



Fungal Biology

PLP 4653C/PLP 6656C

INSTRUCTOR: Dr. Matthew E. Smith

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LABORATORY SUPPORT:

C. Benton Willis

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Office Hours: by appointment

COURSE(S): PLP 4653C and PLP6656C are taught concurrently. Undergraduates are expected to enroll in PLP 4653C whereas graduate students should enroll in PLP6656C. Students enrolled in the graduate course will be responsible for additional writing assignments and will be held to a higher standard for the fungal collections project and for their participation in class discussions based on the primary literature.

PREREQUISITE: BSC 2010 and BSC 2011 *or* PLP3002C (or consent of instructor)

CREDITS: 4

Course Website: <https://lss.at.ufl.edu/> (e-Learning in Canvas)

CLASS TIMES & LOCATIONS:

Lectures & Labs: 2306 Fifield Hall, Monday and Wednesday, 12:50 -3:50 pm (Period 6-8)

Final Exam: **13 December 2024 at 7:30 AM**

BRIEF DESCRIPTION

Mycology is the study of fungal biology. Fungi are extremely diverse in terrestrial and aquatic ecosystems and they serve as the most important decomposers of organic materials. Fungi are also ecologically and economically important as symbionts and pathogens of a wide variety of plants and animals. The main objective of this course is to provide students with a broad overview of fungi. Much of the class will focus on fungal ecology, diversity, and evolution. During the course, students will: 1) learn about fungi, their biology, and the important impacts they have on humans and natural ecosystems, 2) collect and identify a variety of different fungi from local habitats, and 3) use microscopy to examine the morphology of fungi in the laboratory. We will also read, discuss, and critique modern journal articles that address various aspects of fungal biology.

COURSE OBJECTIVES

By the end of this course, students will be able to:

1. Read, interpret, and critique scientific journal articles focused on fungal biology
2. Locate and use fungal biology resources to interpret fungal nomenclature, taxonomy, and systematics
3. Identify major groups of fungi based on morphology (both in the field and in the lab)
4. Understand and explain the ecological roles and trophic modes of major fungal groups
5. Read and interpret phylogenetic trees
6. Use a dichotomous key to identify local macrofungi
7. Perform molecular and computational tasks necessary for DNA barcoding of fungi
8. Give a presentation with appropriate visual aids
9. Provide constructive criticism during a peer review

TEXTS (Suggested, not required):

- Introduction to Fungi. 3rd Edition (2007) Webster & Webster. Cambridge University Press.
- Bessette, A. E., Bessette, A. F., & Lewis, D. P. (2019). Mushrooms of the Gulf Coast States: A Field Guide to Texas, Louisiana, Mississippi, Alabama, and Florida. University of Texas Press.

ABSENCES AND MAKE-UP WORK: Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>.

ATTENDANCE: Attendance is mandatory. This is a highly experiential course - you are expected to participate in every class and laboratory. There will be occasional quizzes and activities that will contribute to your grade in the class. Missed activity grades, tests, and quizzes can be made up for excused absences. Activities in class require that you: 1) have done the readings or other appropriate preparation, 2) show up on time, and 3) actively participate in class. *If you have to miss class for any reason, please contact me to ensure that we can provide any information that you missed if at all possible.*

LABORATORY: The laboratory will emphasize principles and concepts of mycology through demonstrations and hands-on exercises using living organisms and prepared specimens as well as short field trips. Labs will typically include an introduction to the exercise, work with demonstration or experimental materials, and sometimes an assignment to be handed in either at the end of the session or the beginning of the subsequent session. It is strongly advised (but not required) that you keep a lab notebook for all labs. Your lab notebook will not be graded, but a well-kept notebook will be highly beneficial to you in preparing for exams.

EXAMS AND GRADING: Grading is based on a total of 600 possible points for graduate students and 550 points for undergraduates. The grading will be based on a combination of participation in class discussions and laboratory activities, quizzes, a final exam, and several projects. For undergraduates there will be two projects: The Fungi EOL/Wikipedia Project and the Fungal Collection Project (see below). Graduate students will have an additional project (The Special Graduate Student Project – sounds mysterious because it is!). These projects will be introduced toward the beginning of the term and students will have opportunities to work on their independent projects throughout the semester in lab. The quiz grade will be based a series of short quizzes that will be completed in class (students will be allowed to drop their lowest quiz score). The final exam date and time is listed above.

COURSE PROJECTS:

For the **Fungi Wiki project**, students will select a target fungus of their choice (preferably from a designated list of nominated fungi) research the biology of that fungus, and then summarize what is known about the fungus on a Wikipedia page. This project will also involve a peer-review process whereby fellow students will provide constructive feedback to improve the webpage. Students will also give a brief presentation to introduce their fungus to the class.

For the **Fungal Collections Project** students will collect, identify, and preserve local fungi to be deposited in the Florida Museum of Natural History. Students will have opportunities to learn basic fungi identification skills to help them with this project during labs and field trips throughout the semester. We will go over this assignment in detail before you start.

