BIOC16 – Evolutionary Genetics & Genomics

Winter 2021

Lecture Tu 2:00PM – 4:00PM
Tutorial Th 1:00PM – 3:00PM

This course will be delivered entirely online

Instructor:	Dr. Kristen Brochu	Online Office Hours:	TBD (1.5 hours) or by appointment.
Teaching Assistant:	Nishant Singh nishant.singh [at] mail.utoronto.ca	Online Office Hour:	TBD

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

COURSE DESCRIPTION

Evolutionary genetics and genomics are critical disciplines in biology, focusing on the evolution of the structure and function of single genes, as well as the relationships of all genes combined to influence complex trait evolution at the genomics level. In this course, we will cover the fundamentals of modern ecological and evolutionary genetics and genomics, by examining three major themes:

1) The importance of scale

Scientists study genetics and genomics at scales from individual genes to whole genomes, as well as the genetic basis for phenotypes from simple mendellian traits to complex behaviours. We will explore how the forces of evolution affect each scale and how they are all connected.

2) Variation – the basis for evolution

Genetic variation is the basis for all evolution and we will examine the key forces that produce and maintain this variation at multiple scales (from genes to genomes), both within and between species.

3) Signatures of change

Many methods are used to quantify genetic and phenotypic changes, as well as the selection pressures acting on organisms. We will cover classic experimental studies that demonstrate critical concepts in evolutionary theory.

COURSE GOALS & OUTCOMES

The goal of this course is to enable students to apply insights gained from classic and modern genetic and genomic techniques to understand how variation is produced, maintained, and distributed within and among populations at multiple scales. By the end of the course, you will be able to:

A) Course Specific Knowledge

1. Describe the four agents of evolution and discuss how they influence variation at multiple scales
2. Calculate Wright's F-statistics, as well as compare and contrast the different evolutionary processes that influence population differentiation
3. Summarize common techniques in quantitative genetics
4. Outline the evolutionary significance of phenotypic plasticity
5. Explain the mechanisms of epigenetic gene regulation and their role in evolution
6. Apply the principles of positive selection to assess both genetic evolution in a population and evolutionary divergence between species

B) Inter-Disciplinary Competencies

7. Critique and synthesize information from cutting edge scientific papers
8. Justify the qualities that make an effective oral presentation and compose effective peer-feedback
9. Design an oral presentation to confidently present scientific information to your peers

GRADING & EVALUATION

If you have a question about your grade on any assignment, please make an appointment to discuss it with me outside of class. If you dispute a grade on any assignment, please submit a written description of the issue and make a case for why you believe the grade should be altered with reference to the assignment guidelines and grading rubric. I will consider your request and meet with you to discuss my decision. Requesting a reassessment of your work will never result in a lower grade on the assignment in question.

The breakdown of your final grade is as follows:

Assignment	Short Description	Points (/100)	Due Date	Learning Outcome Assessed
Participation	Attendance & participation in tutorial discussions	5	Weekly	7
Problem Set	Short set of multi-format problems on lecture material	5	Mar 16	1-6
Tutorial Presentation Peer Review	Peer-assessment for all other student tutorial presentations (9 sessions x 0.56 pts)	5	Weekly on Th	8
Tutorial Paper Critique	Summarize one paper and develop four discussion questions for each tutorial session (9 sessions x 1.67 pts)	15	Weekly on Th	7
Tutorial Presentation	Presentation of paper and discussion facilitation	15	Variable	7,8,9
Midterm Exam	Two hour exam consisting of multi-format questions (in class)	25	Feb 23	1-6
Final Exam	Three hour exam consisting of multi-format questions (during final exam period)	30	TBD	1-6

I will post a document on the course website describing the guidelines for all assignments as well as a grading rubric for the critique and presentations. Late assignments will not be accepted without a valid reason. Valid reasons include students who add the course after an assignment was due or are registered with AccessAbility.

REQUIRED TEXTBOOK
Conner & Hartl 2004. A Primer of Ecological Genetics. Oxford University Press.

COURSE WEBSITE
You can find all course materials online via Quercus.

