



BIOL*3040 Methods in Evolutionary Biology

Winter 2019

Section(s): C01

Department of Integrative Biology

Credit Weight: 0.50

Version 1.00 - December 12, 2018

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-Requisite(s): 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

- Lecture: Monday, Wednesday, 10:30 - 11:20 h
- Lab: Wednesday, 12:30 - 14:20 or 14:30 - 16:20 h

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: Jinzhong Fu
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Office: SC1 1458
Office Hours: By appointment

Instructor: Mehrdad Hajibabaei
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Office: CBG 108

3 Learning Resources

Lab instructions will be provided by professors.

3.1 Required Resource(s)

Various Primary Research Papers (Readings)

Software Manuals (Other)

Arlequin (Software)

<http://cmpg.unibe.ch/software/arlequin35>

DNAsp (Software)

<http://www.ub.edu/dnasp>

GenBank and BLAST (Software)

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

MEGA5 (Software)

<http://www.megasoftware.net>

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.

3.2 Recommended Resource(s)

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 method.
 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 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 a historical science such as 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, including the use of both morphological and molecular data. 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 7-	Research programs & evolutionary methods	General concepts & theory	Data Sources and formats & intro Mesquite
2. Phylogenetics and Comparative Methods	Week 2 Jan 14-	Phylogenetic trees	Parsimony	Intro to PAUP & Morphological data
	Week 3 Jan 21-	Model-based phylo & substitution models	Maximum likelihood	PAUP & DNA sequence data Assignment 1
	Week 4 Jan 28-	Confidence evaluation	Bayesian inference	PAUP, Mesquite & confidence
	Week 5 Feb 4-	review	Comparative methods	Mesquite - PIC Assignment 2
	Week 6 Feb 11-	Character evolution/ Molecular clock	Tree thinking/Uses of phylogenies	Term Exam 1
	Feb 18-	Winter Break	No Classes	No Labs

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3. Biodiversity and Population Genetic Methods	Week 7 Feb 25-	DNA Barcoding	Phylogenetic Diversity	BOLD
	Week 8 Mar 4-	Phylogeography	Allele, haplotype, genotype frequencies	MEGA Assignment 3
	Week 9 Mar 11-	DNA sequence polymorphism	Coalescent	DNAsp
	Week 10 Mar 18	Tests for selection	Historical demography	DNAsp & MEGA – (DNA sequence data)
	Week 11 Mar 25-	Population genomics	Review	Assignment 4 Term exam 2
	Week 12 Apr 1-	Case study	Case study	No Lab

6 Assessments

Course Component	Description	Learning Goals
Lab Assignments (4)	Small data analysis assignments focused on particular methods or software tools.	1-5, 7
Term Exams (2)	The exams will be written in lab periods and include both theoretic and practical questions.	1-6
Case Study Report	Students will independently evaluate a case study and	3-7

prepare a 5-page report.

- **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 report will be provided in a separate document.

6.1 Marking Schemes & Distributions

Name	Scheme A (%)	Scheme B (%)
Lab Assignment #1	5	5
Lab Assignment #2	5	5
Term Exam #1	25	35
Lab Assignment #3	5	5
Lab Assignment #4	5	5
Term Exam #2	35	25
Case Study Report	20	20
Total	100	100

6.2 Assessment Details

Lab Assignment #1 (5%)

Date: January 28th 10:30 AM, Courselink

Learning Outcome(s): 1,2,3,4,5,7

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

Lab Assignment #2 (5%)

Date: February 11 10:30 AM, Courselink

Learning Outcome(s): 1,2,3,4,5,7

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

Term Exam #1 (25%)

Date: Tue, Feb 13, In your registered lab period and lab room.

Learning Outcome(s): 1,2,3,4,5,6

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

Lab Assignment #3 (5%)

Date: March 11 10:30 AM, Courselink

Learning Outcome(s): 1,2,3,4,5,7

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

Lab Assignment #4 (5%)

Date: March 25 10:30 AM, Courselink

Learning Outcome(s): 1,2,3,4,5,7

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

Term Exam #2 (35%)

Date: Tue, Mar 27, In your registered lab period and lab room

Learning Outcome(s): 1,2,3,4,5,6

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

Case Study Report (20%)

Date: April 15th 12 PM, Courselink

Learning Outcome(s): 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.
3. Term exam with highest percentage of total marks is weighted 35%, while the other midterm exam is weighted 25%.

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.uoguelph.ca/~ksomers/>

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 regulations and procedures for [Academic Consideration](#) are detailed in the Undergraduate Calendar.

9.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second

semester. The regulations and procedures for [Dropping Courses](#) are available in the Undergraduate Calendar.

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 book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: www.uoguelph.ca/sas

9.6 Academic Misconduct

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 discourages misconduct. 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.

The [Academic Misconduct Policy](#) is detailed in the Undergraduate Calendar.

9.7 Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate 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 which apply to undergraduate, graduate and diploma programs.
