

BZ220-001: INTRODUCTION TO EVOLUTION
SPRING 2020 COURSE SYLLABUS

PROFESSORS: Dr. Evan Forsythe and Dr. Jennifer Neuwald

TEACHING ASSISTANTS: Ms. Jennifer Brady and Ms. Maybellene Gamboa

CONTACT INFORMATION & OFFICE HOURS:

| | Dr. Forsythe | Dr. Neuwald | Ms. Brady | Ms. Gamboa |
|---------------------------|--|--|--|---|
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| Office Hours: | T/Th: 3:30PM–4:40PM (when teaching) | T/Th: 12:30 – 1:30 PM (when teaching) | M: 12:30-1:30PM & F: 10-11AM (all semester) | Th: 10:30AM – 12:30PM (all semester) |
| Lectures covering: | MICROEVOLUTION Aug. 27 – Oct. 15 | MACROEVOLUTION Oct.17 - Dec. 12 | - | - |

- We strongly encourage you to try to meet with us during office hours. However, if the times above do not work with your schedule, please contact one of us to schedule an appointment.
- Please include “**BZ220**” as part of the subject line **in all e-mails**

LECTURE: Tuesday / Thursday 2:00 – 3:15 PM; Yates 104

- Lecture slides and study guides will be posted prior to each lecture on our Canvas site.

COURSE MATERIALS:

- Recommended Textbook: *Evolutionary analysis* (5th edition) by Freeman & Herron (2014) (**2 copies on reserve at the library**). Students can purchase a hard copy or ebook option through the CSU Bookstore. *While purchasing the text is optional, it is expected that you will use it as a reference if you are struggling with concepts or want to review topics that we cover in lecture.*
- iClicker: register **before Tues., Jan. 28**. Details on how to do this can be found on our course Canvas site.
- Calculator: capable of power, exponent, and square-root functions. Calculators capable of storing/displaying text (e.g., graphing calculators, smartphones) are **not** allowed during exams.

COURSE WEB SITE: <http://info.canvas.colostate.edu/login.aspx>

- 2019F-BZ-220-001 Introduction to Evolution

COURSE OBJECTIVES:

Students will be able to have an informed discussion about the process of descent with modification (i.e., evolution). This process includes describing the mechanisms by which lineages change (including heredity) and reviewing the general history of life. Students will be able to construct and test evolutionary hypotheses, for studies of both short-term change (microevolution) and studies of descent among species (macroevolution). Refer to the “**Course Learning Objectives**” section below for detailed core competencies expected of students by the end of the semester.

GRADING:

We will be using the plus/minus system when assigning final grades. Pluses will be assigned for the highest two percentage points for a given letter grade for A, B, and C grades (e.g., 98 – 100% = A+). Minuses will only be assigned for grades that we choose to raise upwards (e.g., an 89.6% might be raised to an A- if the student actively participated in class, attended office hours, and completes all quizzes). Note that it is university policy that C-, D+, and D- grades cannot be assigned. As such, do not expect a high D to be changed into a C. All biology and zoology majors need at least a C in this class to graduate with these majors.

| | |
|-----------------------|--|
| Two preliminary exams | 190 points (2 exams @ 95 points each) |
| Final exam | 125 points |
| Quizzes | 120 points (13 quizzes @ 5-10 points each) |
| Discussion groups | 20 points (2 discussions & write-ups @ 10 points each) |
| iClicker questions | 75 points (50 questions @ 1.5 points each) |
| GRAND TOTAL: | 530 points , but your final-grade percentage will be calculated from 510 points (effectively giving you 20 free points). |

- **20-free-points grading example**: if you have 465 points at the end of the semester then $465 / 510 = 91\% = \text{"A"}$ for your course grade (instead of $465 / 530 = 87\% = \text{"B"}$).
- **Regularly check your scores** on Canvas. **YOU** are responsible for knowing how you are doing in class.
- If you have questions regarding the grading, **you must resolve the issue within two weeks** from when the scores are posted on Canvas. For exams, e-mail the professors **and justify** why you believe your answer was correct. For quizzes and discussion sections, e-mail the appropriate TA with your justification.

