



# BIO 508

## Evolution and Biodiversity

### Instructor Info —



Dr. Rosana Zenil-Ferguson



Student learning hours:  
Wednesdays 2:30-3:30 or  
by appointment



Biology Learning Center



roszenil@uky.edu

### Course Info —



Prerreq: BIO 303 or Graduate student



Tuesday and Thursday



3:30 - 4:45 pm



JSB 243

### Description

BIO 508- Evolution and Biodiversity is an undergraduate and graduate seminar focused on understanding the principles of phylogenetic comparative methods applied to the Tree of Life.

### Materials. Anticipated cost to students: \$0

All articles will be provided through Canvas. We will use RStudio (for graduate students, we will also have some opt-in RevBayes tutorials), both are free but require you to have a good and updated laptop.

### Technology

This class requires a working laptop. A tablet is an option, but it can be difficult to set up. Please talk to me about your options. Attendance in person is necessary since this is a discussion, lecture, and computer tutorial-based course.

### Learning Outcomes

By the end of the semester, the graduate students will be able to:

1. Understand how phylogenetic trees are built.
2. Develop basic computer skills to manipulate phylogenetic trees and traits.
3. Become familiar with the primary literature of comparative methods.
4. Develop quantitative reasoning to follow methods and results in scientific articles.
5. Infer correlations between traits using a phylogenetic tree as part of the modeling approach.
6. Model traits on a phylogeny and perform ancestral state estimation.

### Grading Scheme

30%	Computer practicals
20%	Participation and Reading Quiz
20%	Midterm- Modeling plan and descriptive stats
30%	Final report- Full comparative analysis with interpretation

Grades will follow the standard scale: A = 90-100; B = 80-89.99; C = 70-79.99; D = 60-69.99; E <60.

## Computer Practicals

There are 9 computer practicals in the semester. We will work during class on these tutorials, completing them in one week. Submission will be done through Canvas.

## Participation and Reading Quiz

There are many readings in this course. I will quiz you on concepts and ideas from the articles after I have introduced the basics during the lecture. Some of the readings are challenging, but they won't be long. Make sure you are taking your time to understand them. I am happy to discuss any of these readings one-on-one. Another way to compensate for missing points in the reading quizzes is by participating and asking questions during the class. Participation is optional, but highly encouraged. As a reminder, every student in the class is new to this topic, regardless of their current degree or background. My goal is to introduce you to a completely new (and exciting!) field.

## Midterm- Modeling plan plus descriptive statistics (maximum 3 pages)

Your midterm is very simple. For undergraduate students, I will provide you with some trees and traits to plot some phylogenetic summary statistics. You will describe what kind of analysis you will do as your final project and why. For graduate students, I will ask you to find your own tree and traits (I am happy to give you directions on where to find data), describe your plan for the final project, and also create some summary statistics for your data. Altogether, this midterm should be no longer than 3 pages and should cite specific references that will be essential for your final project.

## Final report (max 7 pages)

Your final report will be a complete phylogenetic comparative analysis. You will start by introducing the problem, describing your tree and traits. Later, you will be describing a comparative method to solve the problem. Finally, you will discuss the importance of your results and what you have learned about comparative methods. I will be providing you with clear guidance and a rubric with the sections required for your final. I have allocated time during the semester to work together on this final project, hoping that you feel supported and guided through the whole process.

## Getting Help, Late Work, and Absences

We have constant surges of respiratory viruses, and many duties in the semester. I expect there will be health/fieldwork challenges we all have to deal with. As an instructor, I will try my best to accommodate the unexpected challenges you will experience. However, I have some basic rules to make it work for all of us.

### Rules for communication

1. Early rather than later. Inform me quickly of an issue [in writing with one week of anticipation](https://www.uky.edu/universityabsences). It is easier for me to get organized and find a solution if you missed part of the class. Of course, for illnesses, notify me as soon as possible. In general, late work should be made up within a week if your absence falls in the categories listed here <https://www.uky.edu/universityabsences>. In short, these rules cover: significant illness, the death of family members, UK-sponsored trips, major religious holidays, and interviews for full-time jobs after graduation.
2. Report your issue directly to me or through email [roszenil@uky.edu](mailto:roszenil@uky.edu)
3. If there is a true emergency, email me at [roszenil@uky.edu](mailto:roszenil@uky.edu) with the title: EMERGENCY- BIO508!
4. After you report your issue, I will come up with a solution (a make-up when appropriate and justified). Please take the time to read the rules <https://www.uky.edu/universitysenate/excused-absences>.

