Biol 465X / EEOB 565X
Macroevolution
Course Syllabus

INSTRUCTORS	Office	Office Hours	Telephone	e-mail address
Dr. Dean Adams	315 Bessey	by appointment	294-3834	dcadams@iastate.edu
Dr. Tracy Heath	339 Bessey	by appointment	294-3931	phylo@iastate.edu

CLASS MEETINGS: Tuesday/Thursday 2:10 pm – 3:30 pm; 203 Bessey Hall

Course Description: (3) Cr. 3. *Prereq.: Biol 315*. The history and diversity of life on earth; evolutionary patterns and processes above the species level. Examine diversity from a phylogenetic perspective. Empirical exercises include: phylogeny estimation, ancestral states, estimating diversification rates, evaluating the tempo and mode of evolution, biogeographic patterns, and trait associations across the tree of life.

READING MATERIALS:
Readings from the primary literature will also be utilized and distributed on the course Canvas page (https://canvas.iastate.edu/courses/68351) and course website: https://eeob-macroevolution.github.io/

COURSE OUTCOMES:
Upon completion of the course, students will:
- Understand patterns of diversity in the fossil record, and changes in that diversity over time
- Understand macroevolutionary patterns and processes, and the difference between gradualism, stasis, and punctuated equilibrium
- Become familiar with 'tree thinking', and understand the principles of using a phylogenetic perspective to address evolutionary questions in biology
- Gain experience in applying cutting-edge phylogenetic methods for testing hypotheses in macroevolution

COURSE OBJECTIVES:
- Be able to explain the history of life on earth, including major extinction events
- Know the concepts of gradualism, stasis, and punctuated equilibrium and their importance
- Understand the concepts of tempo and mode as applied to species diversification and morphological evolution
- Become familiar with statistical phylogeny estimation methods and be able to apply them to biological data
- Know how to estimate diversification rates and how to compare them
- Understand the major macroevolutionary models of trait evolution, including Brownian motion, Ornstein-Uhlenbeck, and early-burst models
- Know how to implement the phylogenetic comparative method for evaluating macroevolutionary trends across a phylogeny

COURSE MATERIALS:
Most course information and materials will be distributed on Canvas and GitHub. There you will be able to view this syllabus, lecture notes, description of assignments, special materials supplied by the instructor.

GRADING:
Final grades will be based on three main course components, with undergraduates and graduate students evaluated using separate criteria for participation and the final project.
- Midterm = 20%
- Participation in discussions and practicum = 40%
- Final project = 40%

Discussion participation – *Undergraduate students* must submit at least one question to the Canvas Discussion Board (submit via the Discussion Topic Questions for Participation forum) for every paper assigned for discussion (see course schedule). Additionally, undergraduates should attempt to participate in the discussion of the paper in class. *Graduate students* must actively participate in and help the instructors lead the in-class discussions of the course materials.

Practicum participation – The in-class practicum exercises will all include synthesis questions that can be answered once the exercise is completed. All students must submit their answers to these questions on the course Canvas site.

RESEARCH PROJECT:
Research projects will be conducted during the second half of the course. After the mid-term, the course will consist of applied topics and software demonstrations. Students may select any of these topics as the basis of their project, and will conduct an analysis on real or simulated data. The final project will consist of three components:

1. A 1-page summary of the project that provides the background and motivation of the study (due on March 13, 2020).
2. A 10-minute presentation (with 2 minutes for questions), these presentations will be given to the entire class on April 28 and 30.
3. All data and script files needed to execute the analyses (graduate students).

DISABILITY ACCOMMODATIONS:
Iowa State University complies with the Americans with Disabilities Act and Sect 504 of the Rehabilitation Act. If you have a disability and anticipate needing accommodations in this course, please contact (instructor name) to set up a meeting within the first two weeks of the semester or as soon as you become aware of your need. Before meeting with (instructor name), you will need to obtain a SAAR form with recommendations for accommodations from the Disability Resources Office, located in Room 1076 on the main floor of the Student Services Building. Their telephone number is 515-294-7220 or email disabilityresources@iastate.edu. Retroactive requests for accommodations will not be honored.

