



BIOL*3040 Methods in Evolutionary Biology -

DRAFT

Winter 2022

Section(s): 01

Department of Integrative Biology

Credit Weight: 0.50

Version 1.00 - December 02, 2021

1 Course Details

1.1 Calendar Description

This course will provide students with an understanding of some of the major analytical approaches used in modern evolutionary biology and an appreciation of the relevance of these methods to other branches of the life sciences. This includes the analysis of molecular data, phylogenetics and "tree thinking", population genetics, genomics, phenotypic selection, experimental evolution, and hypothesis generation and testing in historical sciences. In addition to lectures, laboratory sessions will be devoted to practical training in analytical tools using specialized computer software and real datasets. Students will also be exposed to recent scientific literature and will undertake an independent project in order to experience these approaches in action.

Pre-Requisites: BIOL*2400

1.2 Course Description

Knowledge of basic genetics and evolutionary theory is required.

Note: Limitations of departmental resources may restrict entry into this course.

1.3 Timetable

This course will be offered in Blended format and may change according to Public Health recommendations. The course includes the following components:

- Lecture: Monday, Wednesday, 10:30 - 11:20 h (remote synchronous on Zoom)

- Lab: Wednesday, 12:30 - 14:20 or 14:30 - 16:20 h (in-person)

1.4 Final Exam

Exam time and location is subject to change. Please see WebAdvisor for the latest information.

2 Instructional Support

2.1 Instructional Support Team

Instructor:	Mehrdad Hajibabaei
Email:	mhajibab@uoguelph.ca
Telephone:	+1-519-824-4120 x52487
Office:	CBG 108
Office Hours:	By appointment

3 Learning Resources

Lab instructions will be provided by professors.

3.1 Required Resources

Various Primary Research Papers (Readings)

Software Manuals (Other)

GenAlex (Software)

<https://biology-assets.anu.edu.au/GenAlEx/Welcome.html>

GenBank and BLAST (Software)

<http://www.ncbi.nlm.nih.gov/genbank>

Mesquite (Software)

<http://mesquiteproject.org/mesquite/mesquite.html>

PDAP (Software)

http://mesquiteproject.org/pdap_mesquite

PAUP (Software)

https://people.sc.fsu.edu/~dswofford/paup_test/

D2L Course Site (Website)

<https://courselink.uoguelph.ca>

Materials relevant to the course will be posted on the D2L course site. In addition, all written assignments will be submitted via the D2L dropbox.

STRUCTURE (Software)

<https://web.stanford.edu/group/pritchardlab/structure.html>

3.2 Recommended Resources

Phylogenetic Trees Made Easy: A How-To Manual (Textbook)

<http://www.sinauer.com/detail.php?id=6069>

Hall, B.G. (2011). *Phylogenetic Trees Made Easy: A How-To Manual, 4th Edition*. Sinauer Associates.

4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Retrieving and organizing data.
 2. Working with scientific computer software that analyses data in the areas of population genetics, phylogenetics and the comparative methods.;
 3. Identifying, stating and evaluating research hypotheses or questions. Placing hypotheses and questions in the context of research programs.
 4. Identifying data and statistical tests needed to test a research hypothesis or evaluate a question.
 5. Making inferences about evolutionary processes in context of a research hypothesis or question and from the results of statistical analyses of data.
 6. Summarize and assess conceptual or theoretical basis of an evolutionary method.
 7. Scientific writing, including the presentation of data in the form of tables and/or figures, as well as presenting a critical review of an evolutionary question and a case study of an individual's research program.
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5 Teaching and Learning Activities

5.1 Summary of Course Topics

1. **Scientific Methods in Evolutionary Biology:** This topic will focus on understanding the sorts of questions that arise in evolutionary biology, the role of inference and comparative methods, and the kinds of data and analyses that can be brought to bear on such questions.

2. **Phylogenetics and Comparative Methods:** This topic will introduce some basic methods of phylogenetic reconstruction and biodiversity analysis using various data sources. Limitations of the available approaches will also be presented. Correct interpretation of phylogenies (“tree thinking”) will be strongly emphasized and common misconceptions will be addressed. Tree thinking will form a basis of understanding phylogenetically independent contrasts (PICs) in species-level correlation analyses as well as character state reconstructions and the mapping of characters onto evolutionary trees.
3. **Population Genetic Methods:** This topic will focus on the use of molecular and genomic data to infer the influence of microevolutionary processes in the past. This will include a review of the major mechanisms of microevolution (mutation, natural selection, genetic drift, gene flow) and how these can be detected and quantified.

