

**EEB460H1F/EEB1460H Molecular Evolution and Genomics
Department of Ecology & Evolutionary Biology
University of Toronto**

**Course Syllabus
Fall 2014**

Course Description:

Processes of evolution at the molecular level, and the analysis of molecular data. Gene structure, neutrality, nucleotide sequence evolution, sequence evolution, sequence alignment, phylogeny construction, gene families, transposition.

Prerequisite:

BIO240H1/BIO250Y1/BIO255Y1, BIO260H1/HMB265H1

Exclusion:

BIO460H1/BIO461H1

Time and Location:

Lecture:

Wednesday 10 – 11

Friday 10 – 12

Ramsey Wright 229

Labs:

Some Fridays 10 – 12, see course schedule below for specific dates

Ramsey Wright 107/109

Course Staff:

Lecturers:

Dr. Allan Baker (course coordinator)

Department of Ecology and Evolutionary Biology

Royal Ontario Museum

Phone: 416 586-5520

e-mail: allanb@rom.on.ca

Dr. David M. Irwin

Department of Laboratory Medicine and Pathobiology

Room 6211 Medical Sciences Building

Phone: 416 978-0519

e-mail: david.irwin@utoronto.ca

Office Hours:

Fridays, 2 - 4

Teaching Assistant:

Ramesh Arunkumar

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Course Policy on E-mail Usage:

We will reply to legitimate e-mail inquiries from students using their University of Toronto e-mail accounts within 48 hours (not on weekends/holidays). If you do not receive a reply within this period, please resubmit your question(s) and/or phone. Please note that some servers (such as hotmail) can be unreliable in both sending and receiving messages. We encourage you to send your mail using your UTOmail e-mail account (see www.utorid.utoronto.ca). You can easily forward mail received at your UTOmail account to the e-mail account that you use regularly. Each e-mail message must include in the Subject line the course identifier and a concise and clear statement of purpose [e.g., EEB460: Questions concerning Lab 1]; otherwise it is likely to be deleted, along with spam messages and messages potentially containing viruses. Please make sure you consult the course outline/syllabus, other handouts, and the course website BEFORE submitting inquiries by e-mail. Where a question cannot easily or briefly be answered with a reply e-mail, we will simply indicate to the student that s/he should see us (or our TA) during the announced office hours, or suggest an alternative meeting time. E-mail should NOT be seen as an alternative to meeting with the instructor (or the TA) during office hours. Nor should e-mail be used as a mechanism to receive private tutorials (especially prior to tests) or to explain material that was covered in lectures you missed.

Course Website:

Logging in to your Blackboard Course Website:

Like many other courses, EEB460 uses Blackboard for its course website. To access the EEB460 website, or any other Blackboard-based course website, go to the UofT portal login page at portal.utoronto.ca and log in using your UTOrid and password. Once you have logged in to the portal using your UTOrid and password, look for the **My Courses** module, where you'll find the link to the EEB460 course website along with the link to all your other Blackboard-based courses.

Activating your UTOrid and Password:

If you need information on how to activate your UTOrid and set your password for the first time, please go to www.utorid.utoronto.ca. Under the "First Time Users" area, click on "activate your UTOrid" (if you are new to the university) or "create your UTOrid" (if you are a returning student), then follow the instructions. New students who use the link to "activate your UTOrid" will find reference to a "Secret Activation Key". This was originally issued to you when you picked up your Tcard at the library. If you have lost your Secret Activation Key you can call 416-978-HELP or visit the Help Desk at the Information Commons on the ground floor of Robarts Library to be issued a new one. **The course instructor will not be able to help you with this.** 416-978-HELP and the Help Desk at the Information Commons can also answer any other questions you may have about your UTOrid and password.

E-mail Communication with the Course Instructor:

At times, the course Instructor may decide to send out important course information by e-mail. To that end, all UofT students are required to have a valid UofT e-mail address. You are responsible for ensuring that your UofT e-mail address is set up AND properly entered in the ROSI system. You can do that by using the following instructions:

To submit the information to activate your UTORid and password (see above), you will need to click the “Validate” button. Follow the instructions on the subsequent screens to receive your utoronto.ca address. Once you have your UofT e-mail address, go to the ROSI system (www.rosi.utoronto.ca), log in and update the system with your new UofT email address.

You can **check your UofT e-mail** account from

1. The UofT home page www.utoronto.ca: From the Quick Links menu on the top right, choose “my.utoronto.ca”. Enter your UTORid and password, and when the Welcome page opens, click “WEBMAIL”.
2. E-mail software installed on your computer, for example Microsoft Outlook or Mozilla Thunderbird. Visit the Help Desk at the Information Commons or call 416-978-HELP for help with the set up.

