

## **Perspectives in Ecology and Evolutionary Biology of Fungi**

EEB 409—Perspectives in Ecology and Evolutionary Biology

Instructor: Dr. P. Brandon Matheny. Lab/Office: Hesler 332/334; tel. 865-974-8896; [pmatheny@utk.edu](mailto:pmatheny@utk.edu)

Meetings: Tues, Thur 9:40 am – 10:55 am; Hesler 427

Office hours: by appointment.

Blackboard site: <https://blackboard.utk.edu/>

Readings will be posted as PDFs on Blackboard; in addition, the following textbook will be used: Knisely, K. (2013) A student handbook for writing in biology. Fourth edn.

**Scope:** This course will introduce upper-division undergraduate students and beginning graduate students to ecology and evolutionary biology of fungi, revealed mostly through use of molecular techniques. Many fungi, and the ecological roles they serve, are often obscure due to their ephemeral nature, difficulty of detection, and convergent gross morphological similarities. Despite these limitations, advances in molecular biology have uncovered an unanticipated depth of diversity in fungi and permitted scientists to address research questions not possible until only recently. This seminar will provide an overview of the revolution in fungal evolution and ecology by examining the primary literature, most of it published recently with an occasional mixture of classic papers that have withstood the test of time.

**Course Learning Objectives:** (1) Read and interpret scientific texts, figures, and tables. (2) List the five big ideas in biology. (3) Identify biological scenarios that incorporate big ideas in biology. (4) Know distinguishing features of fungi. (5) Improve your writing.

**Format, Expectations, and Grading:** The course is organized around three major themes of biodiversity: taxonomic, genetic, and functional diversity. A few years ago the National Science Foundation announced a campaign to fund proposals that intersect these three topics and to spur research that integrates these disparate disciplines. The course will begin with several background lectures providing an introduction and background to fungal biology, fungal ecology, and methods of evolutionary analysis. When necessary, background material may also be presented by me before discussion of assigned readings. In total, approximately thirty papers from the primary literature will be assigned for reading and student-led discussions. This sounds like a lot (it is!), but because of the amount of reading, writing, and discussion required, there will be no exams other than the final, which will be a take-home exam. As a conciliatory note, most paired readings include a main research paper preceded by a short commentary paper or paired with a short *Science* or *Nature* paper.

A short quiz will be presented at the beginning of each class to which a reading has been assigned. This will ensure that students come to class having read and understood the material. Quiz questions may also serve as points of discussion.

Students will submit three papers that summarize and synthesize each major theme of the course (taxonomic, genetic, and functional diversity). These summaries and syntheses should be at least 1500 words in length and not more than 2000 words. Details about paper guidelines and expectations will be forthcoming.

Grades are based on quizzes, three papers, and the take-home final. Up to five points will be assigned for each quiz. A total of 25 quizzes will be given. The two lowest scores will be discarded. Thus, up to 115 quiz points are possible. Each paper will be worth 50 points for a total of 150 points. The take-home final exam, based on materials presented in lecture and topics presented in the papers, will constitute 75 points. Thus, 340 total points are possible. The final will be primarily a mixture of short answer and essay questions.

Note that EE409 is a designated 'writing-intensive' or communication through writing (WC) course and as such fulfills a general education requirement.

**Field trip(s):** If the weather is conducive, field trips will be planned to introduce students to fungi in the field. Excursions will likely be a half-day affair during the morning on non-home football weekends. Possible dates include **Sep 13, Sep 20, Sep 27, Oct 18, Nov 1 and/or Nov 8.**

Five big ideas in biology:

- (1) **Evolution:** Populations of organisms and their cellular components have changed over time through both selective and non-selective evolutionary processes.
- (2) **Structure and Function:** All living systems (organisms, ecosystems, etc.) are made of structural components whose arrangement determines the function of the systems.
- (3) **Information Flow and Storage:** Information (DNA, for example) and signals are used and exchanged within and among organisms to direct their functioning.
- (4) **Transformation of Energy and Matter:** All living things acquire, use, and release matter and energy for cellular / organismal functioning.
- (5) **Systems:** Living systems are interconnected, and they interact and influence each other on multiple levels.

### **Disability Statement**

The Office of Disability Services (ODS) is committed to providing equal opportunities for students with disabilities at the University of Tennessee. Appropriate accommodations will be made to enable persons with disabilities to satisfy the General Education requirements. EEB409 is a WC or writing-intensive course. Students with documented disabilities should contact the Office of Disability Services for assistance with appropriate accommodations at (865) 974-6087 or [ods@tennessee.edu](mailto:ods@tennessee.edu).