For the **The Special Graduate Student Project (graduate students only!)**, students will meet with the TA and professor Smith to confirm the details of this special project.

The course **participation grade** is compiled based on attendance, participation in lecture and lab activities, and active participation during field trips and paper discussions.

Graduate Student Grading

Component	Points
Class & Lab Participation	50
Quizzes	100
Final Exam	100
Fungal Collection Project	200
Fungi EOL/Wiki project	100

Special Graduate Student Project	50
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Total Number of Possible Points: 600

Undergraduate Student Grading

Component	Points
Class & Lab Participation	50
Quizzes	100
Final Exam	100
Fungal Collection Project	200
Fungi EOL/Wiki project	100

Total Number of Possible Points: 550

GRADES AND GRADE POINTS:

For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Grade points will be assigned as follows.

<u>Letter Grade</u>	<u>Percentage</u>
A	95 – 100
A-	90 – 94.9
B+	87 – 89.9
B	83 – 86.9
B-	80 – 82.9
C+	77 – 79.9
C	73 – 76.9
C-	70 – 72.9
D+	67 – 69.9
D	63 – 66.9
D-	60.1 – 62.9
E	60 or below
WF	NA
I	NA
NG	NA
S-U	NA

ACADEMIC HONESTY – As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: *“We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.”* You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: *“On my honor, I have neither given nor received unauthorized aid in doing this assignment.”*

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: <http://www.dso.ufl.edu/SCCR/honorcodes/honorcode.php>.

Students are expected to strictly follow these guidelines:

1. Complete their own independent work (unless the assignment has specifically been defined as a group project) and turn it in on time.

2. Cite sources in their written assignments so that the veracity of their statements can be independently verified by the instructor.
3. Use quotations to designate text that was generated by another person.
4. Know the definition of the word “plagiarism” and ensure that their academic work does not plagiarize the work of others (see www.plagiarism.org/).

SOFTWARE USE – All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

CAMPUS HELPING RESOURCES – Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university’s counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu/cwc/*
 - Counseling Services
 - Groups and Workshops
 - Outreach and Consultation
 - Self-Help Library
 - Training Programs
 - Community Provider Database
- *Career Resource Center, First Floor JWRU, 392-1601, www.crc.ufl.edu/*

SERVICES FOR STUDENTS WITH DISABILITIES – The Disability Resource Center (0001 Reid Hall, 352-392-8565, www.dso.ufl.edu/drc/) coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation

COURSE FEEDBACK – Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens they and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

COURSE RECORDING – Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor. Publication without permission of the instructor is prohibited. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party services. A student who publishes a recording without written consent may be subject to a civil action or disciplined by the University.

Outline of major topics to be covered in the course:

- Overview of fungal tree of life
- Basics of light microscopy
- History of mycology
- Macrofungi: basic field identification
- Lineage-specific techniques for microscopic identification of fungi

- Species- and lineage-level diversity based on morphology and environmental sampling
- Basic concepts in molecular phylogenetics
- Specimen preservation and fungarium curation
- Emerging fungal diseases of plants and animals
- Identifying unknown fungi with DNA barcoding and phylogenetic analysis
- Basic ecology and systematics of insect-associated and nematode-associated fungi
- Species concepts and cryptic species in fungal biology
- Lichen biology and morphology
- Mycorrhizal ecology and evolution
- Fungi as medicines, toxins, and food products
- Fungal sexuality and reproduction
- Fungal endophytes of plants, bacterial endophytes of fungi
- Aquatic fungi – the biology and diversity of the “chytrids”
- Fungi-like organisms: Oomycota and Slime Molds

Assigned readings for Paper Discussions

Discussion 1 – Speciation and Species Boundaries

- Taylor et al. (2000) Phylogenetic species recognition and species concepts in fungi. *Fungal Genetics and Biology*. 31: 21–32.
- Chow et al. (2020). "Tracing the evolutionary history and global expansion of *Candida auris* using population genomic analyses. *MBio*. 11(2):10-128.

Discussion 2 – Phylogenies and Phylogenetic Diversity

- Strasser & Monaghan (2022) Phylogenomic insights into the early diversification of fungi. 32(16), 3628-3635.
- Amses et al. (2022). Diploid-dominant life cycles characterize the early evolution of Fungi. *PNAS*. 119:36 e2116841119
- (Optional): Galindo et al. (2021) Phylogenomics of a new fungal phylum reveals multiple waves of reductive evolution across Holomycota. *Nature Communications*. 12(1): 4973

Discussion 3 – DNA Barcoding and Sequence-based Classification

- Gazis et al (2011) Species delimitation in fungal endophyte diversity studies and its implications in ecological and biogeographic inferences. *Molecular Ecology*. 20: 3001-3013
- Swenie et al. (2024) PacBio high-throughput multi-locus sequencing reveals high genetic diversity in mushroom-forming fungi. *Molecular Ecology Resources*. 24(1):e13885.

Discussion 4 – Fungal Symbioses

- Wu et al. (2022) Evolutionary innovations through gain and loss of genes in the ectomycorrhizal Boletales. *New Phytologist*, 233(3), pp.1383-1400.
- Koch et al. (2021) Symbiotic nitrogen fixation in the reproductive structures of a basidiomycete fungus. *Current Biology*. 31: 3905-3914.

