BZ424 - Systematic Zoology - Spring 2024 8:00 to 8:50 p.m. MWF Anatomy/Zoology E112 Course Information

Instructor:	Dr. Tanya Dewey
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Office Hours:	Wednesdays 2 to 3 p.m. or by appointment

Communication:

Questions requiring extended replies or explanations cannot be answered by email. Please come to office hours or make an appointment for detailed discussions. I will make every attempt to respond within 1 business day, although weekends and holidays will result in longer response times. Please make sure that your Canvas settings allow you to receive prompt notification of announcements so that I can use that as a tool to send important reminders and clarifications.

Textbooks and Course Materials:

Readings: There is no textbook for Systematic Zoology. Every week will be a little different, but all readings, assignments, or additional materials will be available via Canvas in the weekly modules.
 Canvas Site: A Canvas site has been set up for this class, see the site for resources and announcements.

Course Objectives:

BZ424 is a course designed to introduce the core principles of systematic zoology and explore in depth the many biological issues that are part of the field, including issues of species concepts, speciation, taxonomy and classification, constructing and evaluating hypotheses of evolutionary relationships, characters used in taxonomy, species descriptions, the taxonomic literature, museums and museum science, and careers in systematic zoology.

At the end of this semester, you will be able to:

- 1. Interpret patterns of evolutionary history on trees of varying complexity.
- 2. Distinguish between homoplasy and homology, including ways of estimating homology, such as positional homology in sequence data.
- 3. Compare and describe the different analytical frameworks used to generate evolutionary trees, including the computational "cost" of each and how they treat character data.
- 4. Identify the relationship between technological advances in generating molecular data and the development of new analytical frameworks.
- 5. Explain the need for heuristic approaches in phylogenetic analysis and describe how a variety of heuristic approaches are used to explore tree space.
- 6. Describe the importance of taxonomic nomenclature and the principles used to name, diagnose, and communicate about taxa.
- 7. Identify the ways that museums contribute to systematic science in the past, present, and into the future.
- 8. Discuss the social and cultural impacts of the history of systematic science on people around the world and consider changes to address those impacts.

Grading Policy:

Your grade in the class will be based on the following:

- Exams 3 Exams X 100 = 300 pts (%54 = %18 each exam)
- Taxon Account and Ignite Talk 100 pts (18%)
 - Taxon selection and initial literature list (10 pts)
 - Diversity, Geographic Range, and Habitat sections (10 pts)
 - Physical Description and Reproduction sections (10 pts)
 - Lifespan/Longevity, Behavior, Communication and Perception sections (10 pts)
 - Food Habits, Predation, and Ecosystem Roles (10 pts)

- Economic Importance for Humans (positive and negative) and Conservation Status sections (10 pts)
- Systematic and Taxonomic History and Other Comments sections (10 pts)
- Peer review of taxon account (5 pts)
- Final complete taxon account (incorporating edits) (5 pts)
- Ignite talk on Taxon Account 20 pts (3%)
- Phylogenetic Analysis of your Taxon (total 80 pts) (~14%):
 - Phylogenetic Question (10 pts)
 - Genbank Exercise (10 pts)
 - Multiple Sequence Alignment (10 pts)
 - Maximum Parsimony Analysis (10 pts)
 - Maximum Likelihood Analysis (10 pts)
 - Calculating Support Metrics (10 pts)
 - Phylogenetic Analysis Narrative (20 pts)
- Other Assignments (73 pts) (13%)
 - Weekly in-class activities or discussions on Canvas (12 x 4 = 48 pts)
 - Pre-assessment: Molecular Systematics of *Reithrodontomys*, Take I (5 pts)
 - Post-assessment: Molecular Systematics of *Reithrodontomys*, Take II (5 pts)
 - Library Exploration (5 pts)
 - Tree Reading (5 pts)
 - Notes from Nature Badge (5 pts)

Total: 553 points

Exams: All exams will be short answer questions and will be administered on Canvas to allow for some flexibility in timing. You can use your notes, but exams will be timed. Success on exams requires being prepared. Students are expected to adhere to CSU academic integrity policies and *cannot* work on exams together.

Late work: I am happy to accept late work with no decrease in grade with advance notice of your request to submit late work. Please note that work over one-week late results in lost opportunities for feedback on that work. Work submitted over one week late will lose 10% of its value for each additional week that it is late.

<u>Class Schedule</u>: The estimated schedule for course topics covered is found below. Please note: there may be changes as we accommodate your interests and the schedules of several guest speakers! Again – keep your eye on Canvas and be aware of announcements made in class! See Canvas for all assignments and due dates.

