

# Molecular Ecology (Biology 327)

## Spring 2022

(T R 8:30 – 9:45 am ISC 136)

### 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.

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### 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: Mon 1-2 pm (by appt via Google Calendar), W 1:30-2:30 pm  
In-person (**in ISC 107**) or online: R 10-11 am

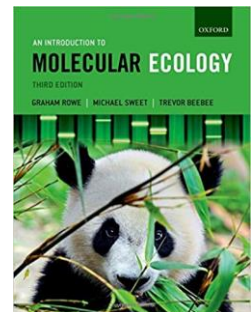
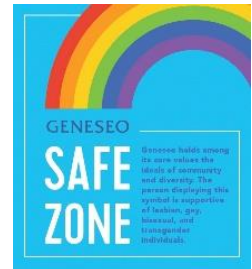
Course description from Bulletin: This course explores how molecular methods are used to address research questions in ecology. The techniques for generating molecular marker data as well as the properties and applications of different types of molecular data will be examined. Topics will include phylogeography, 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](https://canvas.geneseo.edu)

What you will need: Internet access, computer with Microsoft Word, Microsoft Excel, R, and RStudio installed, Top Hat account ([www.tophat.com](http://www.tophat.com), join code 615284)

Required text: *Introduction to Molecular Ecology* (3<sup>rd</sup> 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 approaches to these research questions
- interpret data from common analyses employed in molecular ecological studies
- 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

## COVID-19 related considerations

### Attendance expectations and public health

In the context of the COVID-19 pandemic, it is vital that we all do what we can to protect the health and safety of each other. If you are experiencing symptoms associated with COVID on a day that class meets in-person, do not attend. Remember that it is better to stay home if you are not feeling well than to attend class and risk spreading illness to others. I will also follow this advice, so if I do not feel well, I may run a class through Zoom or post a recorded lecture instead of holding class in-person. Throughout the semester, please be proactive in communicating about absences. I can support you in keeping up with class if you are out for COVID-related reasons, but I need you to take responsibility for being transparent and clear in letting me know when you are out and why. Also please remember that we are primarily a face-to-face institution. Although I can work with you on keeping up, you may miss some course content and extended absences may impact your ability to realize your full potential in this class. For extended absences (i.e., more than a couple of days of classes), you should contact the Dean of Students who can assist with reaching out to your professors about challenges you face and accommodations you may require.

### 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**. 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, [www.geneseo.edu/dean\\_students](http://www.geneseo.edu/dean_students)) can assist and provide direction to appropriate campus resources. The college also has collected resources in a [Coping with College webpage](#).

## Face masks

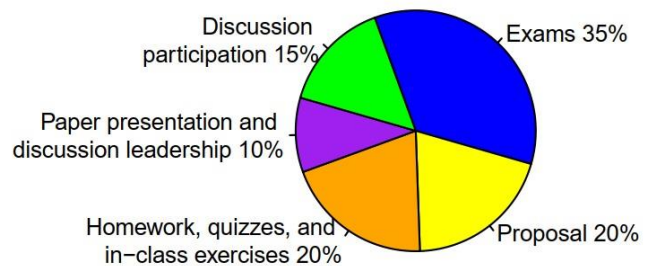
According to [current campus policy](#), face masks are required in all instructional spaces (including classrooms, lecture halls, and laboratories) and all common areas including residence halls and academic buildings. If you forget your mask, please be sure to pick up a disposable one before entering the classroom. Masks must be worn for the duration of class sessions and must cover both your mouth and your nose. If you do not have a mask or are unwilling to wear one properly, you will be asked to leave the classroom. I cannot safely hold class if all students are not wearing face masks properly. If my teaching could be more accessible if I wear a clear face mask, please let me know as soon as possible. Students who have concerns about wearing a face mask due to a documented disability need to contact the Office of Accessibility Services ([access@geneseo.edu](mailto:access@geneseo.edu)) to request reasonable accommodations.

## **How is your grade determined?**

There are five main components to your course grade.

### Exams (35% of grade)

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 (20% of grade)

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 Canvas.

### Paper presentation and discussion leadership (10% of grade)

You will work with a partner to present and guide discussion on a primary research paper. Your presentation should be a brief ( $\approx 15$  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 and your partner will facilitate participation of all class members in the discussion of the paper by preparing engaging discussion questions. See Canvas for more details.

