

Molecular Ecology (Biology 327)

Spring 2021: TR 10 – 11:15 am

Course overview

Molecular ecology is a young and exciting field that is taking advantage of the rapid development of new techniques in molecular genetics as well as advances in the theoretical and statistical approaches to interpreting the wealth of molecular data now available. These new techniques permit ecologists and evolutionary biologists to address questions in a wide variety of research areas, including phylogeography, population genetics, conservation genetics, behavioral ecology, microbial ecology, adaptation, ecological genetics, hybridization, and speciation. By providing new tools for testing hypotheses, the employment of molecular markers has revolutionized many of these research areas. While molecular ecology is a technologically rich discipline, its roots, and indeed its relevance, lie in one of the oldest scientific pursuits—natural history. Observations of the natural variation within and between organisms inspire the research questions pursued by molecular ecologists. These research efforts utilizing molecular approaches often help provide answers relevant to another long-lived scientific pursuit—the study of evolutionary processes and patterns. Through this course, I hope that in addition to appreciating the tools that molecular ecology employs, you will also marvel at the fascinating stories of natural history, evolution, and diversity that molecular ecology can tell.

Course details

Instructor: Dr. Jennifer L. Apple (*she/her/hers*) Office: ISC 258 Lab: ISC 340
e-mail: applej@geneseo.edu Phone: 245-5442
Office hours: Online only, see Canvas for details

Instruction modality: Online with regular synchronous meetings via Zoom at our originally scheduled class time of 10 – 11:15 am on Thursdays

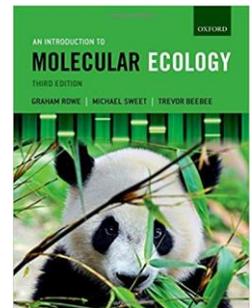
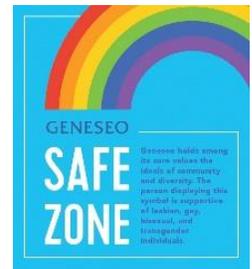
Course description from Bulletin: This course explores how molecular methods are used to address research questions in ecology. The techniques for generating molecular marker data as well as the properties and applications of different types of molecular data will be examined. Topics will include phylogeography, population genetics, conservation genetics, behavioral ecology, adaptation, ecological genetics, speciation, hybridization, and microbial ecology.

Prerequisites: Proficiency in Basic Requirements and Biol 203 and Biol 222

Course website: canvas.geneseo.edu

What you will need: Internet access, computer with Microsoft Word, Microsoft Excel, R, and RStudio installed; computer with webcam and microphone to participate in Zoom meetings (or smartphone)

Required text: *Introduction to Molecular Ecology* (3rd ed, 2017) by Graham Rowe, Michael Sweet, and Trevor Beebee (ISBN:978-0198716990).



Learning outcomes

Upon completion of this course, successful students will be able to:

- identify and describe the common contemporary molecular markers and analyses used to address ecological questions
- describe the wide range of research directions that comprise the field of molecular ecology and the common molecular and analytical approaches to these research questions
- interpret data from common analyses employed in molecular ecological studies by applying knowledge of molecular methods, evolutionary processes, and principles of population genetics
- effectively communicate the interpretation and significance of research findings
- thoughtfully discuss and evaluate the conclusions reached in scientific papers based on the presented results and proposed hypotheses
- explore, interpret, and synthesize the primary literature to develop a written proposal for addressing an original ecological or evolutionary research question using molecular tools

How this course will run

Course format and attendance expectations

This is an entirely online course with some **synchronous online sessions** that will be conducted via Zoom. As you registered for a course with a TR 10 – 11:15 am meeting time, you should continue to hold these periods free from other commitments. However, I recognize that any number of obstacles, from technological issues to family commitments, may prevent you from participating in any given synchronous session. If you are unable to attend, there will be no penalty, but you will still need to complete the assignments related to those synchronous sessions (or a make-up assignment) – it is up to you to be proactive in obtaining the instructions for those assignments so that you can submit them on time.