Forwarding your utoronto.ca e-mail to a Hotmail, Gmail, Yahoo or other type of e-mail account is not advisable. In some cases, messages from utoronto.ca addresses sent to Hotmail, Gmail or Yahoo accounts are filtered as junk mail, which means that e-mails from your course instructor may end up in your spam or junk mail folder.

You are responsible for:

1. Ensuring you have a valid UofT e-mail address that is properly entered in the ROSI system
2. Checking your UofT e-mail account on a regular basis.

CQUEST Accounts for Computer labs:

A CQUEST account is needed to use the computers in the computer labs. All undergraduate students in Faculty of Arts & Sciences courses can request a CQUEST account (if you do not already have one) from www.cquest.utoronto.ca. See the CQUEST website for instructions on requesting and activating your account. You must activate your account before the first lab; this cannot be done on a CQUEST computer.

CQUEST accounts will be requested for the graduate students taking EEB1460. Graduate students must send their FULL NAMES, BIRTH DATE, and STUDENT NUMBER to david.irwin@utoronto.ca by September 14, 2014, so that accounts can be set up before the first lab.

Readings:Required Textbook:

Molecular Evolution, A Phylogenetic Approach
Roderic D M Page & Edward C Holmes
Blackwell Science, 1998

Used copies should be available in Bookstores or online

Additional required readings (papers) will be posted on Blackboard

Alternative Textbooks:

Fundamentals of Molecular Evolution, 2nd Edn
D Graur & WH Li, Sinauer, 1999

Molecular Evolution
WH Li, Sinauer, 1997

Purpose and Objectives of the Course:

The purpose of this course is to introduce students to the field of Molecular Evolution.

The specific objectives of the course include:

- (1) To provide a critical examination of methods for studying molecular evolution and the current standing of the field.
- (2) To provide an overview of methods used to understand the evolution of genes, genomes, species, and populations.

Organization of the Course:

The course is a lecture based course with four 2-hour computer labs. DRAFT versions of PowerPoint slides will be available on the Blackboard website prior to lectures. DRAFT slides will not be updated, and material presented in lecture is the final version. Students are required to attend lectures to acquire complete details.

Lab materials will also be available on the course Blackboard website. Students are required to attend labs to understand how the computer programs can be used to address questions in the lab assignments and for their Term projects.

Dr. Baker is the Course Coordinator and responsible for the overall management of the course.

Dr. Irwin will give lectures in the first half of the course and be responsible for Lab Assignments 1 and 2, and the Mid-term Exam.

Dr. Baker will give lectures in the second half of the course and be responsible for Lab Assignments 3 and 4, and the Final Exam.

The Teaching Assistant may be involved in the marking of the Lab Assignments.

The Term Projects will be marked jointly by Drs. Baker and Irwin.

Evaluation:

The grade for this course will be derived from 4 lab assignments, a term project, a midterm exam, and a final exam. Each of the lab assignments are worth 5% of the final grade and the term project is worth 30%. The mid-term (2-hour) and final (2-hour) exams are each worth 25%. The mid-term covers Dr. Irwin's lectures, while the final exam covers Dr. Baker's lectures (i.e., it is not cumulative).

Lab Assignments:

Lab assignments are designed to introduce students to computer programs used in Molecular Evolution, and that could be used for their Term Project (see below). The assignments will consist of a series of specific analyses that can be conducted using computer programs. A brief description of the results and students interpretation of the results is expected. Lab assignments cannot be submitted electronically and must be submitted in hard copy.

Term Project:

Conduct an evolutionary analysis of a molecular data set and write up as a manuscript for submission to a scientific journal. The subject of the evolutionary analysis can include any question in evolution that can be addressed using molecular data; examples include species phylogeny, evolution of a gene family, or evolution of a gene. Examples of previous years projects are listed on Blackboard. The evolutionary analysis should be conducted using a dataset of about 10-20 molecular sequences (both DNA and protein sequences are acceptable). Data should be acquired and analyzed by approaches and computer programs introduced to you through the labs of this course (i.e., GenBank, Ensembl, Clustal, MEGA, PHYLIP, ModelTest, MrBayes – not all programs are required for each project, use those that are appropriate for your project).

If you have questions concerning the suitability, or choice, of your evolutionary question and/or your data set please contact the instructors well in advance of the submission deadline.

