, Malvaceae, Rosaceae, Cucurbitaceae | Quiz 4 |
| **6** | Arid land vegetation, high protein seeds, and seedbanks — *what makes beans so special?* | Fabaceae | Quiz 5 |
|  | **Module 4: Cacti, other caryophyllids, and some asterids** | | |
| **7** | Anomalous secondary growth and unusual morphologies — *how have plants adapted to extreme environments?* | Amaranthaceae, Nyctaginaceae, Cactaceae, Apocynaceae, Boraginaceae  *Career discussion: public agency land management* | Quiz 6 |
| **8** | Secondary compounds, herbivores, and medicines — *how do plants defend themselves and when does it fail?* | Solanaceae, Convolvulaceae | Exam 2 (Th 10/17) |
|  | **Module 5: Sunflowers and more asterids** | | |
| **9** | Animal pollination, inflorescence diversity — *how do sessile plants find mates?* | Lamiales, Phrymaceae | Quiz 7 |
| **10** | Extreme inflorescences and rates of speciation — *why are there so many DLCs?* | Asteraceae and its tribes  *Career discussion: environmental consultants* | Quiz 8 |
|  | **Module 6: Grasses and other monocots** | | |
| 11 | Monocots and orchid ecology — *how are monocots unusual?* | Orchidaceae, Asparagaceae, Cyperaceae | Quiz 9 |
| **12+** | Grasslands, grasses, and grain crops — *is Poaceae the most important plant family?* | Poaceae | Exam 3 (Tue 11/19) |
|  | **Module 7: Conservation, connections, and conclusions** | | |
| **13&14** | Conservation, biodiversity and climate change — *how are we changing plant life?* | *Career discussion: botanical gardens* | Quiz 10 |
| 15 | Research project presentations |  |  |
| 16 | Review for Final |  |  |
|  | Final exam |  | Tue 12/17  8:00 – 10:00 am |

### Policies

#### Course Attendance

This course is in-person and requires active engagement. However, life can intervene, and sometimes you might need to miss a class. At start of the semester, students will be asked to establish “note-buddies” – someone who commits to sharing their notes should you really need to miss class. In-class activities may be available for makeup for absences excused in advance. Exams are not available for makeup unless the absence is deemed necessary by the Dean of Students.

#### 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.).

#### Subject to Change

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

#### Additional University-wide Policies

Links to the following UA policies are provided here:

<https://catalog.arizona.edu/syllabus-policies>

* Absence and Class Participation Policies
* Threatening Behavior Policy
* Accessibility and Accommodations Policy
* Code of Academic Integrity
* Nondiscrimination and Anti-Harassment Policy

## Research Project

Through this project, you will gain experience with an aspect of plant biodiversity of particular interest to you, and relevance to your career goals. The deliverables will be (1) a short presentation to the class (3-4 minutes for undergraduates, 6-8 minutes for graduates; times may be adjusted depending on enrollment) and (2) a short written report (1-2 pages for undergraduate students, 3-4 pages for graduate students, excluding figures and references).

#### Instructions

1. Select Topic (10 points)

* Select a plant biodiversity topic of interest to you. To do so, schedule a 15-minute meeting with the instructor to discuss your interests and “pitch” your project idea. Options abound; here are a few general topics, with some suggested focus questions:
  + Plant biodiversity and climate change. What do we expect for natural habitats over the coming one to five decades, or beyond? How will urban horticulture be impacted, or change?
  + Conservation. How will we protect natural resources into the future? How are conservationists prioritizing among species, landscapes, or regions, and where are improvements possible?
  + Curation. How do modern natural history museums maintain collections? Interested in curating a small section of material?
* Meet with the instructor (zoom and in-person options are available), then submit your idea as a few sentences in Assignments.
* Due the end of Week 3
* *The Topic must be approved by the instructor before you can proceed.*

1. Project Proposal (20 points)
   * What to do: write a two- to three-paragraph summary of the project idea, the resources that you have found, and the general direction for your project.
   * How to submit it: post your summary on the D2L discussion, then provide substantive comments on submissions from at least four peers.
   * When to submit: by the end of Week 5 with comments due Week 6
   * *The Project Proposal must be approved by the instructor before you can proceed.*
2. Project Progress Report (20 points)
   * What to do: using feedback from step 2, complete the project (review the literature, curate a group of specimens, or whatever you have successfully proposed)
   * How to submit: write a quick summary of progress on the project, submit to Assignments
   * When to submit: by the end of Week 12
   * *The Project Progress Report must be approved by the instructor before you can proceed.*
3. Project Report (20 points)
   * What to do: write it up! 1-2 pages for undergraduate students, 3-4 pages for graduate students, excluding figures and references
   * Submit in Assignments
   * One re-write will be allowed
   * Due at the start of Week 15 (re-write due by the time of the final exam)
4. Project presentation (30 points)
   * Create slides and present your project!
   * Submit your slides to Assignments
   * Presentations will occur in Week 15

See D2L for more details regarding format, structure, and rubrics.