IB 335: Plant Systematics

Course Syllabus - Spring 2024

Course Time and Place

Lecture	(AL1)	MWF	9:00 – 9:50 AM	Room 2083
Lab	(AB2)	M	1:00 – 2:50 PM	Room 4072
Lab	(AB3)	M	3:00 – 4:50 PM	Room 4072

Course Description

This class surveys the 500-million year evolutionary history of terrestrial plants, from the earliest spore-producing land plants to Darwin's "abominable mystery" of flowering plant evolution. It introduces phylogenetic principles and methods for identifying, naming, and classifying plant diversity. A total evidence approach to phylogenetic systematics is presented where genetic, morphological, and paleontological data are used in reconstructing the evolutionary relationships of extant and extinct taxa. Labs will focus on plant classification and identification. The class meets three times a week for lecture and paper discussions and once a week for a two-hour lab. Credit: 4 undergraduate hours.

Instructors

Dr. Surangi W. Punyasena (spunya1@illinois.edu)
Associate Professor, Plant Biology; Affiliate: Geology; Geography; Illinois Informatics Institute; NCSA
Office and hours: MH 139, Fridays 10 am – 12 pm

Lance Jones (lanceej2@illinois.edu)
Teaching Assistant, Plant Biology
Office and hours: TBA

Student Learning Outcomes

By the end of the semester, you will be able to:

- Describe the major clades of plant diversity and their evolutionary relationships
- Describe the phylogenetic characters that define these clades
- Explain the principles of phylogenetic systematics and apply these to the categorization of plant diversity
- Apply the scientific method and philosophy of hypothesis testing to plant systematics
- Use plant scientific names correctly, including the names of infraspecific taxa, interspecific hybrids, and cultivated varieties
- Apply knowledge of floral, fruit and vegetative features and use dichotomous keys to identify unknown plants to family, genus, and species
- Explain the significance of plant systematics and taxonomy to other areas of biological research, including evolutionary biology, ecology, and conservation

A second set of goals relate to your development as a successful life-long learner; these include developing the abilities to:

- Evaluate your own knowledge and skills
- Analyze and interpret the primary scientific literature
- Communicate scientific arguments through written and oral work
- Work collaboratively on scientific problems

Prerequisites

This course is intended for sophmores, juniors, and seniors with prior coursework in biology. Enrollment is recommended only for students who have taken IB 100, IB 103, or IB 150 or with the consent of the instructor.

Course Website and Communication

Course assignments, readings, the current syllabus, and Zoom links for online participation are posted on the Learn@Illinois Moodle website: https://learn.illinois.edu/course/view.php?id=76406

You will need your NetID and password to gain access. Updates to the course will be announced in lecture and as announcements on the course website. Please contact me if you have any problems accessing it.

Official university e-mail addresses are used for course communications. Please note that you are expected to check your university issued e-mail account regularly and act on any communications received. Due to privacy restrictions, I may not be able to respond to e-mail messages sent from non-university e-mail accounts.

Course Structure

We meet three times a week for lecture (50 minutes). **Mondays and Wednesdays** introduce and review the week's topics. **Fridays** are structured around paper discussions. Lab meets on **Mondays** for 1 hour and 50 mins. The anticipated lecture and lab schedule is listed at the end of this document. PDFs of lecture slides will be available on the course website the morning before class. You should anticipate spending an average of eight additional hours per week on assignments and reading.

Assigned Reading and Required Textbook

Reading assignments serve two purposes. They provide context and background to the material covered in lecture and they are the source of content for Friday discussions. Weekly assignments are detailed on the course website.

Readings are from peer-reviewed literature and our **REQUIRED** textbook:

Walter S. Judd, Christopher S. Campbell, Elizabeth A. Kellogg, Peter F. Stevens, and Michael J. Donoghue.
Plant Systematics. A Phylogenetic Approach. Fourth Edition (2016)
Sinauer Associates, Inc. Sunderland, Massachusetts, USA
ISBN-10: 9781605353890
ISBN-13: 978-1605353890

The book is available for purchase at the university bookstore and on reserve at the Funk ACES Library.