### Participation in class discussions (15% of grade)

We will be exploring the primary literature in molecular ecology through in-class discussion 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 hand in four thoughtful questions or comments (a typed, hard copy) for *each* 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 in-class 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 (20% of grade)

Throughout the course, we will have in-class activities or homework assignments that reinforce the concepts we are studying. Some of these exercises will require your laptop computers, as we work with software commonly used by molecular ecologists. Some in-class activities may require additional work outside of class that you will turn in as homework. Intermediate assignments related to your proposal will count toward your homework grade. In addition to the frequent “mini-quizzes” on daily reading, you will have three longer in-class 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 study guide for each quiz.

### COVID-19 contingencies

We must be flexible in this course as public health considerations might force us to make changes to how this course runs over the course of the semester. If restrictions on face-to-face interactions interfere with course activities, some of the assignments described above may be altered or replaced, the means of content delivery may change, and the course schedule may require revision. If this is the case, be assured that my priorities are student success, course continuity, and accessibility of information.

### 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**

#### Come prepared to class sessions

In addition to learning course material beyond what is presented in the textbook, class sessions often consist of activities that reinforce course content and practice skills that you will need to demonstrate on exams. You will get more out of the class and each class session if you read the textbook and any supplementary reading by the date indicated on the syllabus. On most days you will be given a graded mini-quiz (1-2 questions) about the day’s reading. These mini-quiz questions will be selected from study questions that I will post via a Google Doc for each day’s reading. They will likely be administered via

Top Hat ([www.tophat.com](http://www.tophat.com), join code 615284), which you can access using a smartphone, tablet, or your laptop. I will update reading assignments in class as adjustments in our schedule require; additional supplementary readings may be posted on Canvas. On some days I might ask you to bring in your laptops so that we can practice data analysis using freely available software; make sure your computer battery is charged and install any necessary software as instructed for these activities. It is your responsibility to check Canvas and your e-mail frequently for course-related announcements. Make sure you set your notifications in Canvas to keep up to date with course activities.

### Take advantage of course resources and study aids

I continually update a Google doc with study questions that you can use to help guide your review of course material and prepare for mini-quizzes and reading quizzes on the primary literature papers (available in a Google drive folder; you might want to make your own copy to create a version you can edit). PDFs of the lecture slides are also posted in a Google drive folder.

### 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!

### Come see me if you need help!

*Office hours.* Some 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 will also hold some in-person office hours at a set time in our lab room, ISC 107. Generally, I will not meet with students for office hours in my office.

*Email communication.* I can often answer your questions by email as well. I will try to get back to you within 24 hours.

### 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, OneDrive, 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!

### Respect our learning environment

Please help promote an effective learning environment by avoiding distractions and disruptions to others. Silence your cell phone and refrain from texting/browsing while in class except when phone use

is needed for class participation (i.e., Top Hat questions). I will permit the use of laptops for taking notes (and of course in-class activities that require them) but will ask you to turn them off if I see they are not being used for classroom activities and/or are distracting to others. Please be courteous to me and your classmates by arriving on time.

### **Diversity and inclusion**

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 scientists of diverse identities and backgrounds in the field of molecular ecology. I hope to create an inclusive and supporting learning environment in which anyone can succeed, regardless of your identity (race, gender, ethnicity, sexual orientation, age, socioeconomic status, religion, and ability). I want to provide for students' growth as scientists and learners and promote a sense of belonging.

### **Land acknowledgment**

The SUNY Geneseo campus is located in the historic homelands of the Seneca Nation of Indians and Tonawanda Seneca Nation. As stated in the [Community Commitment to Diversity, Equity, and Inclusion](#), "we at SUNY Geneseo have an obligation to recognize all who, through history or identity, have been marginalized or oppressed, made invisible or silenced."

### **Other course policies**

#### **Late work**

Completion of the assignments in a timely manner is important for understanding and applying course content. Graded assignments will be penalized by a loss of 5% of the total assignment's points possible per day. 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 (<https://www.geneseo.edu/handbook/academic-dishonesty-policy>), 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.

Turnitin.com. To help insure against 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 for the detection of plagiarism. Note 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 to ensure equal access to academic programs, activities, and services at Geneseo. Students with letters of accommodation should submit a letter to each faculty member and discuss their needs at the beginning of each semester. Please contact the Office of Accessibility Services for questions related to access and accommodations: [access@geneseo.edu](mailto:access@geneseo.edu), 585-245-5112, [www.geneseo.edu/accessibility-office](http://www.geneseo.edu/accessibility-office).

Reporting bias-related incidents. Here at SUNY Geneseo, we want to provide a space where everyone feels welcome to learn and grow in their identities as well as in their role as students, faculty, and staff. If in the unfortunate instance you experience an incident of bias, we encourage you to reach out to the we encourage you to reach out to the Chief Diversity Officer ([routenberg@geneseo.edu](mailto:routenberg@geneseo.edu)), Interim Director of Multicultural Affairs ([nweathers@geneseo.edu](mailto:nweathers@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.