Synchronous sessions

Typically on **Thursday of each week**, we will have either a particular activity to complete to apply concepts from lecture and your reading assignments or discussions of primary literature, most of which will be led by your fellow classmates. I expect you to attend each session for its duration or until you complete the activity according to the instructions provided. Any introductory explanation I provide will be recorded, in case you cannot attend during the session, and you will still be required to complete the activity. Student presentations will also be recorded.

In general we will not meet synchronously on Tuesdays, though I will be available for online office hours at that time. It is expected that you will be viewing the week's posted lecture videos and doing course readings during the first half of the week. Each Wednesday, you will take a lecture/reading quiz. Performing these tasks will prepare you for each Thursday's activity.

How is your grade determined?

There are five main components to your course grade.

Exams. Both exams for this course (a mid-term and final) will be take-home exams. You will be given each exam at least one week in advance of its due date. The exams will include a combination of essay questions, problem-solving exercises, data analysis using population genetics

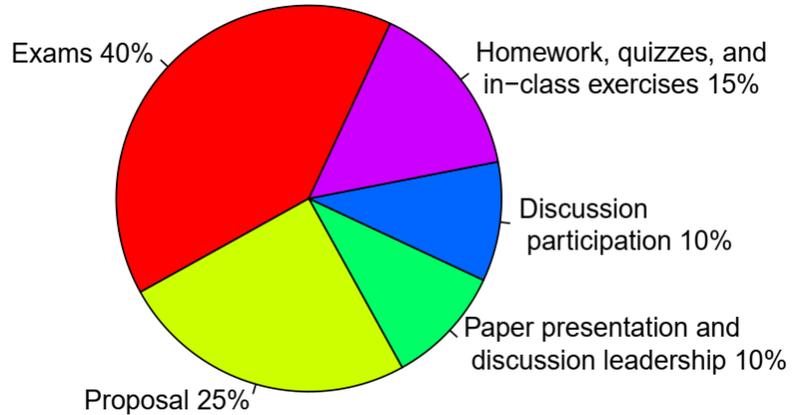
computer programs, and interpretation of data. You may use your textbook, notes, and other materials to answer these questions, but you may not discuss the exam with classmates or seek help from anyone in responding to the questions. (You may ask questions of me for clarification, if necessary.) You must cite information from all sources and observe the policy on plagiarism described below.

Written proposal. You will develop and write a proposal (8-12 pages) for a study that employs molecular tools to address a particular ecological or evolutionary question. The project you propose must be *original* and *feasible*. Detailed guidelines for this assignment are provided on [this Canvas page](#).

Paper presentation and discussion leadership. You will present and guide discussion (via Zoom) on a primary research paper. Your presentation should be a brief (≈ 15 minutes) but well-organized introduction to the paper which provides relevant background about the study system and research question(s) including reference to previous work from other studies. It should also provide a brief overview of the methods and include effective visual aids to enhance our understanding of the study system and approach. You will facilitate participation of all class members in the discussion of the paper by preparing engaging discussion questions. See [this Canvas page](#) for more details.

Participation in class discussions. We will be exploring the primary literature in molecular ecology through in-class discussion via Zoom of original research papers. Everyone should read the papers carefully and critically in preparation for these discussions. Verbal participation in these discussions is expected and will be 60% of your participation grade. On the day of the discussion, you must submit four thoughtful questions or comments for the paper being discussed that day; these questions/comments will not be accepted late since their purpose is to prepare you to discuss the paper in class. You will also be given a short quiz on the reading (based on questions posted in advance). Scores on this quiz and your written questions/comments will make up 40% of your participation grade.

Homework, quizzes, and in-class exercises. Throughout the course, we will have in-class activities (during synchronous Zoom sessions) or homework assignments that reinforce the concepts we are studying. Some of these exercises will require free software programs (including R and RStudio) commonly used by molecular ecologists. Intermediate assignments related to your proposal will count toward your homework grade. In addition to the weekly quizzes on the lectures/readings, you will have three longer online quizzes on the course material. These will consist of multiple-choice, true/false, fill-in-the-blank, or short answer questions. You will be given a specific study guide for each of these longer quizzes.