EXAM INFORMATION:

- All exams are multiple-choice, true-false, and/or matching. Answer keys will be posted on Canvas.
- Last year's exams and exam keys are provided on Canvas.
- The second preliminary exam includes ~15% cumulative material. The final exam is ~35% cumulative.
- In the event of an emergency or university-sanctioned activity, make-up exams can be requested with (i) proof of the emergency or university-sanctioned activity and (ii) within 24 hours of the regular exam. Decisions about whether a make-up exam is warranted in the case of an emergency will be made at the sole discretion of the professor, and thus, are not guaranteed. **Make-up exams will be oral or short-answer essays**; the multiple-choice exam is only given at the scheduled date and time.
- The **final exam is on Tuesday, May 12th from 2:00pm-4:00pm** in Yates 104. Make sure you do not have travel arrangements that will result in you missing the exam!

OPEN-BOOK/OPEN-NOTES QUIZZES:

- Thirteen quizzes worth 5 – 10 points each will be administered through Canvas (*refer to the schedule below*).
- Quizzes will **open on Fridays at 5 PM** for material covered that week. Quizzes are available for one week and then automatically **close the next Friday at 5 PM**. Answers are posted on Canvas as soon as the quiz closes.
- **Late submissions will not be accepted** and will result in a zero for that assignment. **Please pay attention to the deadlines!** If you submit the quiz at 5:01 PM, it will be late.
- Students are permitted to work through the quizzes together, but it is in violation of the Student Conduct Code for students to give or receive answers without applied effort. Refer to the "Academic Integrity" section below.
- Because students have an entire week to complete quizzes, **there are no make-up quizzes** (unless a university-excused absence covers the entire week).

DISCUSSION SESSIONS:

- All students are required to attend **two** 50-minute discussion sessions (worth 10 points each) during the semester. Each student must attend one microevolution session **as well as** one macroevolution session.
- Students are responsible for signing up for discussions. Make sure to do this early to get spots that work with your schedule. Sessions for **microevolution** discussion will be available for sign-up between **Jan.21-Feb. 6**. Sessions for **macroevolution** discussion will be available for sign-up between **Mar.3-Apr. 2**.
- If students need to change the time they signed up for, they must coordinate with and **gain approval** from the appropriate TA.
- Discussion session documents are located on *Canvas/Modules/Discussion Materials* and provide details on the schedule, how to sign up, discussion assignments, and expectations.

IClicker QUESTIONS:

- There will be, on average, two iClicker questions per class.

- Each question is worth 1.5 points: 0.5 points for participating, plus 1 point for a correct answer.
- iClickers must be registered on Canvas before you can receive course credit. We will practice with iClickers the first two class periods. iClickers will then be worth real points starting the third class period. Please register your iClicker before then. We cannot give you course credit if you do not register your iClicker.
- It is **your responsibility** to make sure that (i) you bring your iClicker to every class, (ii) you have it registered properly on Canvas, (iii) you set the channel correctly **each time**, (iv) you have back-up batteries, (v) you log your answer during the time allotted, and (vi) your points are showing up in Gradebook.
- There are **no make-up iClicker points**. The 20 free points we give for the course can be applied to any missed points. This applies to students who miss class, as well as students who attend, but experienced a technical difficulty. Please refer to the Canvas page for getting technical assistance with your iClicker, if needed.
- You may work in groups to figure out the answers, but it is a violation of the Student Conduct Code for students to be given answers without applied effort.
- iClicker questions and answers will **not** be posted on Canvas.

