

BIOL 4307 and 5336: MOLECULAR EVOLUTION

Spring 2010

Name: Dr. Esther Betrán

Office Number: Room B15 Life Science Bldg.

Office Telephone Number: 817-272-1446

Email Address: betran@uta.edu

<http://www.uta.edu/biology/betran/index.htm>

<http://www3.uta.edu/faculty/betran/>

Office Hours: Tuesdays and Thursdays 13:00 - 2:30 pm

Course Number, Section Number, and Course Title: BIOL 4307 and BIOL 5336, Section 001, MOLECULAR EVOLUTION Spring 2010

Time and Place of Class Meetings: Life Science Building, Room 101, Tuesdays and Thursdays from 11:00 am - 12:20 pm

Description of Course Content: The interpretation of the new wealth of sequences can only be achieved through understanding the dynamics of evolutionary change at the molecular level. Molecular evolution focuses on understanding how genes and genomes evolve. Molecular biology provides the data while population genetics provides the theoretical framework. A major goal of this course is to provide tools to interpret the genetic variation within and between species, reconstruct the evolutionary history of genes and species, and reveal the fingerprints of natural selection in action at the molecular level.

The course will mainly consist of theoretical lectures and problems and quizzes related to the lectures. A few seminal and relevant scientific papers will be read and commented on in class. In addition, there will be three sessions of computer lab. Sequence alignments and phylogenetic and population inferences will be performed with the help of the instructor. During these sessions students will familiarize with the software while answering questionnaires.

Student Learning Outcomes: In the lectures, I hope to cover most of the textbook, discuss few relevant scientific papers and give problems to solve. In the computer labs we will use three different free softwares (CLUSTAL, MEGA and DNAsp). The student will learn the material from the lectures, how to solve problems and how to use several softwares.

Requirements BIOL 3315 and BIOL 2343 or BIOL 3339 for undergraduates and BIOL 5311 or consent from the instructor for graduate students.

I will be very strict with the prerequisites so make sure you check with me. In general I require good genetics, statistics and general evolutionary background.

Required Textbooks and Other Course Materials:

Required text:

Either Molecular Evolution by Wen-Hsiung Li. Sinauer Associates, 1997 ISBN 0-87893-463-4 or Fundamentals of Molecular Evolution by Dan Graur and Wen-Hsiung Li. Sinauer Associates, 2000 ISBN 0-87893-266-6

Other texts:

Molecular Evolution: A Phylogenetic Approach by Roderic D.M. Page and Edward C. Holmes. Blackwell Science, 1998.

Principles of Population Genetics, 4th Edition, by Daniel L. Hartl and Andrew G. Clark. Sinauer Associates, 2007.

Molecular Evolution and Phylogenetics by Masatoshi Nei and Sudhir Kumar. Oxford University Press, 2000.

Descriptions of major assignments and examinations with due dates: There will be 2 midterm exams and 1 comprehensive final exam. There will also be weekly problem sets that will be returned the week after and three computer lab sessions with questionnaires that will also be returned the week after every session.

Grading Policy:

Exams: 2 midterm exams and 1 comprehensive final exam

Grading Policy:

Problem sets	10%
Computer lab questions	20%
Midterm I	20%
Midterm II	20%
Comprehensive final exam	30%

Grading Scale:

90-100%	A
80-89%	B
70-79%	C
60-69%	D
0-59%	F

Make-up Exam Policy:

I would not allow make-up exams unless there is a documented case of extreme circumstance. Students who find they are unable to attend an exam should inform me as soon as possible.

Attendance Policy: Attendance to the lectures is strongly recommended. Attendance to computer lab session is compulsory.

Drop Policy: The last day to drop with an automatic W is April 2, 2010. Students should refer to university drop policy for any additional aspects of this policy.