Grading scale

| | | |
|-------------|-------------|-------------|
| A 93-100% | B 83-86.9% | C 73-76.9% |
| A- 90-92.9% | B- 80-82.9% | C- 70-72.9% |
| B+ 87-89.9% | C+ 77-79.9% | D 60-69.9% |

I follow conventional rounding procedures, so a 92.94% would represent an A- (rounded down to 92.9%), while a 92.95% would be rounded up to 93.0% and an A.

How to be successful in this course

Health and well-being in a stressful time: take care of yourself

The changes brought on by COVID-19 have impacted us all in a number of ways and will continue to do so at various times and to varying degrees during the upcoming semester. Your health and well-being are foundational to your ability to learn, and if you find that you are feeling unwell (physically or mentally) and it is impacting your ability to complete your coursework, please reach out. Because the learning environment will be different than it has been in the past, the indicators that usually let you know something is wrong may not be as clear to you or those around you as they would be during a typical semester. Additionally, the ways in which you normally engage in self-care may have been disrupted. Please remember that it's never too late to ask for help. The [Dean of Students](#) (585-245-5706) can assist and provide direction to appropriate campus resources. The college also has collected resources in a [Coping with COVID webpage](#).

Adjust to the rhythm of the course

In an online course in which you access much of the course material on your own schedule, it is especially important that you establish a weekly rhythm in viewing lecture videos and doing course readings and keep up with weekly deadlines so that you do not fall behind. You are expected to pay attention to the syllabus, emails from me, and posted announcements on Canvas to keep pace with the course's activities. Here are some [helpful tips for students adjusting to online learning](#).

Keep up with the material

You will get more out of the class and our synchronous sessions if you view lecture videos and read the textbook and any supplementary reading in preparation for our Thursday synchronous session. To help keep you on track and test your understanding of the material, you will need to complete a short Canvas quiz by Wednesday night each week. These quiz will be selected or adapted from study questions that I will post via a Google Doc for each week's readings and lectures.

Participate in discussions

Sixty percent of your participation grade is based on your contributions to class discussions of primary literature. While you might find it intimidating to speak up in class, if you have read the papers and developed some questions and comments about what you read (as you are required to do before each discussion), you already will be prepared with something thoughtful to say. Discussions are more interesting when everyone participates – please do not think you can't make a valuable contribution!

Back up your work.

Do yourself a favor to avoid last-minute computer calamities and stress by saving your work frequently and backing up your files using some kind of cloud storage system like Google Drive, Dropbox, or some other service. CIT provides some [tips on data backup](#). Also, don't wait until the day before a deadline to get started!

Getting help with online classes

CIT has developed a [number of resources that can help you formulate good strategies for success in online courses](#). These include general strategies for keeping on track with your courses as well as more specific resources about learning experiences that you may encounter in an online course. The Office of the Dean for Academic Planning and Advising has also introduced the new KOALA ([Knights' Online Academic Learning Assistance](#)) course support resource. Throughout the semester, if you need help with online learning strategies, you can contact the KOALA support desk, which will assist you with identifying resources and strategies for success. CIT also provides a range of [technology support resources](#). When you are in Canvas, the Help menu on the left side of the screen will also direct you to a number of CIT supports, including self-help resources and options to request technology assistance.

Communicating with me

All of my office hours will be **online** this semester and conducted via Zoom video conference. I will have regular "walk-in" office hours which are first-come, first-served. You may have to wait in the Zoom "waiting room" until I finish with other students. I will also have scheduled 15-min office hour sessions that you can sign up for via my Google Calendar. See Canvas for details. If any of the posted times do not suit you, you can email me to set up another appointment for a video conference. When doing so, please suggest some possible times that you are available to meet in your email to make our correspondence more efficient. I can often answer questions by email as well, without the need for a video conference. Please feel free to contact me; I will try to get back to you within 24 hours.

Course policies

Attendance at "synchronous" online sessions

Accessing course materials online may be challenging - we've all experienced things like unforeseen emergencies and internet disruptions. Although this course includes some "live" or synchronous course activities, we can all be understanding about the challenges posed by the COVID-19 pandemic and the limits of technology. If you miss a synchronous session, please let me know as soon as possible so that we can discuss ways to keep you on track - it is your responsibility to get in touch with me in a timely manner to make up what you have missed. Note that you will not be subject to grading penalties if you are unable to attend scheduled synchronous online meetings due to pandemic-related obstacles, though you still must complete the work associated with those sessions. If you are experiencing longer-term disruptions, please be proactive in communicating with me and contact the Dean of Students if you expect to be out for an extended period of time.