TIPS FOR DOING WELL IN BZ220:

- **Become familiar with Canvas and the resources posted therein!**
 - Review the “Practice Exams & Study Tips” page.
 - Watch the ~2min videos on the “Science of Learning” page.
- **Attend class**, be prepared, and be ready to engage with the material → don’t be a passive learner!
- **Seek help!**
 - Office hours are open times when we encourage students to ask questions or talk about the material.
 - Study with your classmates. Explain concepts to each other. Peer-learning is proven to be highly effective. Don’t know anyone? → ask those you work with during class or discussion.
 - Tutoring services are available through various organizations on campus (e.g. [Biology](#), [Eagle Feather](#), [TILT](#).)
- **Study effectively!** Do not just memorize material → actively work to understand it!
 - Use the textbook to clarify material we discuss in class (*copies on reserve in the library*).
 - Use the study guides at least weekly to identify important concepts (*under each lecture on Canvas*).
 - Use the Canvas quiz questions to gauge your understanding (*start them early and submit them ON TIME!*)
 - Use the practice exams to get a sense of what exams are like (*Canvas/Modules/Course Info & Materials*).

EXPECTATIONS FOR AN EFFECTIVE LEARNING ENVIRONMENT:

- **Instructors:**
 - Start and end class on time and communicate in a timely manner.
 - Facilitate your learning of the material to the best of our ability.
 - Evaluate your learning with assessments that reflect the material covered in class.
- **Your Classmates:**
 - Work to maintain an environment free from distraction (refrain from personal conversation, playing games, on-line shopping, etc. during class time → it makes it hard to hear and pay attention!)
 - Actively engage with each other to work through problems, discussions, and in-class exercises.
- **You:**
 - Come to class (and complete assignments) on time; refrain from packing up until class is dismissed.
 - Make a concerted effort to try to understand the material (e.g. take time to study, use the resources provided, ask for help when needed).
 - *Other:* _____.
- **All:**
 - Adhere to the [CSU Principles of Community](#) (Inclusion, Integrity, Respect, Service, Social Justice).

STUDENTS WITH DISABILITIES:

If you have a disability that requires special accommodation in this class, then you may be eligible for accommodations/auxiliary aids under the Americans with Disabilities Act of 1990 and Section 504 of the Rehabilitation Act of 1973. Please contact the [Student Disability Center](#) in room 121 in the TILT Building on the

Oval, 491-6385, to determine eligibility for accommodations or auxiliary aids during this class. Getting registered with the Student Disability Center takes time so do this well before the first exam.

As per [CSU policy](#), pets and Emotional Support Animals (ESAs) are not allowed in classrooms or academic buildings, including Biology and Yates. Service animals are a separate legal classification than ESAs. Service animals are animals trained to perform a specific function to assist their handler. Service animals are allowed in both classrooms and labs and must follow proper service animal behavior, including not interacting with other people, other service animals, or museum specimens (which can be deadly to animals). If you are attending with a service animal, you must identify the animal to your TA and instructor at the start of the semester. If you require a service animal or ESA you are strongly encouraged to communicate with the [Student Disability Center](#).

HONORS BREAKOUT SECTION:

Those students who have registered for the Honors Section (BZ220-231) can find the Honors syllabus on the regular course Canvas site (Canvas/Modules/Honors Breakout) as well as the Honors Canvas page for BZ296 (*see below*). The Honors Section is run as a breakout. Thus, in addition to the regular lecture time, we will meet weekly on **Wednesdays from 10:00 AM-10:50 AM in Biology 133**. You will receive a grade for your performance in lecture as well as a separate honors grade (1 credit) based on your performance in the breakout section. **You must also enroll in BZ296** to receive the separate honors grade and to access the Honors Canvas site. All honors students should contact Dr. Neuwald with questions about the honors breakout section.

ACADEMIC INTEGRITY:

This course adheres to the [Academic Integrity Policy](#) of the General Catalog and the Student Conduct Code. The consequence of cheating on BZ220 exams, quizzes, and other forms of assessment is a **failing class grade**. Furthermore, all cases of cheating will be formally reported to Student Conduct Services at the [Student Resolution Center](#) for them to consider additional penalties.

