BIOL 4494/5494 – Fall 2019

Population and Evolutionary Genetics

Course Catalog Description: Introduces the genetic processes underlying evolutionary change in microbial, plant and animal populations. Topics include: sources of variation, Hardy-Weinberg equilibrium, population genetic structure, natural selection and other evolutionary forces, quantitative genetics and molecular phylogenetics. Emphasis on experimental data. Prereq: One year of general biology and general genetics with grades of "C-" or higher. Cross-listed with BIOL 5494.

Logistics

Instructor:	Gregory Ragland, Ph.D.	**Office:** Science 4113	
E-Mail:	gregory.ragland@ucdenver.edu	**Phone:** 303-315-7673	
Course time:	Lecture: Tues, Thurs 3:30 – 4:45 PM		
Course location:	North Classroom 2001	**Canvas:** https://ucdenver.instructure.com/courses/417570	
Drop in Hours:	Tuesday and Thursday, 12– 1:00 PM or by appointment		

Prerequisites: BIOL 2051, BIOL 2061, and BIOL 3832 with a grade of C- or higher. A course in biostatistics would be helpful, but is not required. This prerequisite material will **not** be extensively reviewed in class. Please arrange to meet with the instructor if you are concerned about your preparation in any of these areas.

Course Communication: I will primarily use Canvas for all communications; please make sure that your current email address is correct in Canvas, and that you have your settings adjusted to receive notifications. **Please do not e-mail me directly;** use the Canvas messaging system. I will bounce e-mails back to you and request that you use Canvas. I am not trying to avoid you – this is the best way for me to be sure that your message does not get buried under the monstrous stack of regular e-mail I receive every day. Canvas messaging should primarily be used to arrange meetings outside of office hours. Any issues with grades or grade changes must be communicated in-person. Please do not message content-based questions; post those questions to the appropriate discussion forum on canvas, attend drop in hours, or schedule an appointment to discuss.

Required Materials:

None to purchase, but we will rely heavily on a Coursera module that is free to audit, including lecture material and online quizzes. If you would like a text as a reference, I use the third edition of Principals of Population Genetics by Hartl and Clark, but a more modern, post-genomic era text would be An Introduction to Population Genetics: Theory and Applications by Nielson and Slatkin (1st edition).

Coursera module: Introduction to Genetics and Evolution
Author: Mohammed Noor, Duke University

https://www.coursera.org/learn/genetics-evolution

Dr. Noor is a leading authority on evolutionary genetics, and the available videos cover base materials that we will use to expand upon and apply to problem sets and discussions of primary literature during our class meetings.

Internet-capable device, preferably one you can type with. We may occasionally do some internet/library based research in class, but in the last three weeks of the semester, we will workshop individual projects in each of our class meetings. You will need access to software, documents, code, etc. in order to perform this work.

Class Format: We will be 'flipping' the classroom. To those unfamiliar, this means that you will view/read material that would be presented as a lecture in a traditional lecture-style class **BEFORE** class meetings. This will allow us to use our class meetings to expand upon more complex concepts, and more importantly, to apply new knowledge to solve problems or engage in discussions that will model formal assessments (i.e., quizzes). The Coursera modules will essentially replace text book reading, though we will still have reading assignments as well, mostly using primary scientific literature. Population genetics, lecture style courses have been around long before I was born, and Dr. Noor has produced an excellent, basic version that would be silly to try and reinvent. Rather, we will use that material as a stepping off point, much as you would traditional text book readings. This raises two important points:

1) It is critical that you complete the assigned videos/readings prior to class. We start where they leave off, so if you do not keep up with your 'homework', it will be extremely difficult to keep up.
2) Come to class prepared to 'do' rather than to passively listen. I will present some short 'lecture' segments, but we will spend the bulk of our time discussing, working problems, or researching in class.

Finally, the last ~3 weeks of the course will be devoted almost entirely to workshopping individual projects that will culminate in a final report and a presentation.

Attendance will be crucial to success in the course. That being said, I will not be taking attendance, so please take responsibility for your own learning.

Instructor's Description

Genes clearly influence nearly every aspect of organismal form and function. Yet, we would have learned very little about how genes affect physical appearance, physiology, disease susceptibility, etc., if genes were not variable. Likewise, all biology classes would be extremely boring if not for genetic variation, the 'fuel' that drives evolution. This course focuses on genetic variation; specifically, how do we leverage variation to learn about the process of evolution and the relationship between genetic variants and important traits. The backbone of the study of variation is deceptively simple – all variation can be traced to differences in the number and order of just four nucleotides that are the genetic code. This course will start there, with the basics, then use simple models and summaries of seminal experiments to illustrate more complex, emergent properties of evolving populations. Massive advances in sequencing technology have enabled us to explore variation on genome-wide scales unimaginable even a few decades ago; throughout the course we will use examples and data made possible by this so-called Next Generation Sequencing (NGS). In addition to discoveries made from genetic model organisms, we will emphasize human variation and applications in human evolutionary history and disease genetics.