LECTURES: Most lectures will be delivered as "chalkboard" discussions, where I will produce content (e.g. notes, calculations, and drawings) live during lecture. This means you must attend class to take effective notes. These handwritten notes have the advantage of being an active process of recording which promotes information retention and will include rendering of graphs and important formulas. I will NOT post any notes for the chalkboard lectures so if you miss a lecture it is your responsibility to watch the recording or ask a classmate for their notes. I strongly encourage students to ask questions, seek clarification, and discuss concepts during the lecture. Interruptions are encouraged!

TUTORIALS: Weekly tutorials will consist of student-led discussions of key scientific papers and their associated methodologies. The first tutorial session will feature an example presentation and presentation tips by the TA, as well as a discussion of the grading rubric. Each student is required to present one (1) paper during the term and lead the corresponding class discussion. A list of candidate papers will be provided on Quercus.

You will also be required to submit nine (9) paper critiques throughout the term to be due at the START of each tutorial. Each week that you are not presenting, you must select one paper from the set to be discussed and submit a single page report summarizing the hypotheses, methods, major findings, broad significance and implications, and limitations of the paper. In addition, you must submit four discussion questions stemming from the paper (included in the one page limit for the report).

At the end of each tutorial you must submit a peer-evaluation for each presenter in that session. These evaluations are used to give additional feedback to your peers and will be graded on a pass/fail basis. Additional information will be provided in the first tutorial session.

MISSED EXAMS
Students that are unable to attend the midterm for religious reasons, short-term illness, or several personal circumstance must notify the instructor by email at least 3 working days before the midterm and submit documentation. Students who miss the midterm for a medical reason must present a completed UTSC medical certificate (available via the registrar's website) that confirms their illness, and medical attention, at the time of the exam. *Medical certificates will be verified*. Students that miss the midterm with no acceptable, documented excuse will receive a "0" grade for that test. Students that **miss the Final Exam** must petition the Registrar to write a deferred exam.

COMMUNICATION POLICY

There are several ways to get help in this course. The first and best is through the online office hours held by myself and the TA. These office hours will be held using the 'Bb Collaborate' link on the Quercus navigation bar. I am also happy to arrange office hours by appointment if you cannot attend the weekly scheduled hours. Questions can also be posted to the online discussion board or emailed. Please use your university email address for email and treat all of our communication professionally. I treat all of my students with respect and expect to be granted the same courtesy. Please allow at least 48 hours for a response to your question. Major announcements will be posted to Quercus. It is your responsibility to be aware of any announcements made in class.

CLASS DISCUSSION ETIQUETTE

Please feel welcome to turn your video on during lecture, but it is not required. Feel free to discuss the course in the chat window, but please stay on topic and be respectful of your fellow students. This applies to both live discussions as well as discussion boards on Quercus. There will be two general discussion boards. One will be for student-to-student communication, where I will not comment. The other will be for comments and/or questions for me. I will monitor this discussion board regularly, but students are also welcome to respond to threads and answer questions. Please allow 24 hours for a response. I recommend that you regularly check the discussion board for new content to enhance your studying. Again, please respect your fellow students on these discussion boards and maintain a considerate dialogue. Please see the EDI statement below for a link to the Student Code of Conduct.

EQUITY, DIVERSITY, AND INCLUSION STATEMENT

"The Department of Biological Sciences acknowledges the barriers that people of colour and other marginalized groups face, particularly in science and academia. As a department, we are highly committed to creating a welcoming scientific community where everyone feels safe, comfortable participating, and which provides the necessary support to thrive. We acknowledge and are disheartened that Black, Indigenous and other marginalized communities are, and always have been, disproportionately impacted by systemic racism and face barriers within academia. In August 2020, our department formed an equity and inclusion task force that will meet regularly to discuss equity and inclusion and enact improvements to our departmental practices by actively engaging with the literature on best practices, and seeking ongoing input from all members of the department including students, post-doctoral fellows, staff and faculty. Among our main priorities will be a commitment to hire and support faculty and staff that are representative of our diverse student population, and to promote a departmental culture that will foster inclusive teaching and research excellence."

Part of the aim of this course is to generate productive discussions around topics of genetic variation. As such, I expect everyone to show respect for the different backgrounds, experiences, beliefs, and values expressed by any member of this class. There will be no tolerance for behaviour or speech that violates the Code of Student Conduct (found here: https://www.utsc.utoronto.ca/edio/policies-procedures). Find out more about UTSC's commitment to EDI here: https://www.utsc.utoronto.ca/edio/.