COURSE LEARNING OBJECTIVES:

By the end of the semester, students should be able to demonstrate an understanding of the following:

Content (Evolution) Competencies:

Microevolution

1. An abundance of evidence and strong inference support evolutionary change leading to a complex tree of life with extinction, changing lineages, and common descent.
2. Evolution is a gradual process in the sense that it is the accumulation of many small changes. These changes may occur over long periods of time, but can also occur relatively quickly.
3. Discrete and continuous variation are both important in evolution, and they both can have a genetic basis.
4. Evolution means changes in **allele** frequencies over time. We can detect changes in allele frequencies, and thus test whether a population is evolving, using Hardy-Weinberg predictions.
5. Natural selection is not the only mechanism for evolution. Mutation, migration, drift **and** selection are all evolutionary forces. Non-random mating (and other processes like linkage) does not cause allele frequency changes on its own, but it can enhance the effects of mutation, migration, drift and selection.
6. Mutation and migration alone *generally* cause little change in allele frequencies, so they are not strong evolutionary forces. However, they are important in creating and maintaining genetic variability that is necessary for drift and selection to act.
7. Drift and selection can each cause large changes in allele frequencies, so they are considered to be strong evolutionary forces. They cannot produce evolutionary change without genetic variability. In small populations, drift is the stronger force. In large populations, selection is the stronger force.
8. All heritable traits, including behavior and life history, are subject to the same laws of evolution.

Macroevolution

9. Conservation of life includes not just preserving the species, but also the evolutionary processes.
10. Adaptive traits increase the fitness of the organisms in which they occur. They are derived, not primitive, characteristics.
11. Sexual reproduction imposes different selective pressures on females vs. males. Generally, this difference leads to competition among males for access to females, and females being choosy about which male they mate with.
12. Phylogenetic analyses are used to infer hierarchical relationships among species (and higher-level groups) using synapomorphies (shared derived character states).
13. Speciation involves isolation of populations (not always geographic) followed by divergence of the isolated populations (through genetic drift, natural selection, and/or sexual selection).
14. Life may be recognized using three criteria: it has a genotype, a phenotype, and it evolves. All extant life is believed to have derived from a single common ancestral lineage.
15. The three main lineages of life are: Bacteria, Archaea, and Eukarya. The deep evolutionary history of these domains is represented more as a web than a tree—a community of interacting species that exchanged genes.
16. The fossil record reveals major evolutionary events in history: extinctions, transitions, diversifications.
17. Evolution of the human lineage has occurred through a series of branching events, not in a linear sequence. Both ancient and modern humans evolved in Africa. Human populations on other continents evolved from these African humans.

Technical (Core Biology) Competencies:

(from AAAS (2011) [Vision and Change in Undergraduate Biology Education](#)):

1. Apply the process of science: hypothesis testing, evaluation of evidence, problem-solving
2. Use quantitative reasoning: develop and interpret graphs, apply statistics, analyze data
3. Use modeling and simulation: analyze data, understand stochasticity
4. Appreciate the interdisciplinary nature of science: understand the role of other sciences in evolution and vice versa
5. Communicate and collaborate: scientific writing, explaining concepts, collaborative learning and research
6. Understand the relationship between science and society: relate social contexts to evolutionary problems, use evolution to help address societal problems
7. Apply situational skills while coordinating with classmate colleagues during active learning opportunities and discussion.
8. Apply critical thinking to reason through problems, evaluate information, and draw appropriate conclusions.

Note: *A copy of this syllabus can be found on our course Canvas page (Canvas/BZ220/Syllabus). That document has embedded links to the webpages referred to throughout.*