Course Goals

By the end of the semester, students will be able to:

1) Recognize and explain the distinction between genetic control of phenotypes and genetic variation for phenotypes
2) Infer genetic drift, gene flow, and natural selection from standard population genetic models
3) Infer different modes of evolution from standard models of molecular evolution
4) Interpret primary literature presenting population and evolutionary genetic data and analyses
5) Design an analysis pipeline to perform Genome Wide Association Studies (GWAS) based on full genome resequencing data, and interpret the results

Assessment

Grades will be based on the following assessments:

Assessment	Percentage of Final Grade
Quizzes (3 total)	30
Discussion (lead and participation)	20
Problem sets	20
Final project	30

Final grades will be based on the following standard scale:

A	93 – 100 %	Superior/Excellent	D+	67 – 69.9 %	Minimum passing	
A-	90 – 92.9 %		D	63 – 66.9 %		
B+	87 – 89.9 %		D-	60 – 62.9 %		
B	83 – 86.9 %	Good/Better than average	F	< 60 %	Failing	
B-	80 – 82.9 %					
C+	77 – 79.9 %	Competent/Average				
C	73 – 76.9 %					
C-	70 – 72.9 %					

You will have access to your grades via Canvas as we progress through the semester. Please note that there will be no negotiation about changes in final grades. A curve will be implemented, at the instructor's discretion, if the class average falls far below a mean of 70% at the time the final grades are calculated.

Grade Disputes: Any disputes with grades reported on the Canvas grade book for any assignment must be reported to the instructor within 1 week of the grade being posted. Problems will be resolved in a timely manner.

Re-Grade Policy: Mistakes do occasionally happen while grading. Students will be offered the opportunity to request that specific exam or quiz questions be re-graded. Each requested question will be re-graded in its entirety. The instructor will add *or* subtract points if too few or too many points, respectively, were awarded the first time the question was graded. **Re-grade requests must be made in-person (see 'communication' section).**

No extra credit: There's plenty to keep you busy; don't ask for more.

Exams

There will be three quizzes during the semester, each aligned with learning objectives achieved through Coursera material, readings, in-class discussions, and problem sets. The quizzes will mirror the types of questions on problem sets and the types of questions that we address during discussions of the primary literature. A good long-format answer will cohesively convey information, and not merely be a collection of relevant keywords. Full credit for a question will require a comprehensive answer.

I am generally able to return quizzes within 5 – 7 business days.

Missed Quizzes: There will be no makeup quizzes. If you miss one quiz with a valid, documented excuse, I may agree to grade you based on the averages of the remaining quizzes. Missing two quizzes will result in a failing grade for the course.

Coursera assignments and readings

Most classes through ~2/3 of the semester require viewing of Coursera videos and completion of online (ungraded) quizzes PRIOR to and in preparation for class. We will also periodically read peer-reviewed papers in preparation for class discussions and/or problem sets.

Problem Sets

We will work on three problem sets during class throughout the semester, each related to materials that will be assessed on the three quizzes. Each will have a final due date prior to a quiz, but we will progressively work our way through them during most class meetings. It's important that you keep up with the problem sets as we cover specific problems; we will not spend a lot of time reviewing old material once we've already covered it. There will be plenty of time in class to consult with me and other classmates as we work through current material.

Online Discussions

We will spend 4 class sessions discussing a paper from the primary scientific literature (there will be other readings that we will discuss less formally). Each of you will lead one of these discussions, which will include a brief summary followed by a moderated conversation of talking points that you and other students have found interesting, confusing, surprising, etc. Specific instructions will be given as we get closer to our first discussion.

Individual project

Each student will conduct an actual Genome Wide Association Study on real data, and relate the results to human population and disease dynamics. This is the only part of the course where grading for graduate students differs from grading of undergraduates; more specific instructions will follow later in the semester. The project will culminate with a written report and a brief presentation to the class.

Late assignments

All written assignments will have clearly defined deadlines and will be submitted through Canvas. If an assignment is turned in after this time but within 24 hours of the due date, the assignment will receive a maximum of 90% of the possible points. Each subsequent 24 hour period that the assignment is late will further reduce the maximum possible points by 10%. You will need to make arrangements with me to turn in late assignments. **Quizzes and the final project are the exceptions: turning either in late will result in a 0.**

Canvas course website

This class will use Canvas. The site is located at https://ucdenver.instructure.com/courses/417570. Log in with your university user name and password (it should be the same as you use for your email). If you have any problems please contact cuonlinehelp@ucdenver.edu the first week of class. The instructor cannot provide IT support. Canvas will be used to post relevant course material and links to scientific articles and other readings. The site should be checked regularly for course-related announcements and discussions. **You should make sure that you are receiving notifications** (account settings in upper right banner, then click on "Notifications" in the left-hand navigation). If you want it to, Canvas will text you, email you, send you a private tweet, use facebook notifications -- there's no excuse for not knowing what's going on in the course.

Respect your fellow students

Please remember that the classroom should be an environment conducive to learning. I will treat you with respect; please also treat your fellow students with respect. All electronic devices with an audible signal must be silenced during class. Text messaging not related to class or talking on your phone during class is not acceptable; you will be asked to leave the class. Class begins and ends on time. Adherence to the University of Colorado Denver Student Code of Conduct is expected.

