

BIOL 439
NATURAL SELECTION AND MICROEVOLUTION
Fall 2024

Course Description:

The course is focused on understanding how natural selection interacts with genetic and population processes to make organisms adapted to their environment and to create biological diversity. This course focuses on the core processes and mechanisms involved in adaptation and natural selection, extending to evolutionary genetics and genomics. Topics include: genetic variation, selection, drift and inbreeding, evolution of domestication, molecular evolution, aging, genealogy, human evolution. It will address evidence for adaptation and natural selection at the phenotypic, genetic/genomic level and at the molecular level.

Prerequisite / Co-requisite:

Essential prerequisites/co-requisite: BIOL 302/3.0 or BIOL 303/3.0) and a minimum GPA of 2.0 in the Biological Foundations List (BIOL 102/3.0; BIOL 103/3.0; BIOL 201/3.0; BIOL 202/3.0; BIOL 205/3.0; BIOL 206/3.0; BIOL 302/3.0; BIOL 303/3.0; BIOL 330/3.0; BIOL 334/3.0; BIOL 339/3.0; BIOL 341/3.0)

Learning Objectives:

The goal of Biology 439 is to provide (i) an exploration of the field of Evolutionary Genetics, (ii) a critical assessment of evolutionary ideas, (iii) experience in understanding research and literature around evolutionary genetics, (iv) experience presenting and discussing evolutionary biology. The course will review the foundations of evolutionary genetics, and the core processes and mechanisms involved in adaptation and natural selection. Tutorials will highlight hands-on approaches to research in evolutionary biology by working with real data and reading and discussing the literature.

By the end of the course, students will have:

- A strong understanding of evolutionary principles and main genetic mechanisms.
- An appreciation of the process of natural selection and adaptation, including the limits to adaptation.
- An understanding of how organisms adapt to their environment, including humans.
- An appreciation of the diversity of research and analytical approaches used to study evolutionary processes.
- Improved writing and presentation skills, including various formats (written, oral, graphic).

Texts:

THERE IS NO REQUIRED TEXTBOOK

Useful Textbooks:

Evolutionary Analysis by Jon C. Herron and Scott Freeman. Pearson Publishers.

Evolution: Making Sense of Life by Doug Emlen & Carl Zimmer. MacMillan Learning.

Other sources:

We will be reading selected articles from the primary literature, and other readings posted in OnQ.

Assessment (may be subject to minor changes):

Tests (15% x 2)	30%
Assignments (6% x3)	18%
Literature Discussion and Summary (4% x3)	12%
News Article	5%
Research Proposal	15%
Presentation	15%
Participation in class discussions	5%

Test 1 and 2 (15% each x 2) – 30%

In-class, not cumulative. Tests will consist of a mix of short answer and long answer questions. Emphasis will be on concepts and problem solving. Students will be allowed to use one page of notes.

Assignments (6% each x 3) – 18%

We will use virtual experiments to help understand and explore various aspects of the course material. The assignments will involve handing in a worksheet that will be assessed. You can ask questions about the worksheets during the tutorial sessions.

Literature Discussion and Summary (4% each x 3) – 12%

We will discuss 3 papers from the primary literature during tutorials. The papers will be selected to match the content of the lectures. For each paper you will hand in a brief summary of the paper and be expected to participate in discussion during tutorial.

News article – 5%

You will be responsible for finding a recent (<6 month old) news article about a current issue that involves evolution. You will hand in a 1-page summary of the article and give a short 5 minute presentation.

Research Proposal – 15%

You will choose an article from the primary literature to use as a focus study. You will briefly summarize the paper, and then design a follow up study and write a research proposal.

Presentation – 15%

You will be responsible for summarizing a research concept by making a creative presentation, which you will present to the class. You will also write a short research report on the topic.

Participation – 5%

You are expected to actively participate in class and tutorial discussions.

Due-dates, late, and missing assignments:

Tests have to be conducted during class time, unless you have an approved academic consideration. For all other assignments, you will be penalized 10% for each day that an assignment is late. Missing assignments will be given a 0. Please contact me if you have any questions.