Computer and Lab Supplies

You will need a laptop for online assessments and lab examinations, and for carrying out keying exercises. Drawing pencils, an eraser, and a small ruler are required for the laboratory. Dissection tools will be provided for those who do not have their own.

Friday Discussions

Our Friday classes focus on the reading of the primary scientific literature. Each week, you are responsible for an in-depth reading of one peer-reviewed journal article. You are required to answer three questions on the reading as a group activity in Friday's class. Responses will be graded for thoughtfulness and the degree to which they demonstrate close reading of the material. We will discuss these responses as a class each Friday.

Midterm and Final Exams

There are two written exams. Both are in-class, in-person, and closed book. The format will be short answer and essay. You will have the entire 50 minutes of class to complete each exam. The anticipated exam dates are listed at the end of this document.

Lab Assignments

Monday laboratories include written assignments that are completed in lab and *turned in at the end of the lab period each week*.

Lab Practical Exam

There will be one online lab practical exam at the end of the semester. It will be in-person, approximately 70 minutes long, and will include identification of plant taxa and morphology. The anticipated exam date is listed at the end of this document.

Lecture Responses (Extra Credit)

We will have an optional 5-minute lecture response at the end of every Monday/Wednesday lecture. The activity is an opportunity to reflect on what you learned and will allow you to ask additional questions that will be addressed online or in the following lecture. This response will be turned in using the course website. Responses must be received *by the end of day 11:55 pm* in order to receive extra credit.

Grading and Assignment Values

Grading is on a 1000-point scale, with points distributed as follows:

Friday discussion assignments (14 total, lowest two dropped)	240
Midterm	160
Final	160
Weekly lab assignments (13 total, lowest two dropped)	330
Lab Practical (Final)	110
Extra Credit: Lecture feedback submitted (2 points per lecture)	54

Letter grades will be assigned according to an absolute scale.

A+	>970 points	C+	770-799 points
A	930-969 points	C	730-769 points
A-	900-929 points	C-	700-729 points
B+	870-899 points	D+	670-699 points
B	830-869 points	D	630-669 points
B-	800-829 points	D-	600-629 points
		F	0-599 points

Grade Disputes

Questions regarding grading should be raised within one week of the grades being uploaded to the Canvas gradebook. It is your responsibility to review your grades on a regular basis.

The Learning Environment

Our classroom is an inclusive, collaborative environment for focused learning. A fundamental expectation is that you treat your classmates with respect. Disruptive behavior, including unauthorized use of phones and computers, is not permitted. You will be asked to use your laptop or a tablet for class assignments but will be asked to stop all non-lecture-related uses (social media, texting, web surfing, completing homework, etc.) Anyone violating this policy will first be given a warning, and then asked to leave class, forfeiting any credit for in-class assignments.

Late Assignments and Absences

Monday/Wednesday lectures will be recorded and live-streamed. It is your responsibility to review the recordings of any lecture that you miss. Up to two Friday paper discussions and two lab assignments may be missed without penalty. Exams, practicals, and late assignments will only be allowed with an absence letter from the Office of the Dean of Students (https://odos.illinois.edu/community-of-care/resources/students/absence-letters/).

Request for Special Accommodations

Disability Resources and Educational Services (DRES) provides students with academic accommodations, access, and support services. To contact DRES, visit 1207 S. Oak St., Champaign, call 217-333-1970, e-mail disability@illinois.edu or go to the DRES website at https://dres.illinois.edu/. Information on applying for DRES services are available here: https://dres.illinois.edu/information-before-you-apply/application-process/.

To obtain disability-related academic adjustments and/or auxiliary aids, students must provide the instructor with a Letter of Academic Accommodations from DRES. Students who require assistance should apply for DRES services and speak with the instructor as soon as possible. Note that exams at alternate facilities should be arranged at a time within 24 hours of the regularly scheduled exam.