Additional requirements for Graduate Students enrolled in EEB1460: (1) You are required to choose your own evolutionary question and data set. (2) You will also give a 15-20 minute presentation (PowerPoint followed by questions) of your project in the week following submission of your paper (date of presentation TBA).

Paper Format: Your evolutionary analysis is to be written in the style of a manuscript (an example will be posted on Blackboard) that would be submitted to *Molecular Biology and Evolution*. (for format guidelines see:

http://www.oxfordjournals.org/our_journals/molbev/general_author_guidelines.html)

EXCEPT:

(1) The limit for number of pages is 20 double-spaced (or 10 single-spaced) for text (i.e., not including title page, figures, and tables).

- (2) There is a limit of 5 for the number of figures and tables (total number of figures and tables cannot exceed 5) – and tables and figures cannot be multi-part.
- (3) Additional files are not permitted.
- (4) Preferred format of submission is as a single PDF file. For alternative formats please contact us before submitting.

Submission of Paper: Papers must be submitted electronically from your UofT e-mail account (e.g., your.name@mail.utoronto.ca) to both david.irwin@utoronto.ca and allanb@rom.on.ca by 11:59 PM Sunday November 23. You should receive an e-mail confirmation of receipt by 12:00 Noon the day following submission. If you do not receive an acknowledgement please contact us immediately.

Due date: Sunday November 23 by 11:59PM

Late penalty: Deduction of 10% per day from final mark of paper. You must also inform us before the due date that the paper will be submitted late.

Exams:

Mid-term and final exams will be 2 hours in length. Exam questions will be problem solving or short essay answer. The mid-term exam is currently scheduled for Ramsay Wright 143, but may be moved (depending on class size) to a different location to provide greater space to write the exam. A previous mid-term and final exam will be posted on the Blackboard website before each exam.

Mark Schedule:

Specific dates for assignments, term project and mid-term exam are listed below (the date and location for the final exam has not yet been scheduled by the faculty of Arts and Sciences).

| Date | Due | Title | Percentage |
|-------------|------------|--------------|-------------------|
| Sept. 19 | Oct. 1 | Lab 1 | 5 |
| Oct. 3 | Oct. 10 | Lab 2 | 5 |
| Oct. 17 | | Midterm Exam | 25 |
| Oct. 31 | Nov. 14 | Lab 3 | 5 |
| Nov. 14 | Nov. 19 | Lab 4 | 5 |
| | Nov. 23 | Term Project | 30 |
| TBA | | Final Exam | 25 |

Missing a Test:

If you miss a test, a U of T “Verification of Student Illness or Injury” note or a letter from your college registrar is required in order to request special consideration or to write a make-up test. You must contact the instructor within 2 days of missing a test. Medical certificates must confirm your inability to attend a test and the dates of your illness, and must show that the physician was consulted at the time of the illness. Students who miss the final examination must petition to the Faculty.

Assignments: (submission policy, lateness penalties, printing)

Lab assignments must be submitted on paper. Assignments are due at the beginning of class on the due date and are to be given to the instructor. Assignments received later than the due date will be penalized 10% per day that they are late. Exceptions to the lateness penalty for valid reasons such as illness, compassionate grounds, etc. will be entertained by the instructor only when supported by written documentation (e.g., a completed U of T medical certificate). To conserve paper, lab assignments should be submitted double sided without a cover page. The Term Project must be submitted electronically (see above).

Accessibility Needs:

The University of Toronto is committed to accessibility. If you require accommodations for a disability, or have any accessibility concerns about the course, the classroom or course materials, please contact Accessibility Services as soon as possible:
disability.services@utoronto.ca or <http://www.accessibility.utoronto.ca/>.

Writing:

The University of Toronto expects its students to write well, and it provides a number of resources to help you. To find what you need visit the Writing at U of T website (<http://www.writing.utoronto.ca/home>): start with the Frequently Asked Questions page, investigate writing centres and writing courses, look at the advice files, and read the latest announcements about writing support programs. The writing centres provide free individual and group instruction in the many different kinds of writing done by U of T students.

Academic Integrity:

Academic integrity is one of the cornerstones of the University of Toronto (see www.artsci.utoronto.ca/osai/students). It is critically important both to maintain our community which honours the values of honesty, trust, respect, fairness and responsibility and to protect you, the students within this community, and the value of the degree towards which you are all working so diligently.