Late work

Regular individual weekly activities (online quizzes, in-class activities, homework assignments) must be completed by their posted due dates for credit. Staying on track with these tasks is important to give you the tools to assess your progress in learning the material. It will also facilitate the timely posting of answers and return of graded work for all students. If meeting these deadlines becomes a problem for you, please discuss your situation with me. You can turn in these assignments late and still receive feedback, though depending on your timing you might not get work evaluated before the next unit quiz.

Graded homework assignments will be penalized by a loss of 5% of the total assignment's points possible per day and will not be accepted at all after graded work has been returned to students or answer keys have been provided. (But if you think you must turn in something late because of extenuating circumstances, feel free to discuss the situation with me and we can negotiate terms.)

Plagiarism and academic dishonesty

Plagiarism and other forms of academic dishonesty (cheating, turning in another student's work as your own) will not be tolerated. Evidence of academic dishonesty is grounds for a score of zero on any assignment and further action including notifying the department chair, Dean of Academic Planning and Advising, Dean of Students, and Student Conduct Board, which can result a report filed with the Dean of Students.

Plagiarism. According to the [Academic Dishonesty Policy in the Student Handbook](#), plagiarism includes the following:

1. direct quotation without identifying punctuation and citation of source;
2. paraphrase of expression or thought without proper attribution;
3. unacknowledged dependence upon a source in plan, organization, or argument.

In SUNY Geneseo's policy, "Plagiarism is the representation of someone else's words or ideas as one's own or the arrangement of someone else's material(s) as one's own." Take care to properly cite sources of ideas, figures, data, etc. (including internet sources) in your writing and presentations. Even if you properly cite your source, when you borrow wording and sentence structure from the original source and pass it off as your own (i.e., by not using quotation marks), you are guilty of plagiarism. Learn how to paraphrase in your own words information from the original source.

Working with students on homework. Although I do not mind if you work with other students on homework assignments, you must each produce original written answers to the questions and prepare or adapt code on your own (no copying and pasting from classmates). Identical or highly similar responses from two or more students suggest answers are being copied and all students may receive a zero or substantial penalty on the assignment. Feel free to collaborate and help each other, but always turn in your own work.

Online quizzes. It is my expectation that your work on quizzes. I will be attentive to any anomalies that suggest student collaboration on answers in these assessments. It is not appropriate to communicate with other students while taking quizzes, or share information about quiz questions and answers until the quiz has officially closed. As I am being flexible in giving you a window of time to complete these online quizzes, I expect you to respect the integrity of this form of academic assessment. Cheating only impedes your ability to learn and can have serious consequences.

Turnitin.com. To help you avoid plagiarism (intentional and unintentional), both the draft and the final version of your proposal will be subject to submission for textual similarity review to Turnitin.com . Turnitin.com generates originality reports that help you determine if you have inadvertently borrowed too much from your source material instead of paraphrasing appropriately. I encourage you to use these reports as a tool to help you use sources effectively and ethically. (Note that many of the matches that Turnitin identifies are coincidental and not of major concern.) You should be aware that all submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. Use of the Turnitin.com service is subject to the terms of use agreement posted on the Turnitin.com site.

Copyright statement

Many of the materials that are provided to students in this course have been created by me. Students would be best to assume that all course materials are protected by legal copyright. Copyright will be indicated by a “© DATE AUTHOR” on the document. Copyright protection means that reproduction of this material is prohibited without the author’s consent. Thus, students are prohibited from sharing or posting copyrighted material to any websites outside our course Canvas site. Students are also prohibited from reproducing material to be shared with other more limited groups (*e.g.*, sorority/fraternity test bank).