Academic Integrity

All students are assumed to have read and understood the University of Illinois Student Code, (https://studentcode.illinois.edu/) and will be expected to act accordingly. Please review the code carefully as it outlines your rights and responsibilities as a student at this university. Violations will be reported using the FAIR system. Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: https://studentcode.illinois.edu/article1/part4/1-401/. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Course Copyright

Mental Health

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you. If you are in immediate danger, call 911.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

This statement is approved by the University of Illinois Counseling Center

Community of Care

As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050 or http://odos.illinois.edu/community-of-care/referral/). Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe.

Further, as a Community of Care, we want to support you in your overall wellness. We know that students sometimes face challenges that can impact academic performance (examples include mental health concerns, food insecurity, homelessness, personal emergencies). Should you find that you are managing such a challenge and that it is interfering with your coursework, you are encouraged to contact the Student Assistance Center (SAC) in the Office of the Dean of Students for support and referrals to campus and/or community resources.

Disruptive Behavior

Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (https://conflictresolution.illinois.edu; conflictresolution@illinois.edu; 217-333-3680) for disciplinary action.

Emergency Response Recommendations

Emergency response recommendations and campus building floor plans can be found at the following website: https://police.illinois.edu/em/run-hide-fight/. Please review this website within the first 10 days of class.

Religious Observances

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. Students should complete the Request for Accommodation for Religious Observances form should any instructors require an absence letter in order to manage the absence. In order to best facilitate planning and communication between students and faculty, students should make requests for absence letters as early as possible in the semester in which the request applies.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: wecare.illinois.edu/resources/students/#confidential.

Other information about resources and reporting is available here: wecare.illinois.edu.

Anticipated Lecture and Lab Schedule

Updates to the schedule will be announced in lecture and as course announcements on Canvas.

Week 1: Introductions		
17-Jan	W	Intro to class and phylogenetic systematics How to read a scientific paper
19-Jan	F	Morris et al (2018) The timescale of early land plant evolution. Proceedings of the National Academy of Sciences, 115(10), E2274-E2283.
Week 2: Tree thinking		
22-Jan	M	Anatomy of a (phylogenetic) tree
	LAB	Plant morphology I: vegetative morphology **[held at the Plant Sciences Lab]**
24-Jan	W	Molecular and morphological characters
26-Jan	F	Soltis et al (2018) The potential of genomics in plant systematics. Taxon, 62(5), 886-898.
Week 3: Origins and evolution		
29-Jan	M	Plant extinction and evolution: marching to a different beat
	LAB	Plant morphology II: floral morphology
31-Jan	W	Early land plants – growing low and slow
2-Feb	F	Zhang et al (2020) The hornwort genome and early land plant evolution. Nature Plants 6: 107–118.
Week 4: Lycopods, ferns, fern allies		
5-Feb	M	Fern allies, past and present; Carboniferous Illinois
	LAB	Paleozoic fossil plants
7-Feb	W	Cenozoic radiation of ferns
9-Feb	F	Schuettpelz and Pryer (2009) Evidence for a Cenozoic radiation of ferns in an angiosperm-dominated canopy. Proceedings of the National Academy of Sciences, 106(27), 11200-11205.
Week 5: Gymnosperms		
12-Feb	M	Evolution of the seed
	LAB	Extant fern and gymnosperm lab **[held at the Plant Sciences Lab]**
14-Feb	W	Gymnosperm diversity and ecology
16-Feb	F	Codamine et al (2020) The rise of angiosperms pushed conifers to decline during global cooling. Proceedings of the National Academy of Sciences, 117(46), 28867-28875.
Week 6: Basal angiosperms		
19-Feb	M	Origin of angiosperms and the ANA grade
	LAB	Magnoliales and Ranunculales: Magnoliaceae, Ranunculaceae, Papaveraceae
21-Feb	W	Magnollid complex
23-Feb	F	Coiro et al (2019) How deep is the conflict between molecular and fossil evidence on the age of angiosperms? New Phytologist, 223(1), 83-99.
Week 7: Basal eudicots and Fabids		
26-Feb	M	The evolution of the eudicot
	LAB	Saxifragales and Fabids I (Malpighiales): Hamamelidaceae; Euphorbiaceae, Salicaceae, Violaceae