ACCOMMODATIONS STATEMENT

We welcome students with diverse learning styles and needs in this course. If you may require special accommodations in this class, you are encouraged to contact both the AccessAbility Services Office, and myself as soon as possible to ensure that we have time to implement any necessary accommodations. AccessAbility Services staff (located in room AA142) can be reached by phone (416-287-7560) or email (ability [at] utsc.utoronto.ca) and are available by appointment to assess specific needs, provide referrals, and arrange appropriate accommodations.

ACADEMIC INTEGRITY

It is critical for all members of the scientific community, including students, to respect the value of each other's intellectual work and trust the contributions that we all make to the greater body of knowledge. As such, we must all work to protect the integrity of our community, our degrees, and our work by respecting the rules outlines in the University of Toronto's Code of Behaviour on Academic Matters (http://www.governingcouncil.utoronto.ca/policies/behaveac.htm). All students in this course must abide by this code, which outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Academic dishonesty (which includes cheating, plagiarism, and the use of unauthorized assistance) is a serious offense that can lead to suspension or expulsion. Please familiarize yourself with the offenses listed under Section B of the code. If you have any questions about what constitutes a violation of the code, please get in touch with me so that we can discuss it further.

INTELLECTUAL PROPERTY

Part of academic integrity is respecting the intellectual property of content creators/owners. You should be aware that your courses contain the intellectual property of the instructor, the TAs and possibly the University of Toronto. Sharing any course materials (e.g. lecture content, such as audio/visual recordings, handouts, or presentations; assignment materials, such as problem sets/solutions and exams; and other copyrighted material, such as primary literature pdfs) without the express permission of the creator/owner of those materials is a violation of intellectual property rights.

DISCLAIMER

I reserve the right to modify this syllabus and its contents throughout the semester to better achieve course goals and/or to enhance the quality of the course in response to unexpected circumstances or student feedback. I will always endeavor to give students advance notification of any changes. These notifications will be made in class and on Quercus, with the most up-to-date version posted to Quercus.

TENTATIVE SCHEDULE

Week	Day	Date	Topic	Reading	Due
1	Tu	Jan 12	Introduction	Syllabus & Chapter 1	
	Th	Jan 14	Genetics Recap		
2	Tu	Jan 19	Measuring Genetic Variation	Chapter 2	
	Th	Jan 21	Discussion Example & Presentation Tips		
3	Tu	Jan 26	Changes in Allele Frequency I	Chapter 3	
	Th	Jan 28	Discussion 1		Paper Response & Peer Review
4	Tu	Feb 2	Changes in Allele Frequency II	Chapter 3	
	Th	Feb 4	Discussion 2		Paper Response & Peer Review
5	Tu	Feb 9	F-Statistics & Population Differentiation	Chapter 3	
	Th	Feb 11	Discussion 3		Paper Response & Peer Review
6	Tu	Feb 16	Reading Week		
	Th	Feb 18	Reading Week		
7	Tu	Feb 23	Midterm		Midterm
	Th	Feb 25	Discussion 4		Paper Response & Peer Review
8	Tu	Mar 2	Quantitative Genetics I: Introduction & Heritability	Chapter 4	
	Th	Mar 4	Discussion 5		Paper Response & Peer Review
9	Tu	Mar 9	Quantitative Genetics II: Phenotypic Plasticity, Reaction Norms, Linkage Disequilibrium	Chapter 5	
	Th	Mar 11	Discussion 6		Paper Response & Peer Review
10	Tu	Mar 16	Quantitative Genetics III: QTL Mapping	Chapter 5	Problem Set
	Th	Mar 18	Discussion 7		Paper Response & Peer Review
11	Tu	Mar 23	Detecting Positive Selection	Chapter 6	
	Th	Mar 25	Discussion 8		Paper Response & Peer Review
12	Tu	Mar 30	Genomics: The Evolution of New Genes & Lateral Transfer	TBD	
	Th	Apr 1	Discussion 9		Paper Response & Peer Review
13	Tu	Apr 6	Epigenetics & Evolution	TBD	
	Th	Apr 8	Discussion 10		Paper Response & Peer Review