Tentative schedule for the semester

Week 1: Intro to BZ 424 January 17 – (cancelled/snow day) January 19 – Introduction to BZ 424 – goal setting Due: Reflection I (Goal setting)

Week 2: The Science of Systematics and Taxonomy

January 22 - The Science of Systematics January 24 - Taxonomic Nomenclature January 26 – Taxonomic Literature and Taxon Account Assignment *Due: Molecular Systematics of Reithrodontomys reading, Take I*

Week 3: Museums and Collections

January 29 - Tour of Gillette Museum (meet at museum for our class time)

January 31 – Museums and Collections February 2 – Guest Lecture by Dr. Crystal Cooke Due: Submit taxon name and a list of at least 10 literature sources. Due: Submit Phylogenetic Question. Due: Library Exploration Assignment.

Week 4: Tree Thinking, Taxonomic Evidence, and Species Concepts February 5 – Tree Thinking February 7 – Taxonomic Evidence February 9 – Alpha taxonomy and species concepts Due: Diversity, Geographic Range, and Habitat sections Due: Tree Reading Activity

Week 5: Molecular Data

February 12 – Molecular Data and Phylogenetic Questions February 14 – Harvesting GenBank data (in class, bring laptop) February 16 –Exam I Review *Exam I*

Week 6: Gene Trees and Homology

February 19 – Species Trees and Gene Trees February 21 – Reciprocal Illumination: Assessing Homology February 23 – Molecular Homology Due: GenBank Search Due: Physical Description and Reproduction sections

Week 7: Phylogenetic Schools of Thought and Parsimony

February 26 - Multiple Sequence Alignment (in class, bring laptop)
February 28 - Cladistics and Phenetics
March 1 - Building Maximum Parsimony Trees
Due: Multiple Sequence Alignment
Due: Lifespan/Longevity, Behavior, Communication and Perception sections

Week 8: Using Models of Evolution

March 4 – Maximum Parsimony Analysis (in class, bring laptop) March 6 – Using Models of Evolution and Maximum Likelihood March 8 – Model Selection *Due: Parsimony Analysis Due: Food Habits, Predation, and Ecosystem Roles sections*

Week 9: Spring Break! (March 11 to 15)

Week 10: Using Models of Evolution and Tree Searching March 18 – Guest lecture: Dr. Marek Borowiecz
March 20 – Tree Searching and Bayesian Statistical Approaches
March 22 – Maximum Likelihood Analysis (in class, bring laptop)
Due: Maximum Likelihood Analysis
Due: Economic Importance for Humans: Positive, Economic Importance for Humans: Negative, and
Conservation Status sections Week 11: Optimality Criteria and Taxonomic Sampling

March 25 – Comparing Phylogenetic Approaches and Optimality Criteria March 27 - Taxonomic Sampling and Next Steps March 29 – Exam II Review *Exam II*

Week 12: Evaluating Support for Topologies

April 1 – Support for Branching Topologies and Consensus April 3 – Jacknifing and Bootstrapping (in class, bring laptop) April 5 – Support for Branching Topologies and Consensus Due: Systematics and Taxonomic History and Other Comments section Due: Support Metrics

Week 13: Other Applications of Phylogenetic Analysis

April 8 – The Seven Great Questions of Systematic Biology
April 10 – Guest lecture: Dr. Luke Tembrock, Research Scientist, CSU
April 12 – Other Applications of Phylogenetic Analysis
You may wish to review your taxon account and edit so that it is ready for the peer review process

by the end of this week.

Week 14: Museums and the Future

April 15 – Coalescent Modeling and Species Delimitation April 17 – Guest lecture: Dr. Antoinette Piaggio, USDA-APHIS April 19 – Guest lecture: Museums – Historical and Future Scientific Discovery Due on Sunday April 21 by 8 p.m.: Ignite talk videos - what is the coolest thing about your taxon and why does it matter? (In under three minutes.)

Week 15: Sharing your research!
April 22 – Ignite talks!
April 24 – Ignite talks!
April 26 – Ignite talks!
Due: Phylogenetic Analysis of Your Taxon
Due: Peer review comments on draft of complete taxon account.

Week 16: Sharing your research!

April 29 - Ignite talks!
May 1 - Ignite talks!
May 3 - Ignite talks! (Or Exam Review)
Due: Notes from Nature Badge
Due: Final Reflection (Revisiting goals)
Due: Molecular Systematics of Reithrodontomys reading, Take II
Due: Submit final complete taxon account

Exam III: Your last exam will be available on Friday, May 3rd on Canvas. I will arrange a review session ahead of the last exam.