MOLBIO4DD3
Molecular Evolution
Winter 2021 Course Outline

Course Details

Instructor: Ben Evans, evansb@mcmaster.ca, 905-525-9140x26973

Lab/TA's: To be announced.

Lectures: Tu, Th, 11:30-12:20 BSB B154

Lab/Tutorial: Mo, 11:30-12:20 HH217

Course Description and Learning Objectives

MOLBIO4DD3 will explore how molecules change over time within and between species. We will examine principles of molecular evolution and their application to conservation biology, evolutionary ecology, forensic biology, genomics, sex chromosomes, phylogenetics, and behavioural ecology.

We have entered the "post-genomic" era, and "big data" approaches are becoming commonplace tools for biological research, biotechnology, and healthcare. The course begins with an exploration of how we can use forensic techniques and molecular data to gain insights into behavioral ecology. This will lead to discussion of alternative explanations for molecular polymorphism, including the neutral theory of molecular evolution. The role of gene duplication and natural selection in genome evolution will be explored as will the impact of sex and recombination on genome evolution, chromosomal evolution, and natural selection.

Interesting fact(s) or questions(s)
Fundamental questions to be asked (and answered!) include: Can molecules tell time? Is one codon better than another? How does one measure genetic distance? Where do new genes come from? Are gene duplicates really redundant and if so, why do they persist? How are genomes organized? What is the genomic impact of sex with Neanderthals?

A part of the course will be devoted to "case studies" of individual examples of molecular change and how they have been used to study the origin of life, to study the origin of mitochondria, to study HIV viral evolution, to study the evolution of sex determination, to study the historical movements of early humans.

Preparation:
Prerequisites are either Anthro 2D03 or Biology 3FF3

Course Learning Objectives

All biological processes originate from an ancestral form and are sculpted over time by evolution. This course will provide students with unique insights into:

- How molecular evolution shapes biological diversity and biological processes
- How an understanding of molecular evolution can be leveraged towards understanding fundamental aspects of our world such as biological diversity, disease outbreaks, and biological novelty
- How sex chromosomes originate and evolve
- How natural selection influences genomic variation and how we can test for this influence
- How humans evolved and interacted with other populations such as Neanderthals
- How to estimate and interpret evolutionary relationships among species
- How lateral gene transfer influences microbial genomes
- How transposible elements evolve
- How we can understand which genes influence phenotypic variation

By the end of this course students will be able to:

- Critically evaluate peer reviewed papers on molecular evolution
- Understand and interpret methodology in genomics, bioinformatics, and phylogenetics
- Understand the effects of different types of natural selection on genomic variation
- Understand how recombination influences the efficacy of natural selection
- Communicate complex topics in Molecular Evolution

Course Schedule and Format

Lectures and tutorials are currently scheduled to meet in person at the times and places listed above. In the event the winter term is changed to be online, we will hold lectures and tutorials online at the schedule times. In the event of an online offering, all class meetings will be recorded and posted with closed captions. If students do not want to be visible during recordings, they should keep their cameras off. However, for tutorial presentations, students are especially encouraged to use video.

IMPORTANT NOTE

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If any modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes. Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, Avenue to Learn and/or McMaster email.

Course Materials

No textbooks are assigned for this course; all material will be peer reviewed papers that will be posted on Avenue.

Course Evaluation

Two mid-term exams will test concepts from the first and second thirds of the course respectively. The final focus in part on the final third but also the rest of the course and therefore WILL be cumulative.

Problem sets will be due electronically before the tutorial each week by email to the TA. No late problem sets will be accepted. The problem set portion of your grade will be based on the best 8 problem sets that you hand in out of a total of 9 or 10 problem sets that will be assigned in total. In tutorials, students will discuss answers to the problem sets that were due that day with the guidance of the teaching assistant. Student groups will be required to present paper(s), lead discussions including relevant background information, and ask questions.

Mid-term 1 (fifty minutes)	25%
Mid-term 2 (fifty minutes)	25%
Problem sets	5%
Tutorial Presentation, Questions, and Attendance	15%
Final Exam (2 hours)	30%

In the event of a mandated change to an online offering, this **course may** use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

Academic Integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at https://secretariat.mcmaster.ca/university-policies-procedures- guidelines/

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

Authenticity/Plagiarism Detection

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. Avenue to Learn, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

Courses with an On-line Element

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn, LearnLink, web pages, capa, Moodle, Echo360, Microsoft Teams, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

Online Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

Conduct Expectations

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online.**

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx, Echo360, Microsoft Teams or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

Academic Accommodation of Students with Disabilities

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

Requests for Relief for Missed Academic Term Work

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

View the McMaster Student Absence Form (MSAF) for more information.

Academic Accommodation for Religious, Indigenous or Spiritual Observances (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, Avenue to Learn and/or McMaster email.