Grading Method

In this course, all components will be graded using numerical percentage marks. Your course average will then be converted to a final letter grade according to Queen's Official Grade Conversion Scale:

Grade	Numerical Course Average (Range)
A+	90-100
A	85-89
A-	80-84
B+	77-79
B	73-76
B-	70-72
C+	67-69
C	63-66
C-	60-62
D+	57-59
D	53-56
D-	50-52
F	49 and below

Class Attendance

Your presence and participation in class contributes to the knowledge and skills that you will develop throughout this course. I expect that you attend class regularly, participate in class conversations and learning activities. These types of activities provide active engagement, promote a deeper understanding of the course content, and contribute to your success in this course.

Turnitin:

This course makes use of Turnitin, a third-party application that helps maintain standards of excellence in academic integrity. Students will be required to submit their course assignments to onQ through Turnitin. In doing so, students' work will be included as source documents in the Turnitin reference database, where they will be used solely for the purpose of detecting plagiarism.

Queen's Policy Statement on Academic Integrity

Queen's University is dedicated to creating a scholarly community free to explore a range of ideas, to build and advance knowledge, and to share the ideas and knowledge that emerge from a range of intellectual pursuits. Queen's students, faculty, administrators and staff therefore all have responsibilities for supporting and upholding the fundamental values of academic integrity. Academic integrity is constituted by the five core fundamental values of honesty, trust, fairness, respect and responsibility and by the quality of courage. These values and qualities are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University.

The following statements from "The Fundamental Values of Academic Integrity" (2nd edition), developed by the International Center for Academic Integrity (ICAI), contextualize these values and qualities:

1. **Honesty** Academic communities of integrity advance the quest for truth and knowledge through intellectual and personal honesty in learning, teaching, research, and service.
2. **Trust** Academic communities of integrity both foster and rely upon climates of mutual trust. Climates of trust encourage and support the free exchange of ideas which in turn allows scholarly inquiry to reach its fullest potential.
3. **Fairness** Academic communities of integrity establish clear and transparent expectations, standards, and practices to support fairness in the interactions of students, faculty, and administrators.
4. **Respect** Academic communities of integrity value the interactive, cooperative, participatory nature of learning. They honour, value, and consider diverse opinions and ideas.

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Accommodations for Disabilities

Queen's University is committed to working with students with disabilities to remove barriers to their academic goals. Queen's Student Accessibility Services (QSAS), students with disabilities, instructors, and faculty staff work together to provide and implement academic accommodations designed to allow students with disabilities equitable access to all course material (including in-class as well as exams). If you are a student currently experiencing barriers to your academics due to disability related reasons, and you would like to understand whether academic accommodations could support the removal of those barriers, please visit the [QSAS website](#) to learn more about academic accommodations or start the registration process with QSAS by clicking *Access Ventus* button at [Ventus | Accessibility Services | Queen's \(queensu.ca\)](#) To learn more go to: <https://www.queensu.ca/ventus-support/students/visual-guide-ventus-students>

SCHEDULE (May be subject to changes)

Week	Date	Topic	Assessments Due:
1	Sept 2 – 6	Introduction and review	
		Tutorial: None	
2	Sept 9 – 13	Selection in natural populations	
		Tutorial: Literature Discussion	Literature Summary
3	Sept 16 – 20	Phenotypic selection	
		Tutorial: Assignment	Assignment 1
4	Sept 23 – 27	Genomic approaches to selection	
		Tutorial: Literature Discussion	Literature Summary
5	Sept 30 – Oct 4	Local adaptation	
		Tutorial: None	
6	Oct 7 – 11	Adaptation	Test One
		Tutorial: Q&A with JF	
	Oct 14 - 18	READING WEEK: NO CLASS	
7	Oct 21- 25	Genetic correlation & trade-offs	
		Tutorial: Prepare for presentations	
8	Oct 28 – Nov 1	Creative Presentations	Creative Presentations
		Tutorial: None	
9	Nov 4 – 8	Genetic conflict	
		Tutorial: Assignment	Assignment 2
10	Nov 11 – 15	Human evolution	
		Tutorial: Literature Discussion	Literature Summary
11	Nov 18 – 22	Ancestry and coalescence	
		Tutorial: Assignment	Assignment 3
12	Nov 25 – 29	Invasives and domestication	
		Tutorial: None	
13	Dec 2 – 3	Test Two	Test Two
		Tutorial: None	Research Proposal