Discussion 5 – Using molecular data to analyze the evolution and ecology of fungi

- Bradshaw et al. (2024). Phylogenomics of the psychoactive mushroom genus *Psilocybe* and evolution of the psilocybin biosynthetic gene cluster. *Proceedings of the National Academy of Sciences*, 121(3), e2311245121.
- Wang et al. (2023) Invasive Californian death caps develop mushrooms unisexually and bisexually. *Nature Communications*, 14(1), p.6560.

Discussion 6 – Animal Pathogenic Fungi

- Palmer et al. (2014) Molecular characterization of a heterothallic mating system in *Pseudogymnoascus destructans*, the fungus causing white-nose syndrome of bats. *G3: Genes, Genomes, Genetics*. 4(9):1755-63.
- Gray et al. (2023) Broad host susceptibility of North American amphibian species to *Batrachochytrium salamandrivorans* suggests high invasion potential and biodiversity risk. *Nature Communications*. 14: 3270.
- Greenberg and Palen. (2019) A deadly amphibian disease goes global. 363(6434):1386-1388

Course Schedule

		Date	Lecture	Lab	Assignment
1	Mon.	Aug 26	Intro to fungi & the course	Microscope Use	
2	Wed.	Aug 28	Fungi Intro - Nomenclature & Species Concepts	Macrofungi – macromorphology, basics of ID, Agaricoid fungi	
–	Mon.	Sept 2	Holiday	Holiday	
3	Wed.	Sept 4	Agaricomycetes and mycological terms	Dichotomous Key exercise	<i>Dichotomous Key</i>
4	Mon.	Sept 9	Basidiomycota 1	'Gasteromycetes' lab	<i>Fungi Collections Handout</i>
5	Wed.	Sept 11	Basidiomycota 2 Paper Discussion 1	<i>Field Trip to NATL**</i>	
6	Mon.	Sept 16	Wood Decay Fungi [Quiz 1]	Polypore lab	
7	Wed.	Sept 18	Basidiomycota 3	Rusts, Smuts, and Jellies	
8	Mon.	Sept 23	Ascomycota 1	<i>Field Trip to Lake Alice**</i>	<i>Fungi Wiki Handout</i>
9	Wed.	Sept 25	Ascomycota 2 - Pezizales and Orbiliales ¹ [Quiz 2]	Paper Discussion 2	
10	Mon.	Sept 30	Ascomycota 3	Nematode trapping fungi (Intro & setup)	<students bring soil>
11	Wed.	Oct 2	Paper Discussion 3	DNA Barcoding (part 1)	<students bring fungi to barcode>
12	Mon.	Oct 7	Ascomycota 4 [Quiz 3]	Ascocarp morphology	
13	Wed.	Oct 9	Ascomycota 5	Culturing Nematode-Trapping Fungi	Draft of Fungi Wiki due
14	Mon.	Oct 14	Secondary Compounds	Asexual states of Ascomycota	
15	Wed.	Oct 16	Lichens ² [Quiz 4]	Lichen Morphology Lab ²	Fungi Wiki peer review due
16	Mon.	Oct 21	Paper Discussion 4	<i>Lichen Scavenger Hunt Field Trip**</i>	
17	Wed.	Oct 23	Mycorrhizal Symbiosis	Mycorrhiza Lab	
18	Mon.	Oct 28	Fungal-Animal Symbioses ¹	DNA Barcoding (part 2), Molecular Identification & Tree-building ¹	
19	Wed.	Oct 30	Paper Discussion 5 [Quiz 5]	Fungi Wiki Assignment Due + Presentations	Fungi Presentations
20	Mon.	Nov 4	'Zygomycetes'	'Zygomycete' Morphology Lab	
21	Wed.	Nov 6	Fermentation	<i>Local Fungi Business Field Trip</i>	
–	Mon.	Nov 11	Holiday	Holiday	
22	Wed.	Nov 13	Chytrids, Paper Discussion 6	Fungi ID – bring your fungi!	
23	Mon.	Nov 18	'oomycetes' [Quiz 6]	Chytrids & 'oomycetes' Lab Fungi ID – bring your fungi!	
24	Wed.	Nov 20	Fungi for food & food production	Mycophagy Lab	
–	Mon.	Nov 25	Holiday	Holiday	
–	Wed.	Nov 27	Holiday	Holiday	
25	Mon.	Dec 2	Slime molds	Slime Mold Lab Fungi ID – bring your fungi!	Grad Projects Due
26	Wed.	Dec 4	Final Review	Fungal Collections Due!	
	Fri.	Dec 13 7:30 AM	FINAL EXAM	FINAL EXAM	

**Field trips are outside activities. Please wear appropriate clothes & shoes. Prepare to be outside!

¹Special Guest Lecture and Lab with Dr. Benjamin Lemmond and Dr. Marcos Caiafa

²Special Guest Lecture and Lab with lichen expert Laurel Kaminsky.