**Class Schedule EEB409 (tentative and subject to change)**

No.	Date	Topic
01	Th Aug 21	Course organization Lecture 1: Introduction to fungal biology
02	Tu Aug 26	Lecture 2: Ecological roles of fungi / Molecular techniques and characters used in fungal molecular ecology
03	Th Aug 28	Lecture 3: Phylogeny reconstruction and tree thinking
04	Tu Sep 2	<b>Section I: Taxonomic diversity of fungi</b> How many fungal species are known?
05	Th Sep 4	Fungal community ecology: a hybrid beast with a molecular master
06	Tu Sep 9	Global diversity and distribution of macrofungi
07	Th Sep 11	How to know unknown fungi: the role of a herbarium
08	Tu Sep 16	- Fungal ecology catches fire (commentary) - Species abundance distributions and richness estimations in fungal metagenomics – lessons learned from community ecology
09	Th Sep 18	- Scaling up: examining the macroecology of ectomycorrhizal fungi (commentary) - Towards global patterns in the diversity and community structure of ectomycorrhizal fungi
10	Tu Sep 23	Global diversity and distribution of arbuscular mycorrhizal fungi
11	Th Sep 25	Evolutionary criteria outperform operational approaches in producing ecologically relevant fungal species
12	Tu Sep 30	<b>Section II: Genetic diversity of fungi</b> Species and speciation in fungi
13	Th Oct 2	- Eukaryotic microbes, species recognition and the geographic limits of species: examples from the Kingdom fungi - The fungus <i>Armillaria bulbosa</i> is among the largest and oldest living organisms
14	Tu Oct 7	<b>Research paper on taxonomic diversity of fungi in the GSMNP DUE</b> The ectomycorrhizal fungus <i>Amanita phalloides</i> was introduced and is expanding its range on the west coast of North America
15	Th Oct 9	Frequent circumpolar and rare transequatorial dispersals in the lichenised agaric genus <i>Lichenomphalia</i>
16	Tu Oct 14	Phylogeographic analyses of a boreal-temperate ectomycorrhizal basidiomycete, <i>Amanita muscaria</i> , suggest forest refugia in Alaska during the last glacial maximum
	Th Oct 16	<b>Fall Break – no class</b>
17	Tu Oct 21	The genetic diversity of arbuscular mycorrhizal fungi in natural ecosystems – a key to understanding the ecology and functioning of the mycorrhizal symbiosis
18	Th Oct 23	Evolutionary ecology of pungency in wild chilies
19	Tu Oct 28	Bread, beer and wine: <i>Saccharomyces cerevisiae</i> diversity reflects human history
20	Th Oct 30	<b>Section III: Functional diversity of fungi</b> Mycorrhizal fungi: their habitats and nutritional strategies
21	Tu Nov 4	Mycorrhizal vs saprotrophic status of fungi: the isotopic evidence
22	Th Nov 6	Decomposers in disguise: mycorrhizal fungi as regulators of soil C dynamics in ecosystems under global change <b>Review paper on genetic diversity in fungi DUE</b>
23	Tu Nov 11	Friend or foe? Evolutionary history of glycoside hydrolase family 32 genes encoding for sacrolytic activity in fungi and its implications for plant-fungal symbioses
24	Th Nov 13	- Fungal secondary metabolite biosynthesis – a chemical defence strategy against antagonistic animals?

		- Interactions between saprotrophic basidiomycetes mycelia and mycophagous soil fauna
25	Tu Nov 18	The irreversible loss of a decomposition pathway and the single origin of an ectomycorrhizal symbiosis
26	Th Nov 20	The Paleozoic origin of enzymatic lignin decomposition reconstructed from 31 fungal genomes
27	Tu Nov 25	Mycorrhizas and nutrient cycling in ecosystems – a journey towards relevance?
	Th Nov 27	<b>Thanksgiving 27-28 Nov – no class</b>
28	Tu Dec 2	Mushrooms and society California porcini: three new taxa, observations on their harvest, and the tragedy of no commons <b>Hand out take-home exam</b>
	Th Dec 7	<b>Research paper on functional diversity in fungi DUE</b>
	Tu Dec 9	<b>Take home exam due by 10:00 am</b>

### Grading scale EEB409, fall semester 2014

Percentage of total points (600)	Letter grade	Scale
94-100	A	4.0
91-93	A-	3.7
88-90	B+	3.3
84-87	B	3.0
81-83	B-	2.7
78-80	C+	2.3
74-77	C	2.0
71-73	C-	1.7
68-70	D+	1.3
64-67	D	1.0
61-63	D-	0.7
<61	F	0.0