Tentative Course Plan:

Chapters:

1. Introduction. What is molecular evolution?
2. Nucleotide sequence, gene structure, genetic code, and mutations.
3. Dynamics of genes in populations. Allele frequencies. Natural selection. Random genetic drift. Effective population size. Polymorphism and divergence. Linkage disequilibrium.
4. Sequence alignment. Evolutionary change of nucleotide sequences. Multiple substitution problem and the inference of the number of evolutionary events.
5. Rates and patterns of nucleotide substitution. Probability of fixation of a new neutral mutation. Rate of neutral substitution. Synonymous and nonsynonymous substitutions.
6. Molecular phylogenetic inference. Rooted and unrooted trees. Gene trees and species trees. Methods of reconstruction. Branch length estimation. Examples.
7. Molecular clocks. Relative rate tests. Overdispersed clocks. Generation and lineage effects. Examples.
8. DNA polymorphism in the populations. Testing the neutral mutation hypothesis. Polymorphism vs. divergence. Coalescence.
9. Neutral and nearly-neutral theories. Contribution of deleterious, neutral and advantageous mutations to polymorphisms and divergence.
10. Positive selection and adaptive evolution. K_A/K_S measurements. Evolution of lysozyme in langur monkeys. Nonrandom usage of synonymous codons.
11. Joint effects of genetic linkage and selection. Muller's ratchet, selective sweeps, and background selection. Testing predictions of background selection and selective sweeps.
13. Genome evolution I. Evolution of gene duplications. Paralogy and orthology. Dating gene duplications. Probability of nonfunctionalization and subfunctionalization. Concerted evolution.
14. Genome evolution II. Evolution of non coding regions. GC content. Genome size evolution. Repetitive elements.
15. Sex chromosome evolution: extreme genome changes, over and over.

Important University Policies:

Americans With Disabilities Act:

The University of Texas at Arlington is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 92-112 - The Rehabilitation Act of 1973 as amended. With the passage of federal legislation entitled *Americans with Disabilities Act (ADA)*, pursuant to section 504 of the Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens.

As a faculty member, I am required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of that disability.

Student responsibility primarily rests with informing faculty of their need for accommodation and in providing authorized documentation through designated administrative channels. Information regarding specific diagnostic criteria and policies for obtaining academic accommodations can be found at www.uta.edu/disability. Also, you may visit the Office for Students with Disabilities in room 102 of University Hall or call them at (817) 272-3364.

Academic Integrity:

It is the philosophy of The University of Texas at Arlington that academic dishonesty is a completely unacceptable mode of conduct and will not be tolerated in any form. All persons involved in academic dishonesty will be disciplined in accordance with University regulations and procedures. Discipline may include suspension or expulsion from the University.

"Scholastic dishonesty includes but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts." (Regents' Rules and Regulations, Series 50101, Section 2.2)

Student Support Services Available:

The University of Texas at Arlington supports a variety of student success programs to help you connect with the University and achieve academic success. These programs include learning assistance, developmental education, advising and mentoring, admission and transition, and federally funded programs. Students requiring assistance academically, personally, or socially should contact the Office of Student Success Programs at 817-272-6107 for more information and appropriate referrals.

Final Review Week:

A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week unless specified in the class syllabi. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. Classes are held as scheduled during this week and lectures and presentations may be given.

Drop for non-payment of tuition:

Payment must be received by the term due date of Jan. 13, 2010 or your registration will be cancelled and your seat will be released. If your registration is cancelled for non-payment, you may re-register for classes only if seats are available.

Bomb Threats:

If anyone is tempted to call in a bomb threat, be aware that UTA will attempt to trace the phone call and prosecute all responsible parties. Every effort will be made to avoid cancellation of presentations/tests caused by bomb threats. Unannounced

alternate sites will be available for these classes. Your instructor will make you aware of alternate class sites in the event that your classroom is not available.

The University of Texas at Arlington has adopted the University email address as an official means of communication with students. Through the use of email, UT-Arlington is able to provide students with relevant and timely information, designed to facilitate student success. In particular, important information concerning registration, financial aid, payment of bills, and graduation may be sent to students through email.

After Hours Safety Escort

The Sam Mav Escort service provides a service to assist students, faculty, staff and campus visitors to reach their destinations after regular business hours. The hours of service are 7:00 p.m. to 1:00 a.m., Sunday through Saturday. 817-272-3381

MavMail:

All students are assigned an email account and information about activating and using it is available at www.uta.edu/email. New students (first semester at UTA) are able to activate their email account 24 hours after registering for courses. There is no additional charge to students for using this account, and it remains active as long as a student is enrolled at UT-Arlington. Students are responsible for checking their email regularly.

Instructor's note: This syllabus is intended as a guide and there might be unforeseen situations for which changes might be needed to a particular aspect of this syllabus during the semester.