5. I cannot accommodate for unexpected circumstances that are not the ones covered by the Senate Rules at the end of the semester (you know, my dog ate my laptop in the middle of the semester but I just realized during the week before finals, finals or a week after) when most of the work should be done.
6. Incomplete work without justification will receive a zero grade. No late assignments are permitted unless agreed or justified absences, in which case no penalty will be applied to your work.
7. If you use AI to write your midterm, final, or quizzes you will receive a zero grade. I am not interested in the perfection of a computer; writing is difficult and messy. However, I am interested in the way you think and write, even if imperfect. Please revise my policy on AI.
8. After 3 missing practicals or reading quizzes, you will receive an E in this class. This is a course that requires full engagement; without your participation, it becomes impossible to make up for lost work.

**Student learning hours** Student learning hours are Wednesdays at 2:30 at the Biology Learning Center and by appointment (I promise it is much cheaper and more efficient to see me than going to ChatGPT).

## Inclusive Excellence

The University of Kentucky is committed to our core values of diversity and inclusion, mutual respect and human dignity, and a sense of community (Governing Regulations XIV). We acknowledge and respect the seen and unseen diverse identities and experiences of all members of the university community. These identities include but are not limited to those based on race, ethnicity, gender identity and expressions, ideas and perspectives, religious and cultural beliefs, sexual orientation, national origin, age, ability, and socioeconomic status. We are committed to equity and justice and providing a learning and engaging community in which every member is engaged, heard, and valued.

We strive to rectify and change behavior that is inconsistent with our principles and commitment to diversity, equity, and inclusion. If students encounter such behavior in a course, they are encouraged to speak with the instructor of record. Students may also contact a faculty member within the department, the program director, the director of undergraduate or graduate studies, the department chair, any college administrator, or the dean. All of these individuals are mandatory reporters under University policies.

All members of this class, including me, commit to contributing to a respectful, welcoming, and inclusive environment for every other member of the class during our personal interactions and discussions. There exists the role of discussion and debate in academic discovery and the right of all to respectfully disagree from time to time. Students clearly have the right to take reasoned exception and to voice opinions contrary to those offered by the instructor and/or other students (S.R. 6.1.2). Equally, a faculty member has the right – and the responsibility – to ensure that all academic discourse occurs in a context characterized by respect and civility. The accepted level of civility would not include attacks of a personal nature or statements of denigrating another based on race, sex, religion, sexual orientation, age, national/regional origin, or other important identities.

## Statement on Disability

Any student who feels they may need an accommodation based on the impact of a disability is invited to contact me privately. If you have a disability or medical condition that requires special accommodation, a good place to start is our Disability Resource Center <https://www.uky.edu/DisabilityResourceCenter/>. They can help me coordinate accommodations as well.

## Academic Integrity and Ethical Behavior

The following excerpt is taken from the “Students Rights and Responsibilities Handbook, University of Kentucky” regarding cheating:

*“Cheating is defined by its general usage. It includes, but is not limited to, the wrongful giving, taking, or presenting of any information or material by a student with the intent of aiding himself/herself or another on any academic work that is considered in any way in the determination of the final grade.”*

The following excerpt is taken from the “Students Rights and Responsibilities Handbook, University of Kentucky” regarding plagiarism:

*“All academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. When students submit work purporting to be their own but which may in any way borrow ideas, organization, wording, or anything else from another source without appropriate acknowledgment of the fact, they are guilty of plagiarism. Plagiarism includes reproducing someone else’s work. ....If the words of someone else are used, the student MUST put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content, or phraseology intact is plagiaristic.”*

Charges of an academic offense will be made against any student who cheats or commits plagiarism. The MINIMUM penalty for such an offense is the assignment of a grade of E for the course in which the offense occurred. More severe penalties include suspension or dismissal from the University. I have a zero-tolerance policy regarding academic offenses. All the consequences for academic offenses can be seen in this link <https://ombud.uky.edu/students/what-cheating>.

## Non-Discrimination Statement and Title IX Information

In accordance with federal law, UK is committed to providing a safe learning, living, and working environment for all members of the University community. The University maintains a comprehensive program that protects all members from discrimination, harassment, and sexual misconduct. (<https://regs.uky.edu/administrative-regulation/ar-61>).