According to Section B of the University of Toronto's Code of Behaviour on Academic Matters (<http://www.artsci.utoronto.ca/osai/code/the-code-of-behaviour-on-academic-matters>), which all students are expected to know and respect, it is an offence for a student:

- To use someone else's ideas or words in your own work without acknowledging that those ideas/words are not your own with a citation and quotation marks, i.e., to commit plagiarism.
- To include false, misleading or concocted citations in your work.
- To obtain unauthorized assistance on any assignment.
- To provide unauthorized assistance to another student.
- To submit your own work for credit where it has been previously obtained in more than one course without the permission of the instructor.
- To falsify or alter any documentation required by the University. This includes, but is not limited to, doctor's notes.
- To use or possess an unauthorized aid in any test or exam.

There are other offences covered under the Code, but these are the most common. Please respect these rules and the values which they protect.

Term Projects may be submitted to Turnitin (for details see www.teaching.utoronto.ca/teaching/academicintegrity/turnitin.htm). Students agree that by taking this course all required papers may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site.

Lecture Schedule:

Dr. David Irwin

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|----|-----|---|---------|--|
| 1 | Wed | 1 | Sept 10 | Introduction to Molecular Evolution |
| 2 | Fri | 2 | Sept 12 | Aligning Molecular Sequences and Phylogeny Methods |
| 3 | Wed | 1 | Sept 17 | Molecular Evolution Software |
| 4 | Fri | 2 | Sept 19 | Lab 1 – Obtaining and Aligning Data. Assignment 1 handed out, Due. Oct. 1 |
| 5 | Wed | 1 | Sept 24 | Phylogeny Methods |
| 6 | Fri | 2 | Sept 26 | Molecular Phylogeny and Gene Evolution |
| 7 | Wed | 1 | Oct 1 | Evolution of Duplicate Genes |
| 8 | Fri | 2 | Oct 3 | Lab 2 – Constructing Molecular Phylogeny. Assignment 2 handed out, Due. Oct. 10 |
| 9 | Wed | 1 | Oct 8 | Gene and Genome Evolution |
| 10 | Fri | 2 | Oct 10 | Gene and Genome Evolution |
| 11 | Wed | 1 | Oct 15 | Special Topics |
| 12 | Fri | 2 | Oct 17 | Exam |

Dr. Allan Baker

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|----|-----|---|--------|--|
| 13 | Wed | 1 | Oct 22 | Estimating the number of nucleotide substitutions between sequences |
| 14 | Fri | 2 | Oct 24 | Nucleotide substitution in protein-coding genes |
| 15 | Wed | 1 | Oct 29 | Bayesian methods of constructing phylogeny |
| 16 | Fri | 2 | Oct 31 | Lab 3 Models of evolution - Modeltest and MrBayes. Assignment 3 handed out, due Nov. 14 |
| 17 | Wed | 1 | Nov 5 | Compositional bias and effect on phylogeny reconstruction |
| 18 | Fri | 2 | Nov 7 | Molecular clocks, neutral and nearly neutral theory |
| 19 | Wed | 1 | Nov 12 | The MHC gene complex |
| 20 | Fri | 2 | Nov 14 | Lab 4 Analysis of sequence variation and tests of selection. Assignment 4 handed out, due Nov. 19 |
| 21 | Wed | 1 | Nov 19 | Dynamics of genes in populations |
| 22 | Fri | 2 | Nov 21 | Mitochondrial DNA evolution |
| 23 | Wed | 1 | Nov 26 | Summary |
| 24 | Fri | 2 | Nov 28 | |

Audio Recording of Lectures:

Lecture presentations and course materials are the intellectual property of the instructor. If you wish, taping lectures with a personal recorder is permitted. If you bring a recording device to the front of the room, you do so at your own risk and you assume responsibility if it is lost or stolen. You must be present to record the lecture. Lecture materials including audio recordings are for personal use only by students enrolled in EEB460. The distribution, transmission, reproduction, or re-posting of the EEB460 lecture materials including audio recordings, in part or whole, is strictly prohibited without the written permission of the instructor. Students are advised not to treat recordings as a substitute for attending lectures and taking notes.

Laboratory Schedule:

All computer labs are in Ramsay Wright 107

ALL students must have a CQUEST account to use computers in the computer labs – see section above about setting up your CQUEST account.

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|-------|----------|--|
| Lab 1 | Sept. 19 | Obtaining and aligning Molecular Data Lab due Oct. 1 |
| Lab 2 | Oct. 3 | Constructing Molecular Phylogeny Lab due Oct. 10 |
| Lab 3 | Oct. 31 | Models of evolution – Modeltest and Mr. Bayes Lab due Nov. 14 |
| Lab 4 | Nov. 14 | Analysis of sequence variation and tests of selection Lab due Nov. 19 |

All lab assignments are due in hardcopy at the beginning of class (10:10 AM) on the due date.