BZ220 – Introduction to Evolution Spring 2020 COURSE SCHEDULE

| WEEK | DATE | LECTURE | READINGS | QUIZZES | DISCUSSIONS* |
|-------------------------------|----------|--|---|---|--|
| MICROEVOLUTION (DR. FORSYTHE) | | | | | |
| 1 | Tu, 1/21 | Course Intro <i>and</i> Understanding the Science of Evolution | Ch. 2 (Sec. 2.1-2.3) | PRACTICE QUIZ (0pts) DUE: Fri. 1/31 | - No discussion sessions - |
| | Th, 1/23 | Evidence for Evolution | Ch. 2 (Sec. 2.3-2.4) | | |
| 2 | Tu, 1/28 | More Evidence for Evolution and Misconceptions | Ch. 3 (Sec. 3.7) Antolin & Herbers (2001)* | QUIZ 1 (10pts) DUE: Fri. 2/7 | (A) 1/30 → 9am (B) 1/30 → 1pm Gould & Lewontin (1979). <i>The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme.</i> |
| | Th, 1/30 | Mendel, Heredity and The Modern Synthesis | Ch. 3, 9 (Sec. 3.6, 9.1) | | |
| 3 | Tu, 2/4 | Mutation | Ch. 5 (Sec. 5.1-5.5) | QUIZ 2 (10pts) DUE: Fri. 2/14 | (C) 2/4 → 9am (D) 2/4 → 10am Pigliucci & Finkelman (2014). <i>The extended (evolutionary) synthesis debate: where science meets philosophy.</i> |
| | Th, 2/6 | Population Genetics: Hardy-Weinberg | Ch. 5, 6 (CC+ 5.2, Sec. 6.1) | | |
| 4 | Tu, 2/11 | Natural Selection 1 | Ch. 3, 6 (Sec. 3.1-3.3, 3.5, 6.3) | QUIZ 3 (10pts) DUE: Fri. 2/21 | (E) 2/12 → 3pm (F) 2/12 → 4pm Uy et al. (2016). <i>Mutations in different pigmentation genes are associated with parallel melanism in island flycatchers.</i> |
| | Th, 2/13 | Natural Selection 2 | Ch. 3, 9 (Sec. 3.4, 9.3-9.6) | | |
| 5 | Tu, 2/18 | Mutation-Selection Balance and Migration | Ch. 6, 7 (Sec. 6.4, 7.1) | QUIZ 4 (10pts) DUE: Fri. 2/28 | (G) 2/21 → 9am (H) 2/21 → 1pm Bush et al. (2019). <i>Host defense triggers rapid adaptive radiation in experimentally evolving parasites.</i> |
| | Th, 2/20 | Genetic Drift | Ch. 7 (Sec. 7.2) | | |
| 6 | Tu, 2/25 | Non-Random Mating & Inbreeding Depression | Ch. 7 (Sec. 7.4, 7.5) | QUIZ 5 (5pts) DUE: Fri. 3/6 | (I) 2/26 → 11am (J) 2/26 → 12pm Spoelstra et al. (2016). <i>Natural selection against a circadian clock gene mutation in mice.</i> |
| | Th, 2/27 | FIRST PRELIMINARY EXAM (material through 2/20) | | | |
| 7 | Tu, 3/3 | Evolution of Social Behavior | Ch. 12 (Sec. 12.1-12.2, 12.4-12.5) | QUIZ 6 (10pts) DUE: Fri. 3/13 | (K) 3/3 → 4pm (L) 3/3 → 5pm Hendrick, Smith, & Stahler (2016). <i>Negative-assortative mating for color in wolves.</i> |
| | Th, 3/5 | Life History Evolution | Ch. 13 (Sec. 13.1-13.5) | | |
| 8a | Tu, 3/10 | Evolution and Medicine | Ch. 14 (Sec. 14.1-14.7) | | (M) 3/12 → 4pm (N) 3/12 → 5pm Dogantzis et al. (2018). <i>Insects with similar social complexity show convergent patterns of adaptive molecular evolution.</i> |
| MACROEVOLUTION (DR. NEUWALD) | | | | | |
| 8b | Th, 3/12 | Evolutionary Processes and Conservation | Crandall <i>et al.</i> (2000)* Santamaria & Mendez (2012)* | QUIZ 7 (10pts) DUE: Fri. 3/27 | |