Academic Dishonesty

Academic dishonesty is a serious offense that diminishes the quality of scholarship and the learning experience for **everyone** on campus.

CLAS Academic Dishonesty Policy: Students are required to know, understand, and comply with the CU Denver Academic Dishonesty Policy as detailed on the CLAS website. Academic dishonesty consists of plagiarism, cheating, fabrication and falsification, multiple submission of the same work, misuse of academic materials, and complicity in academic dishonesty. If you are not familiar with the definitions of these offenses, or wish to learn more, go to http://www.ucdenver.edu/academics/colleges/CLAS/faculty-staff/policies/Pages/AcademicIntegrity.aspx. This course assumes your knowledge of these policies and definitions. Failure to adhere to them can result in penalties ranging from failure of the assignment or the course to dismissal from the University; be informed and be careful. If this is unclear to you, ask me.

Plagiarism: Writing assignments will be checked automatically (via software) and manually (by me) for plagiarism. Papers/Quizzes that plagiarize the work of others will receive no points, may result in an 'F' grade for the course, and will be referred to Academic Ethic Committee. Copying and pasting from any source is **not acceptable**. The **only** exception are brief quotes that 1) appear in quotations marks in your paper, and 2) are properly cited.

Other Administrative Issues

Access, Disability, Communication: The University of Colorado at Denver is committed to providing reasonable accommodation and access to programs and services for students with disabilities. To be eligible for accommodations, students must be registered with the UCD Office of Disability Resources and Services (DRS) (North Classroom 2514; 303-556-3450, 303-556-4766 (TTY)). The DRS staff has experience assisting faculty in determining reasonable academic accommodations and coordinating these accommodations. I am happy to provide approved academic accommodations outlined in the DRS letter.

Students Called for Military Duty: If you are a student in the military with the potential of being called to military service and /or training during the course of the semester, you are encouraged to contact your school/college Associate Dean or Advising Office immediately.

Campus Closure: In the event that the campus is closed for any reason, any scheduled exam, activity or deadline will automatically be rescheduled for the next meeting of the course and the course syllabus will be adjusted if necessary. Closures on Auraria are announced and updated by the campus operator, (303) 556-2401. Students are also encouraged to enroll in the Auraria Campus Emergency Notification System:

http://www.ucdenver.edu/about/departments/UniversityPolice/Emergency_Management/Pages/RAVE.aspx

Incomplete Grade Policy: Incomplete grades will not be granted to avoid an undesirable grade in the course. The faculty in the College of Liberal Arts and Sciences have passed the following policy relating to the awarding of Incomplete grades. This CLAS policy is consistent with the UCD campus policy.

Incomplete grades (IW or IF) are not granted for low academic performance. To be eligible for an Incomplete grade, students must (1) successfully complete 75 percent of the course, (2) have special circumstances (verification may be required) that preclude the student from attending class and completing graded assignments, and (3) make arrangements to complete missing assignments with the original instructor. A CLAS Course Completion Agreement is required. Completion of a CLAS Course Completion Agreement is strongly required. Incompletes cannot be awarded that stipulate: (1) a student may repeat the entire course, (2) repeat or replace existing grades, (3) allow the student an indeterminate period of time to complete a course, or (4) allow the student to repeat the course with a different instructor. The CLAS Course Completion Agreement is available from the CLAS Advising Office, North Classroom 4002.

Biology Department Grievance procedure: If a student has a grievance with any aspect of a course, the first step is to meet with the instructor during office hours or by appointment to discuss the problem. This discussion should not take place by e-mail. Student and instructor should both maintain a professional, respectful demeanor during this discussion, and make an honest effort to listen carefully and to understand the other's viewpoint. In

laboratory courses, the next step in resolving a grievance after meeting with the teaching assistant may involve a discussion with the faculty member in charge of the laboratory course. If the grievance cannot be resolved by an honest and sincere dialogue between student and instructor, the student may then make an appointment to discuss the problem with the department chair. If still not satisfied, the student may appeal to the Associate Dean. No step in this process may be skipped. See also "Procedures for Student Grievances about Courses or Faculty, CLAS."

CLAS Academic Policies

For relevant university deadlines and procedures (such as the last day to withdraw from a course) as well as academic support sites, please see this website: https://clas.ucdenver.edu/faculty-staff/content/academic-policies and http://www.ucdenver.edu/student-services/resources/Registrar-dev/Documents/AcademicCalendars/AcademicCalendarFall2019.pdf

Disability and Access

For relevant policies and resources facilitating learning with any sort of disability, please see this website: https://clas.ucdenver.edu/faculty-staff/content/syllabi-statement-disability-and-access

Other resources: Academic Advising, Counseling, and tutoring

Weblink for lists of additional learning resources: https://clas.ucdenver.edu/faculty-staff/sites/default/files/attached-files/campus_supports_page_syllabus_insert.pdf

This syllabus is a contract, outlining what students can expect from the instructor, and what the instructor will expect of the students

I have read the syllabus and will abide by all course policies and deadlines:

Student Signature: _____

Date: _____