I am obligated to forward any report made by a student related to discrimination, harassment, and sexual misconduct to the Office of Institutional Equity. Students can confidentially report alleged incidents through the Violence Intervention and Prevention Center (<https://www.uky.edu/vipcenter/>), Counseling Center (<https://www.uky.edu/counselingcenter/>), or University Student Health Service (<https://ukhealthcare.uky.edu/university-health-service/student-health>).

## ChatGPT and AI

New technologies have allowed our society and our species to thrive. This is an exciting time to see AI integrating into our lives and learning. But "with great power comes great responsibility" so here I list some ideas for the responsible use of AI for our class.

The use of AI is permitted for

1. Search for connected content: Example, asking ChatGPT to find similar papers.
2. Search for "how to generate a phylogenetic tree with barplots in R using phytools". This is an example where a specific instruction is given to AI to help overcome a task that is not as critical. Since you will still have to interpret the data, simplifying the plotting can save time. The important part of learning is the interpretation of the plot itself (see below).

The use of AI is NOT permitted for

1. Plagiarism: Submitting AI-generated responses is a clear example of plagiarism, and it is unethical. The biggest worry for this class is that there is so much misinformation on the internet about Evolution that you will likely end up making a false claim. Avoid it, it is not worth it!
2. Making up for the lack of work: Engaging solely with AI can prevent your deeper learning of concepts and the ability to develop critical thinking and problem-solving. These are essential for your career.

I am also learning the potential benefits and pitfalls of AI, and this list is not comprehensive. When in doubt about whether or not you can use it, please ask me! I love new technology, and it can be used in creative ways, but I also want you to maximize your learning, so I want you to engage as much as possible with the material without having to rely solely on tech. I truly dislike how the need for AI is destroying our water resources, so I try my best to minimize my own use. I encourage you to think about this as biologists who care about our natural resources.

If you are feeling so desperate in the class that you think you can resort to cheating, plagiarism, or using CHATGPT or AI, please come talk to me in person. My job is for you to learn in the best possible and most supportive environment. I can almost always find a solution to decrease the pressure but maximize what you get out of this class.

## Tentative Class Schedule

Week	Day	Format	Topic
1	August 26th, 2025	Lecture	Introduction and Software installation
	August 28th, 2025	Lecture	Tree thinking and basic approaches to estimating phylogenies
2	September 2nd, 2025	Lecture	Tree thinking and basic approaches to estimating phylogenies
	September 4th, 2025	Practical	Getting Started in R
3	September 9th, 2025	Lecture	Statistical methods for estimating phylogenies
	September 11th, 2025	No class	
4	September 16th, 2025	Practical	Intro to Phylogenetics in R
	September 18th, 2025	Lecture	Bayesian phylogenetics
5	September 23th, 2025	Practical	MCMC tutorial
	September 25th, 2025	Lecture	Divergence-time estimation
6	September 30th, 2025	Practical	Clade date/ RevBayes
	October 2nd, 2025	Lecture	Phylogenetic Comparative Methods 1
7	October 7th, 2025	Practical	Discrete trait phylogenetic association
	October 9th, 2025	Lecture	Mkn models discrete traits
8	October 14th, 2025	Lecture	Mkn models discrete traits (cont)
	October 16th, 2025	Midterm	1 page project description with summary statistics
9	October 21st, 2025	Practical	Mkn+Hidden states
	October 23rd, 2025	Lecture	Effect of binary character on species diversification: BiSSE
10	October 30th, 2025	Practical	BiSSE/HiSSE
11	November 4th, 2025	Working session	Final project work together
	November 6th, 2025	Working session	Final project work together
12	November 11th, 2025	Lecture	More diversification models
	November 13th, 2025	Lecture	Models of continuous trait evolution (BM, OU, early-burst, etc.)
13	November 18th, 2025	Practical	Models of continuous trait evolution
	November 20th, 2025	Lecture	Phylogenetic Linear models
14	December 2nd, 2025	Practical	Analysis of continuous trait evolution in R
	December 4th, 2025	Lecture	Rethinking comparative methods
15	December 9th, 2025	Working session	Final project work together
	December 11th, 2025	Working session	Final project work together (reading days)
	December 18th, 2025	Final	Final project due at 9 am