| SPRING BREAK (NO CLASS 3/17 & 3/19) | | | | | |
|-------------------------------------|----------|--|------------------------------------|--|--|
| 9 | Tu, 3/24 | Studying Adaptation | Ch. 10 (Sec. 10.1 – 10.6) | QUIZ 8 (10pts) DUE: Fri. 4/3 | (A) 3/25 → 11am (B) 3/26 → 9:30am Oliveri et al. (2015). <i>Why evolution matters for species conservation: perspectives from three case studies of plant metapopulations.</i> |
| | Th, 3/26 | Evolution of Sex | Ch. 8 (Sec. 8.3) | | |
| 10 | Tu, 3/31 | Sexual Selection 1 | Ch. 11 (Sec. 11.1 – 11.4) | QUIZ 9 (10pts) DUE: Fri. 4/10 | (C) 3/30 → 4pm (D) 3/30 → 5pm Blackledge et al. (2003). <i>Are three-dimensional spider webs defensive adaptations?</i> |
| | Th, 4/2 | Sexual Selection 2 | Ch. 11 (Sec. 11.1 – 11.4) | | |
| 11 | Tu, 4/7 | Estimating Evolutionary Trees 1 | Ch. 4 (Sec. 4.1 – 4.3) | QUIZ 10 (5pts) DUE: Fri. 4/17 | (E) 4/7 → 9am (F) 4/7 → 10am Girard et al. (2015). <i>Female preference for multi-modal courtship: multiple signals are important for male mating success in peacock spiders.</i> |
| | Th, 4/9 | SECOND PRELIMINARY EXAM (material through 4/2) | | | |
| 12 | Tu, 4/14 | Estimating Evolutionary Trees 2 | Ch. 4 (Sec. 4.1 – 4.3) | QUIZ 11 (10pts) DUE: Fri. 4/24 | (G) 4/15 → 11am (H) 4/15 → 12pm Zurano et al. (2019). <i>Cetartiodactyla: Updating a time-calibrated molecular phylogeny.</i> |
| | Th, 4/16 | Estimating Evolutionary Trees 3 | Ch. 4 (Sec. 4.4) | | |
| 13 | Tu, 4/21 | Mechanisms of Speciation | Ch. 16 (Sec. 16.1 – 16.4) | QUIZ 12 (10pts) DUE: Fri. 5/1 | (I) 4/23 → 9am (J) 4/23 → 10am Organ et al. (2008). <i>Molecular phylogenetics of mastodon and Tyrannosaurus rex.</i> |
| | Th, 4/23 | Origins of Life & Precambrian Evolution 1 | Ch. 17 (Sec. 17.1 – 17.2) | | |
| 14 | Tu, 4/28 | Origins of Life & Precambrian Evolution 2 | Ch. 17 (Sec. 17.3 – 17.4) | QUIZ 13 (10pts) DUE: Fri. 5/8 | (K) 5/1 → 1pm (L) 5/1 → 3pm Hoskin et al. (2005). <i>Reinforcement drives rapid allopatric speciation.</i> |
| | Th, 4/30 | The Fossil Record | Ch. 18 (Sec. 18.1-18.2, 18.4-18.5) | | |
| 15 | Tu, 5/5 | Human Evolution 1 | Ch. 20 (Sec. 20.1) | - No quiz - | (M) 5/8 → 11am (N) 5/8 → 12pm Wang et al. (2016). <i>Debris-carrying camouflage among diverse lineages of Cretaceous insects.</i> |
| | Th, 5/7 | Human Evolution 2 | Ch. 20 (Sec. 20.2 – 20.4) | | |
| 16 | T, 5/12 | FINAL EXAM (~65% new material [4/7-5/7] + ~35% cumulative) 2:00 – 4:00 PM in our regular classroom. Please do not make arrangements to leave CSU before this date! | | | |

* *These readings can be downloaded from Canvas*

+ *Computing Consequences sections of your textbook*

* *All discussion assignments are due 24hr. prior (e.g. 5/8 at 11am discussion assignment is due 5/7 at 11am). All discussions will be held in BIOLOGY 134. Students will sign up for one session each for Microevolution (A-N) and Macroevolution (A-N). Please refer to our Canvas site for details.*