Student well-being and mental health. 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.

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](http://health.geneseo.edu). To request a counseling appointment, please complete the online form through [myhealth.geneseo.edu](http://myhealth.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](#), food security support, and emergency funding. See the “[Student Success Resources](#)” link on the Canvas course page for more information about these services.

### Molecular Ecology – Spring 2022 Course Schedule

<b>Date</b>	<b>Topic/activity</b> (module indicated in blue)	<b>Reading *</b>	<b>Major assignments</b>
Th 1-27	Introduction to molecular ecology		
T 2-1	<b>Molecular markers &amp; methods:</b> molecular biology/genetics background	<b>1:</b> 1-25, <b>2:</b> 26-35, 43-59	
Th 2-3	<b>Molecular markers &amp; methods</b>	<b>2:</b> 36-43; <b>3:</b> 64-90	
T 2-8	<b>Molecular markers &amp; methods**</b>	<b>4:</b> 91-122	
Th 2-10	<i>Simulating evolutionary processes**</i>	<b>5:</b> 122-138	
T 2-15	Literature research methods**; <b>Population genetics:</b> genetic diversity	<b>7:</b> 206-214	
Th 2-17	<b>Population genetics:</b> HWE; effective population size, bottlenecks	<b>7:</b> 215-220	Quiz #1 – molecular markers & methods
T 2-22	<b>Population genetics:</b> population subdivision	<b>7:</b> 221-230	
Th 2-24	<b>Population genetics:</b> gene flow, landscape genetics	<b>7:</b> 231-242	Proposal topic with 3 primary sources due <b>Friday, Feb 25</b>
T 3-1	<b>Population genetics:</b> <i>data analysis**</i>	TBA	
Th 3-3	<i>Discussion:</i> instructor-led; <b>Behavioral ecology:</b> parentage	See list; <b>6:</b> 165-175	<b>Revised proposal topic due Friday, Mar 4</b>
T 3-8	<i>Discussion:</i> Population genetics	See list	
Th 3-10	<b>Behavioral ecology:</b> relatedness, mating systems, cooperative behavior	<b>6:</b> 175-205	Quiz #2 – population genetics



<b>Date</b>	<b>Topic/activity</b> (module indicated in blue)	<b>Reading *</b>	<b>Major assignments</b>
<b>SPRING BREAK March 14 – 18</b>			
T 3-22	<b>Behavioral ecology:</b> trophic interactions; <i>behavioral ecology data analysis**</i>	<b>5:</b> 139-164	
Th 3-24	<b>Adaptive genetic variation:</b> defining neutral vs. adaptive variation; measuring gene expression	<b>8:</b> 243-260; <b>4:</b> 111-115;	Midterm exam due <b>Monday, Mar 28</b>
T 3-29	<b>Adaptive genetic variation:</b> genomic approaches	<b>8:</b> 261-277	
Th 3-31	<b>Adaptive genetic variation:</b> examples	See list	
Th 4-5	<i>Discussion:</i> Behavioral ecology	See list	Outline & annotated bibliography due <b>Wed, April 6</b>
Th 4-7	<b>Phylogeography:</b> generating genealogical data	<b>9:</b> 278-295	
T 4-12	<i>Discussion:</i> Adaptive genetic variation	See list	
R 4-14	<b>Phylogeography:</b> interpreting trees, networks	<b>9:</b> 295-321	
T 4-19	<b>Conservation genetics:</b> genetic diversity, inbreeding	<b>10:</b> 322-338	Proposal draft due
Th 4-21	<b>GREAT Day – no class</b>		<b>Wednesday, Apr 20</b>
T 4-26	Peer review panels: <i>discuss proposal drafts**</i>		Peer reviews due
Th 4-28	<i>Discussion:</i> Phylogeography	See list	
T 5-3	<b>Conservation genetics:</b> conservation strategies**	<b>10:</b> 339-354	
Th 5-5	<b>Microbial ecology &amp; metagenomics</b>	<b>11:</b> 355-391	
T 5-10	<b>Microbial ecology &amp; metagenomics:</b> special topics	TBA	Quiz #3 – adaptive genetic variation, phylogeography, conservation genetics
R 5-12	<i>Discussion:</i> Microbial ecology	See list	Proposal due <b>Thursday, May 12</b>
T 5-17	Final exam period, 8 – 10:30 am: short proposal presentations		Final exam due <b>Wednesday, May 18</b>

\*\* bring laptop computer to class

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