5.2 Tentative Course Schedule

Topic of Course	Date	Class - Monday	Class - Wednesday	Lab - Wednesday
1. Introduction	Week 1 January 11-	Research programs & evolutionary methods	General concepts & theory	Data Sources and formats & intro Mesquite
2. Phylogenetics and Comparative Methods	Week 2 Jan 18-	Phylogenetic trees	Parsimony	Intro to PAUP & Morphological data
	Week 3 Jan 25-	Model-based phylo & substitution models	Maximum likelihood	PAUP & DNA sequence data Assignment 1
	Week 4 Feb 1-	Confidence evaluation	Bayesian inference	PAUP, Mesquite & confidence
	Week 5	review	Comparative	Mesquite - PIC

	Feb 8-		methods	Assignment 2
	Feb 15- 21	Winter Break	No Classes	No Labs
	Week 6	Character	Tree	No Labs-
	Feb 22-	evolution/ Molecular clock	thinking/Uses of phylogenies	Critical Review Assignment
3. Biodiversity and Population Genetic Methods	Week 7	DNA Barcoding	Phylogenetic	BOLD
	Mar 1-		Diversity	
	Week 8 Mar 8-	Phylogeography	Allele, haplotype, genotype frequencies	GenAlex Assignment 3
	Week 9 Mar 15-	DNA sequence polymorphism	Coalescent	GenAlex
	Week 10 Mar 22	Tests for selection	Historical demography	STRUCTURE – (DNA sequence data)
				Assignment 4
	Week 11 Mar 29-	Population genomics	Case Study	Review

6 Assessments

Course Component	Description	Learning Goals
Lab	Small data analysis	1-5, 7

Assignments (4)	assignments focused on particular methods or software tools.	
Critical Review	Students will prepare a 5-page critical review of the most recent advances of a relevant evolutionary question.	3-7
Case Study Report	Students will independently evaluate a case study and prepare a 5-page report.	3-7

- **Critical Review:** Students select an evolutionary topic/question and prepare a critical review of the most recent advances (based on at least 3 papers) in a 5-page report. Details of the specific requirements for the critical review will be provided in a separate document.
- **Case Study Report:** Students investigate a case study of an individual's research program that uses evolutionary methods. Details of the specific requirements for the case study report will be provided in a separate document.

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Lab Assignment #1	5
Lab Assignment #2	5
Term Exam 1	25
Lab Assignment #3	5
Lab Assignment #4	5
Term Exam 2	25
Case Study Report	30
Total	100

6.2 Assessment Details

Lab Assignment #1 (5%)

Date: , CourseLink

Learning Outcome: 1, 2, 3, 4, 5, 7

Penalty for being late or absent: **Marked zero**

Lab Assignment #2 (5%)

Date: , CourseLink

Learning Outcome: 1, 2, 3, 4, 5, 7

Penalty for being late or absent: **Marked zero**

Term Exam 1 (25%)**Lab Assignment #3 (5%)**

Date: March 17 10:30 AM, CourseLink

Learning Outcome: 1, 2, 3, 4, 5, 7

Penalty for being late or absent: **Marked zero**

Lab Assignment #4 (5%)

Date: , CourseLink

Learning Outcome: 1, 2, 3, 4, 5, 7

Penalty for being late or absent: **Marked zero**

Term Exam 2 (25%)**Case Study Report (30%)**

Date: , CourseLink

Learning Outcome: 3, 4, 5, 6, 7

Penalty for being late or absent: **Marked INC (Incomplete)**

6.3 Note

1. Weighting is applied to percentage of total marks received for an item.
2. Without academic consideration (see above), or prior approval for change of date/time by course instructor.

7 Course Statements

7.1 Missing Deadlines

Written assignments that are submitted after the deadlines indicated in the table above **will not be accepted** and the distribution of course marks **will not be altered** for any student unless Academic Consideration for illness or other compassionate grounds has been approved by the course instructor.

8 Department of Integrative Biology Statements

8.1 Academic Advisors

If you are concerned about any aspect of your academic program:

- Make an appointment with a program counsellor in your degree program. [B.Sc. Academic Advising](#) or [Program Counsellors](#)

8.2 Academic Support

If you are struggling to succeed academically:

- Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist. <http://www.learningcommons.uoguelph.ca/>
- Science Commons: Located in the library, the Science Commons provides support for physics, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: <http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help> and <http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help>

8.3 Wellness

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance. <https://www.uoguelph.ca/counselling/>
- Student Health Services is located on campus and is available to provide medical attention. <https://www.uoguelph.ca/studenthealthservices/clinic>
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations. <http://www.selfregulationskills.ca/>

8.4 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) <http://www.e-laws.gov.on.ca/index.html>. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information

policies please see the Undergraduate Calendar.
 (<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml>)

8.5 Course Offering Information Disclaimer

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

9 University Statements

9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration
<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes
<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community—faculty, staff, and students—to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars

<https://www.uoguelph.ca/academics/calendars>

9.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

9.10 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>

- <https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

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