# Biol 465X / EEOB 565X
## *Macroevolution*
## Course Syllabus

| INSTRUCTORS | Office | Office Hours | Telephone | e-mail address |
|---|---|---|---|---|
| Dr. Dean Adams | 241 Bessey | by appointment | 294-3834 | dcadams@iastate.edu |
| Dr. Tracy Heath | 243 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) and GitHub website: https://eeob-macroevolution.github.io/EEOB-565X-Spring2018

**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 via email to both instructors (dcadams@iastate.edu, phylo@iastate.edu) 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 29, 2017).
2. A 10-minute presentation (with 2 minutes for questions), these presentations will be given to the entire class on May 1st and 3rd.
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/1RCZk2wY5Ty2JRhTjZ1keajfJ_N4UmzgIRh3KT5Px9zg/edit?usp=sharing

| Week | Day | Topic | Reading/Tutorial |
|---|---|---|---|
| 1 | Tue, January 9 | **Lecture:** Introduction: Patterns of diversity in the fossil record | Benton (2015) |
| | Thurs, January 11 | **Lecture:** Lineage diversification, mass extinctions, extinction rates | Raup (1972) |
| 2 | Tue, January 16 | **Discussion:** Modern studies of diversity dynamics in the fossil record | Quental and Marshall (2010) |
| | Thurs, January 18 | **Lecture:** Tempo and mode of trait evolution: disparity, gradualism, stasis, punctuated equilibrium, adaptive radiations | Benton and Pearson (2001) |
| 3 | Tue, January 23 | **Lecture:** Emergent patterns: species sorting, species selection, evolutionary 'channeling' etc. | Stanley (1975); Crespi (2001) |
| | Thurs, January 25 | **Discussion:** Modern studies of punctuated equilibrium | Pennell et al (2014) |
| 4 | Tue, January 30 | **Lecture:** Tree thinking and basic approaches to building phylogenies | Yang (2014), Chapter 3 |
| | Thurs, February 1 | **Discussion:** History of Statistical Phylogenetics | Felsenstein (phyloseminar) |
| 5 | Tue, February 6 | **Lecture:** Statistical methods for reconstructing phylogenies | Yang (2014), Chapter 4 |
| | Thurs, February 8 | **Discussion:** The Tree of Life | Hincliff et al (2015) |
| 6 | Tue, February 13 | **Lecture:** Trait comparisons, trait evolution on phylogenies: Comparative methods | Harvey and Pagel (1991), Chapter 1 & 2 (parts) |
| | Thurs, February 15 | **Discussion:** Continuous trait character evolution | Felsenstein (1985) |
| 7 | Tue, February 20 | Software installation, final project planning | none |
| | Thurs, February 22 | **Exam: Take home midterm due Monday, Feb. 26** | |
| 8 | Tue, February 27 | **Theory:** Bayesian methods for joint estimation of topology and divergence times using molecular and fossil data | Heath and Moore (2014) |
| | Thurs, March 1 | **Practical:** Bayesian divergence time estimation in RevBayes | [link] |
| 9 | Tue, March 6 | **Theory:** Variation in diversification rates, testing diversification rates | TBD |
| | Thurs, March 8 | **Practical:** Estimating lineage diversification rates in RevBayes | [link] |
| 10 | March 12-16 | **Spring Break** | Woo! |
| 11 | Tue, March 20 | **Theory:** Effect of binary character on species diversification: BiSSE | Maddison et al. (2007) |
| | Thurs, March 22 | **Practical:** BiSSe and related models in RevBayes | [link] |
| 12 | Tue, March 27 | **Theory:** Investigating trait correlations | Garland and Ives (2000) |
| | Thurs, March 29 | **Practical:** PIC and PGLS in R | [link] |
| 13 | Tue, April 3 | **Theory:** Ancestral state reconstruction | TBD: Schluter 1997? |

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|---|---|---|---|
| | Thurs, April 5 | Practical: Discrete trait analysis in R (molecules, discrete traits, continuous traits, stochastic character mapping; discrete trait associations) | [link] |
| **14** | Tue, April 10 | **Theory:** Models of continuous trait evolution (BM, OU, early-burst, etc.) | Butler and King (2004) |
| | Thurs, April 12 | **Practical:** Analysis of continuous trait evolution in R | [link] |
| **15** | Tue, April 17 | **Theory:** Multivariate trait evolution | Adams and Collyer (2018) |
| | Thurs, April 19 | **Practical:** Analysis of multivariate traits in R | [link] |
| **16** | Tue, April 24 | **Theory:** Statical methods for historical biogeography | Landis et al (2014) |
| | Thurs, April 26 | **Practical:** Ancestral area reconstruction in RevBayes | [link] |
| **17** | April 30 - May 3 | Student presentations of final projects | none |
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