Student success resources

Accessibility and accommodations. SUNY Geneseo is dedicated to providing an equitable and inclusive educational experience for all students. The Office of Accessibility will coordinate reasonable accommodations for persons with documented physical, emotional, or cognitive disabilities, as well as medical conditions related to pregnancy or parenting. Students with letters of accommodation should submit a letter to each faculty member at the beginning of the semester and discuss specific arrangements. Please contact the Office of Accessibility Services for questions related to access and accommodations: access@geneseo.edu, 585-245-5112, www.geneseo.edu/accessibility-office.

Bias-related incidents. The [Community Commitment to Diversity, Equity, and Inclusion](#) states, “We are here to listen, to learn, to teach, to debate, to change, to grow. We should all be safe to pursue these goals at SUNY Geneseo while being who we are. Together, we commit ourselves to pluralism, cultivating a community that respects difference and promotes a sense of inclusion and belonging.” If in the unfortunate instance you experience an incident of bias, we encourage you to reach out to the Chief Diversity Officer (routenberg@geneseo.edu) and/or our University Police Department. In trying to create an environment that facilitates growth through diverse thoughts and ideas, reporting incidents of bias - including threats, vandalism, and microaggressive behaviors - can help bring a better understanding of our campus climate as well as provide opportunities for learning and restoring harm.

The Department of Biology has pledged to develop more inclusive pedagogical practices and work to promote diversity in our curriculum while confronting racism, particularly ways in which science has been used to sustain it ([Biology Department’s Statement in Support of Racial Justice](#), also available on [Department of Biology website](#)). This course is no exception, and to help achieve these goals I will be highlighting the work of a diversity of scientists.

Student well-being. Prioritizing well-being can support the achievement of academic goals and alleviate stress. Eating nutritious foods, getting enough sleep, exercising, avoiding drugs and alcohol, maintaining healthy relationships, and building in time to relax all help promote a healthy lifestyle and general well-being.

Concerns about academic performance, health situations, family health and wellness (including the loss of a loved one), interpersonal relationships and commitments, and other factors can contribute to stress. Students are strongly encouraged to communicate their needs to faculty and staff and seek support if they are experiencing unmanageable stress or are having difficulties with daily functioning. The Dean of Students (585-245-5706) can assist and provide direction to appropriate campus resources. For more information, see [the Office of the Dean of Students website](#).

Mental health. As a student, you may experience a range of challenges that can impact your mental health and thus impact your learning; common examples include increased anxiety, shifts in mood, strained relationships, difficulties related to substance use, trouble concentrating, and lack of motivation, among many others. These experiences may reduce your ability to participate fully in daily activities and affect your academic performance.

SUNY Geneseo offers free, confidential counseling for students at the Lauderdale Center for Student Health and Counseling, and seeking support for your mental health can be key to your success at college. You can learn more about the various mental health services available on campus at health.geneseo.edu. Getting help is a smart and courageous thing to do -- for yourself and for those who care about you.

Other resources. Additional resources are available to support your academic success and well-being, including academic support services, library research help, computer and technology support, and food security. See the “Student Success Resources” link on the Canvas course page for more information about these services.

Molecular Ecology – Spring 2021 Course Schedule

Notes

- Lecture videos & reading: should be completed by Wednesday of each week
- Activities and discussions: in synchronous sessions at 10 – 11:15 am Thursdays via Zoom
- Due dates of regular lecture/reading quizzes (due Wednesday night) and smaller assignments not indicated on this schedule
- Deadlines are 11:59 pm of the day indicated
- Deadlines and topics covered subject to change; consult Canvas for most up-to-date information

