

This is a tentative course outline. The final outline will be posted the first day of class.

UNIVERSITY OF GUELPH  
COLLEGE OF BIOLOGICAL SCIENCE  
COURSE DESCRIPTION

<b>Course number:</b>	BIOL*3040
<b>Title of course:</b>	Methods in Evolutionary Biology
<b>Semester offered:</b>	Winter 2017
<b>Department:</b>	Integrative Biology
<b>Course instructors:</b>	<b>Cortland Griswold</b>
	SCIE 1474, cgriswol@uoguelph.ca
	office hours by appointment
	<b>Jinzhong Fu</b>
	SCIE 1458, jfu@uoguelph.ca
	office hours by appointment
	Teaching Assistant: TBA
<b>Scheduled classes:</b>	Lecture: Monday, Wednesday, 10:30 - 11:20 h
	Lab: Wednesday, 12:30 - 14:20 or 14:30 - 16:20 h

**COURSE OVERVIEW**

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. Knowledge of basic genetics and evolutionary theory is required.

**Prerequisite:** BIOL\*2400 (Evolution)

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

## COURSE RESOURCES

- Recommended text: Hall, B.G. (2011). *Phylogenetic Trees Made Easy: A How-To Manual, 4th Edition*. Sinauer Associates. <http://www.sinauer.com/detail.php?id=6069>
- Lab instructions provided by professors.
- Various primary research papers.
- Software manuals.

### Software:

- Arlequin (<http://cmpg.unibe.ch/software/arlequin35>)
- DNAsp (<http://www.ub.edu/dnasp>)
- GenBank and BLAST (<http://www.ncbi.nlm.nih.gov/genbank>)
- MEGA5 (<http://www.megasoftware.net>)
- Mesquite (<http://mesquiteproject.org/mesquite/mesquite.html>)
- PDAP ([http://mesquiteproject.org/pdap\\_mesquite](http://mesquiteproject.org/pdap_mesquite))

**D2L course site:** 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.

**Academic Calendar:** The calendar is the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs: <http://www.uoguelph.ca/registrar/calendars/index.cfm?index>

## PROCEDURES

**Email Communication:** As per university regulations, all students are required to check their <uoguelph.ca> email account regularly. Email is the official route of communication between the University and its students.

**Drop Date:** The last date to drop one-semester courses, without academic penalty, for Winter 2017 is Friday, March 10, 2017. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar:  
<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

**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.

**Accessibility:** The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Centre for Students with Disabilities as soon as possible. For more information, contact SAS at 519-824-4120 ext. 54335 or email <csd exams@uoguelph.ca> or see the website:  
<http://www.uoguelph.ca/csd>

**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.

### **POLICY ON LATE OR MISSED COURSE REQUIREMENTS**

Students who are unable to meet a course deadline for a graded component because of illness or compassionate reasons must request Academic Consideration as soon as possible by advising the course coordinator in writing, with their name, id#, and email contact. If approved, alternate deadlines will be arranged.

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.

See the undergraduate calendar for further information on regulations and procedures for Academic

Consideration: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

### **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 have 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:

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

## **SUMMARY OF COURSE TOPICS**

### **1. Scientific Methods in Evolutionary Biology**

This unit 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. Molecular Ecology & Phylogeography**

This unit will cover methods derived from population genetics to understand historic and contemporary microevolutionary processes within a population. This will include a review of the major mechanisms of microevolution (natural selection, genetic drift, gene flow), how these can be detected and quantified, and their implications for evolutionary change at the population level.

### **3. Molecular Phylogenetics and Tree Thinking**

This unit will introduce some basic methods of phylogenetic reconstruction using molecular data and the limitations of the available approaches. Correct interpretation of phylogenies (“tree thinking”) will be strongly emphasized and common misconceptions will be addressed.

### **4. Comparative Methods and Patterns of Macroevolution**

This unit will build upon the tree thinking skills developed in the previous unit. This will include the use of phylogenetically independent contrasts (PICs) in species-level correlation analyses as well as character state reconstructions and the mapping of characters onto evolutionary trees.

### **5. Experimental Evolution**

This unit will discuss various approaches to studying evolution experimentally, both in the lab using model organisms with rapid life cycles (bacteria, protists, plants, insects) and in silico using simulation studies. Students will gain practical experience with in silico Experimental Evolution using Avida.

### **6. Phenotypic evolution at population level**

This unit will present basic methods for estimating heritability and selection differentials on phenotypic traits. Students will also gain practice estimating heritability and selection using statistical software.

### **8. Independent Project and Critical Analysis**

Students will conduct a small research project involving analysis of a dataset assembled from the literature or a database such as GenBank. Further details will be provided at a later date.

### **Guest Seminars**

Researchers from Integrative Biology, the Biodiversity Institute of Ontario, and other departments will be invited to present a summary of their work and to describe how they use particular methods to answer questions in their areas of study. Examples may include the use of DNA barcoding, next-generation DNA sequencing, phylogenetic comparative methods, and other approaches.

## EVALUATION

Course component	Weight	Description
Weekly lab assignments	35%	Small data analysis assignments focused on particular methods or software tools.
Term exams (2)	40%	These exams will be written in class or lab and cover both practical and conceptual/theoretical aspects of evolutionary methods.
Independent project	25%	<b>Students will work in pairs</b> to do a small research project involving analysis of a dataset assembled from the literature or a database.

## TENTATIVE COURSE SCHEDULE

1. Scientific Methods in Evolutionary Biology			
	Class – Monday	Class – Wednesday	Lab – Wednesday
Week 1 Jan 9,11	Course introduction and overview	Overview and philosophical considerations	Introduction to software for evolutionary analysis
2. Molecular Ecology & Phylogeography			
Week 2 Jan 16, 18	Basic pop gen, Fst	Basic pop gen, Fst	Arlequin or GenePop Lab report
Week 3 Jan 23, 25	Applications of Fst and other methods	Case study of molecular ecology	
3. Molecular Phylogenetics			
Week 4 Jan 30, Feb 1	Phylogenetic concepts	Models of molecular evolution	GenBank, MEGA6 Lab report
Week 5 Feb 6, 8	Building trees	Building trees	
4. Comparative Methods & Phenotypic Evolution			
Week 6 Feb 13, 15	Comparative methods	Comparative methods	Exam 1
Break Week - NO CLASSES			
Week 7 Feb 27, Mar 1	Using trees:	Case study	Mesquite Lab report
5. Experimental Evolution			
Week 8 Mar 6, 8	Experimental Evolution with Avida	Experimental Evolution, Avida Exercise	
6. Phenotypic evolution at population level			
Week 9 Mar 13, 15	Phenotypic evolution w/n a population	Phenotypic evolution w/n a population	SPSS Lab report
7. Project preparation			
Week 10 Mar 20, 22	Project Proposal prep	Project Proposal prep	Exam 2
8. Independent Project			
Week 11 Mar 27, 29	Project	Project	Independent project
Week 12 Apr 3, 5	Project	Project	Independent project