

Syllabus, Biology 454 - Evolutionary Genetics

University of North Carolina at Chapel Hill

Instructor: Todd Vision

What

This course is an introduction to the major principles of:

- Population genetics: how the distribution of genetic variation within and between populations is governed by the mutation, migration, genetic drift, and natural selection.
- Quantitative genetics: how changes in genotype affect continuously variable phenotypes.
- Molecular Evolution: how genomes, proteins, and molecular pathways evolve, and how molecules can be used to reconstruct the history of life.

Basic principles are applied to special interest topics in natural history, human biology, agriculture, and conservation.

3 credit hours.

When, Where

Tues-Thurs 12:30-1:45, New West 219

Who

Todd Vision, Associate Professor, 102 Coker Hall, 843.4507, tjv@bio.unc.edu, office hours: Tues 2-4pm

Prerequisites

To enroll in this course, you should have first have taken Biology 201 and Biology 202 or have received the permission of the instructor. It is assumed that you have had the equivalent of a semester course in biology that covered Mendelian genetics, Hardy-Weinberg equilibrium and the basic principles of evolutionary and molecular biology. Comfort with algebra and quantitative thinking is assumed. Facility with statistics, calculus and biochemistry will be helpful, but specific upper level coursework is not required.

Attendance and Preparation for Class

Attendance at lectures, and class participation, is an important component of success in this course and will contribute to the final grade. It is also expected that you will have read the assigned material prior to class. There may be occasional quizzes on the reading material in addition to the problem sets.

Textbook and Readings

The textbook for the course is Richard Halliburton (2004) Introduction to Population Genetics, 1st Edition (ISBN-10: 0130163805, ISBN-13: 9780130163806), published by Benjamin Cummings. It is available from Student Stores for \$134.60 new, \$100.95 used. Special topic readings will be posted on Blackboard.

Grading

- Class participation: 10%
- Quizzes: 10%
- Problem sets: 30%
- Research paper and presentation: 20%
- Midterm exam: 15 %
- Final exam: 15%

Scores will not be curved, but the number of points required for each letter grade will be determined at the end of the course. Undergraduate and graduate students will be graded on independent scales.

Problem sets

There will be three problem sets to help reinforce the quantitative aspects of the material. Much of evolutionary genetics is mathematical and effective learning requires hands-on exercise. Problem set answers will be submitted to Blackboard. You may obtain an extension up until 24 hrs prior to the due date, provided you have a compelling reason; otherwise, late problem sets will be given half-credit. You are encouraged to study in groups and work together on example problems. However, answers to all graded problems must be entirely your own work.

Student presentations and research papers

Early in the course, you will also choose a topic on which to write a ~3000 word research paper using at least three primary research papers. The purpose of this exercise is to hone your skills at research, writing and critical thinking by in-depth examination of a topic of particular interest to you.

Exams

Exams will be take-home and open-book, and will be administered using Blackboard. You will be provided with a list of useful equations so that you can focus effort on understanding the terms and relationships within each equation, and to know which one to apply to a given problem, rather than on memorization. Understanding the concepts, and exercising your own critical thinking, is vastly more worthwhile than memorizing equations or vocabulary. The problem sets will help to prepare you for these sorts of questions.

For undergraduates, an excused absence from an exam requires an official letter from the Dean's office; a documented visit to the health center is not sufficient.

Honor code

You are expected to abide by the UNC honor code and are required to attest to the honor pledge with all submitted work.

See [Class schedule](#)

Class Schedule, Biology 454 - Evolutionary Genetics

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Assigned readings listed after each topic, from Halliburton (2004) *Introduction to Population Genetics*

I. The Dynamics of Alleles & Genotypes

August

Background reading: Ch. 1 & App. A

25 - The Nature of Genetic Variation, Ch. 2.1-2.10
27 - Hardy-Weinberg Equilibrium, Ch. 3

September

1 - Multiple Loci, Ch. 4.1-4.2
3 - Applications to Human Variation, Ch. 4.3-4.4
8 - Natural Selection, Ch. 5.1-5.7
10 - Natural Selection cont'd, Ch. 5.8-5.10
15 - Mutation, Ch. 6.1-6.4
17 - Mutation cont'd, Ch. 6.5-6.7
22 - Problems in Mutation-Selection-Drift Equilibrium (guest preceptor)
24 - Genetic Drift, Ch. 7.1-7.5
29 - Genetic Drift, Ch. 7.6-7.10

October

1 - Inbreeding & Nonrandom Mating, Ch. 8
6 - Population Subdivision & Gene Flow, Ch. 9
8 - Coalescence, Ch. 11.3
13 - Natural Selection Revisited, Ch. 12.3-12.4, 12.6-12.10
15 - Problems in Advanced Population Genetics

Problem Set 1 due by October Oct 19 at 5pm

II. The Genetics of Phenotype Evolution

October, cont'd

20 - Quantitative traits, Ch. 13.1-13.2
22 - *Fall Break - no class*

Midterm Exam due by Oct. 26th at 5pm

- 27 - Phenotypic variance, covariance & correlations
- 29 - Selection on quantitative traits, Ch. 13.3-13.4

November

- 3 - Contributions of individual loci, Ch. 13.5
- 5 - Quantitative Trait Loci (QTL)
- 10 - The Maintenance of quantitative genetic variance, Ch. 13.6
- 12 - Problems in Quantitative Genetics

Problem Set 2 due by Nov. 16th at 5pm

- 17 - Special topic: Genetics of domestication

III. Evolution at the Molecular Level

November, cont'd

- 19 - Neutral Theory of Molecular Evolution, Ch. 10.1-10.3
- 24 - Detecting Selection on Genes & Proteins, Ch 10.4
- 26 - *Thanksgiving Break - no class*

Research Paper due by Nov 30th at 5pm

December

- 1 - Phylogenetics, Ch. 11.1-11.2
- 3 - Phylogenetics cont'd

Problem Set 3 due by Dec 7th at 5pm

- 8 - Special topic: Genome Evolution (*guest lecture*)

Final exam due Friday Dec. 18th at 12pm

See [Syllabus](#)