| Week | Date | Topics & activities | Textbook reading* | Major assignments |
|--|--------|--|---|--|
| Module 1: Molecular markers & methods | | | | |
| 1 | 2 Feb | <i>Lecture topics:</i> Introduction to molecular ecology, Genome basics | 1: 1-25, 2: 26-35, 43-59 | |
| 1 | 4 Feb | <i>Activity:</i> what is molecular ecology? | | |
| 2 | 9 Feb | <i>Lecture topics:</i> Molecular markers I; evolutionary processes | 3: 64-90 | |
| 2 | 11 Feb | <i>Activity:</i> simulating evolutionary processes | | |
| 3 | 16 Feb | <i>Lecture topics:</i> Molecular markers II | 2: 36-43, 4: 91-122, 12: 392-409 | |
| 3 | 18 Feb | <i>Activity:</i> plagiarism, library research methods | | |
| Module 2: Population genetics | | | | |
| 4 | 23 Feb | <i>Lecture topics:</i> Genetic variation, HWE, effective population size, bottlenecks | 5: 122-138, 7: 206-220 | |
| 4 | 25 Feb | <i>Activity:</i> Hardy-Weinberg equilibrium | | Quiz #1: 26-27 Feb |
| 5 | 2 Mar | REJUVENATION DAY <i>Lecture topics:</i> Population structure, gene flow (lighter lecture load) | 7: 221-236 | |
| 5 | 4 Mar | <i>Activity:</i> population genetics data analysis | | |
| 6 | 9 Mar | <i>Lecture topics:</i> selection, gene flow, & drift | 7: 236-242 | |
| 6 | 11 Mar | <i>Discussion:</i> stickleback population genomics | | Proposal topic with 3 sources: 12 Mar |
| Module 3: Behavioral ecology | | | | |
| 7 | 16 Mar | <i>Lecture topics:</i> mating systems, parentage analysis | 6: 165-175 | |
| 7 | 18 Mar | <i>Discussion:</i> population genetics | | Quiz #2: 19-20 Mar |
| 8 | 23 Mar | <i>Lecture topics:</i> sexual selection, sex ratio, cooperative behavior, dispersal | 6: 175-205 | |
| 8 | 25 Mar | <i>Activity:</i> behavioral ecology data analysis | | Midterm exam due 26 Mar |
| Module 4: Adaptive genetic variation | | | | |
| 9 | 30 Mar | <i>Lecture topics:</i> Neutral vs. adaptive genetic variation, gene expression methods | 8: 243-260, 4: 111-115 | |
| 9 | 1 Apr | <i>Discussion:</i> behavioral ecology | | Outline & annotated bibliography - 2 Apr |

| Week | Date | Topics & activities | Textbook reading* | Major assignments |
|---|--------|--|--|-----------------------------|
| 10 | 6 Apr | <i>Lecture topics:</i> identifying adaptive genetic variation - genomic approaches, QTL analysis | 8: 261-277 | |
| 10 | 8 Apr | <i>Activity:</i> data interpretation | | |
| Module 5: Phylogeography | | | | |
| 11 | 13 Apr | <i>Lecture topics:</i> gene genealogies, trees, networks, phylogeographical patterns | 9: 278-295 | |
| 11 | 15 Apr | <i>Discussion:</i> adaptive genetic variation | | |
| 12 | 20 Apr | <i>Lecture topics:</i> Testing phylogeographical hypotheses | 9: 295-321 | |
| 12 | 22 Apr | REJUVENATION DAY | | Proposal draft due 23 Apr |
| Module 6: Conservation genetics | | | | |
| 13 | 27 Apr | <i>Lecture topics:</i> genetic diversity, inbreeding; conservation strategies | 10: 322-354 | |
| 13 | 29 Apr | <i>Discussion:</i> phylogeography | | Peer evaluations due 30 Apr |
| 14 | 4 May | <i>Lecture topics:</i> Metagenomics, microbial ecology, microbiomes | 11: 355-391; 12: 429-432 | |
| 14 | 6 May | <i>Discussion:</i> conservation genetics | | Quiz #3: 7-8 May |
| Module 7: Metagenomics & microbial ecology | | | | |
| 15 | 10 May | <i>Lecture topics:</i> New directions (note: a Monday; follows Tuesday schedule) | 13: 462-468 | |
| 15 | 12 May | <i>Discussion:</i> metagenomics & microbial ecology (note: a Wednesday; follows Thursday schedule) | | Final proposal due |
| Finals week | | | | |
| | 14 May | Presentations of proposal ideas (12 – 2:30 pm) | | |
| | 20 May | Last day of the semester | | Final exam due |

* Chapters refer to the textbook, *An Introduction to Molecular Ecology*, 3rd edition, by Rowe et al. Readings for discussions are available on the course website at canvas.geneseo.edu. Additional readings from other sources may also be assigned and will be posted on Canvas.

The course schedule, reading assignments, and due dates may be revised throughout the semester as adjustments are needed. Updates will be posted on Canvas.