HARASSMENT AND DISCRIMINATION POLICY:
Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. Any student who has concerns about such behavior should contact his/her instructor, Student Assistance at 515-294-1020 or email dso-sas@iastate.edu, or the Office of Equal Opportunity and Compliance at 515-294-7612.

ACADEMIC HONESTY:
The class will follow Iowa State University's policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office.
http://www.dso.iastate.edu/ja/academic/misconduct.html

DEAD WEEK:
This class follows the Iowa State University Dead Week policy as noted in section 10.6.4 of the Faculty Handbook http://www.provost.iastate.edu/resources/faculty-handbook .

CONTACT INFORMATION:
If you are experiencing, or have experienced, a problem with any of the above issues, email academicissues@iastate.edu.

Lecture Schedule

For the up-to-date schedule see: https://docs.google.com/spreadsheets/d/1SDnp_Pp_rqobAC9v-gQFYU7wFjbSl5tP2ASdVnWwP2k/edit?usp=sharing

Week	Day	Topic	Reading/Tutorial	Instructor
1	Tue, January 14	**Lecture:** Introduction: Patterns of diversity in the fossil record	Benton (2015)	DA
	Thurs, January 16	**Lecture:** Lineage diversification, mass extinctions, extinction rates	Marshall (2017)	TH
2	Tue, January 21	**Discussion:** Extinction in the Anthropocene	Dirzo et al (2014)	DA/TH
	Thurs, January 23	**Lecture:** Tempo and mode of trait evolution: disparity, gradualism, stasis, punctuated equilibrium, evolutionary trends, adaptive radiations	Benton and Pearson (2001)	DA
3	Tue, January 28	**Lecture:** Beyond the evolutionary synthesis: levels of selection, constraints in macroevolution, contingency though mass extinctions, etc.	Gould and Lloyd (1999)	DA
	Thurs, January 30	**Discussion:** Evolutionary synthesis and extensions	Point-Counterpoint: Laland et al (2014) Wray et al. (2014)	DA/TH
4	Tue, February 4	**Lecture:** Tree thinking and basic approaches to building phylogenies	Yang (2014), Chapter 3	TH
	Thurs, February 6	**Discussion:** TBD	TBD	DA/TH
5	Tue, February 11	**Lecture:** Statistical methods for reconstructing phylogenies	Yang (2014), Chapter 4	TH
	Thurs, February 13	**Lecture:** More statistical phylogenetics		TH
6	Tue, February 18	**Lecture:** Even more statistical phylogenetics (the Bayesian stuff)		TH
	Thurs, February 20	**Lecture:** Divergence-time estimation		TH
7	Tue, February 25	**Lecture:** Phylogenetic Comparative Methods 1		DA
	Thurs, February 27	**Lecture:** Phylogenetic Comparative Methods 2		DA
8	Tue, March 3	**Practical:** Building trees in R		TH
	Thurs, March 5	**Discussion:** Challenges of phylogenetic inference; software		TH
9	Tue, March 10	**Practical:** Phylogenetic Regression		DA
	Thurs, March 12	**Practical:** Discrete trait phylogenetic association		DA
10	March 16-20	**Spring Break**	Woo!	
11	Tue, March 24	**Lecture:** Effect of binary character on species diversification: BiSSE	Maddison et al. (2007)	TH
	Thurs, March 26	**Practical:** BiSSe and related models in R		TH
12	Tue, March 31	**Theory:** Ancestral state estimation	Cunningham et al. 1998	DA
	Thurs, April 2	**Practical:** Ancestral state estimation		DA
13	Tue, April 7	**Theory:** Models of continuous trait evolution (BM, OU, early-burst, etc.)	Butler and King (2004)	DA
	Thurs, April 9	**Practical:** Analysis of continuous trait evolution in R		DA
14	Tue, April 14	**Theory:** Multivariate trait evolution	Adams and Collyer (2018)	DA
	Thurs, April 16	**Practical:** Analysis of multivariate traits in R		DA
15	Tue, April 21	**Theory:** Statical methods for historical biogeography	Landis et al (2014)	TH
	Thurs, April 23	**Practical:** Ancestral area estimation methods		TH
16	April 28 - April 30	Student presentations of final projects	none	DA/TH