28-Feb	W	Rosids: Fabids vs. Malvids
1-Mar	F	Soltis et al (2019) Darwin review: angiosperm phylogeny and evolutionary radiations. Proceedings of the Royal Society B, 286(1899), 20190099.
Week 8: Midterm Exam, Fabids continued		
4-Mar	M	Fabids - legumes, mulberries, roses
	LAB	Fabids II (Fabales, Rosales, Fagales, Curbitales): Fabaceae; Moraceae, Rosaceae; Fagaceae, Betulaceae; Cucurbitaceae
6-Mar	W	Evolution of nitrogen fixation
8-Mar	F	**MIDTERM EXAM**
Week 9: Spring Break		
Week 10: Malvids		
18-Mar	M	Malvids - primroses and maples, tropical trees, and broccoli
	LAB	Malvids (Myrtales, Sapindales, Malvales, Brassicales):
20-Mar	W	Brassicales – morphological variation within a single species
22-Mar	F	Stull et al (2023) Deep reticulation: the long legacy of hybridization in vascular plant evolution. The Plant Journal, 114(4), 743-766.
Week 11: Superasterids		
25-Mar	M	Cactaceae - succulent adaptations (and convergences)
	LAB	Caryophyllales: Cactaceae, Caryophyllaceae, Portulacaceae, Polygonaceae
27-Mar	W	Caryophyllaceae, Portulacaceae, Polygonaceae - carnations, purslanes, and buckwheat
29-Mar	F	Hernandez-Hernandez et al (2014) Beyond aridification: multiple explanations for the elevated diversification of cacti in the New World succulent biome. New Phytologist, 202(4), 1382-1397.
Week 12: Stem asterids to lamiids		
1-Apr	M	Cornales and Ericales - dogwoods and heaths
	LAB	Ericales and Lamiids I (Solanales, Gentianales): Ericaceae, Solanaceae, Apocynaceae (Asclepiadaceae)
3-Apr	W	Solanales, Gentianales - tomatoes and dogbane
5-Apr	F	Herting et al (2023) Profile of a flower: How rates of morphological evolution drive floral diversification in Ericales and angiosperms. American Journal of Botany, 110(8), e16213.
Week 13: Lamiids continued		
8-Apr	M	Olives, mints, and figworts
	LAB	Lamiids II (Lamiales): Lamiaceae, Oleaceae, Scrophulariaceae
10-Apr	W	Lamiid origins
12-Apr	F	Rose et al (2022) A timeframe for mint evolution: towards a better understanding of trait evolution and historical biogeography in Lamiaceae. Botanical Journal of the Linnean Society, 200(1), 15-38.
Week 14: Campanulids		
15-Apr	M	Pushing daisies
	LAB	Campanulids (Asterales, Apiales, Dipsacales): Asteraceae, Apiaceae, Caprifoliaceae
17-Apr	W	Umbellifers and honeysuckle
19-Apr	F	Palazzesi et al (2022) The rise of grasslands is linked to atmospheric CO_2 decline in the late Palaeogene. Nature Communications, 13(1), 293.

Week 15: Monocots		
22-Apr	M	Evolutionary diversity of parallel venation
	LAB	Monocots
24-Apr	W	Grass adaptations and grassland evolution
26-Apr	F	McSteen and Kellogg (2022) Molecular, cellular, and developmental foundations of grass diversity. Science, 377(6606), 599-602.
Week 16: Systematics and conservation, Final Exam		
29-Apr	M	Phylogenetics applications to conservation
	LAB	**FINAL PRACTICAL**
1-May	W	**FINAL EXAM**