

IMPORTANT: This syllabus form should be submitted to OAA (gsbs_academic_affairs@uth.tmc.edu) a week before the start of each semester.

NOTE to STUDENTS: If you need any accommodations related to attending/enrolling in this course, please contact one of the Graduate School's 504 Coordinators, Cheryl Spitzenberger or Natalie Sirisaengtaksin. We ask that you notify GSBS in advance (preferably at least 3 days before the start of the semester) so we can make appropriate arrangements.

<p>Term and Year Fall 2021</p> <p>Course Number and Course Title: GS11 1103 Evolution of DNA and Protein Sequences <i>(Cross listed with UHealth SPH PH1982)</i></p> <p>Credit Hours: 3</p> <p>Meeting Location: UHealth School of Public Health</p> <p>Building/Room#: RAS Building, Room E705 (NEW ROOM LOCATION)</p> <p>WebEx/Zoom Link:</p>	<p>Program Required Course: Yes X No</p> <p>Approval Code: X Yes No</p> <p>(If yes, the Course Director or the Course Designee will provide the approval code.)</p> <p>Audit Permitted: X Yes No</p> <p>Classes Begin: Sept. 2, 2021</p> <p>Classes End: Dec. 9, 2021</p> <p>Final Exam Week: December 13-17, 2021</p>
---	--

Class Meeting Schedule

Day	Time
Thursday	1:00 – 3:50 pm

<p>Course Director</p> <p>Name and Degree: Yun-xin Fu, PhD</p> <p>Title: Professor</p> <p>Department: Department of Biostatistics and Data Science, UHealth School of Public Health</p> <p>Institution: X <i>UTH</i> <i>MDACC</i></p> <p>Email Address: Yunxin.Fu@uth.tmc.edu</p> <p>Contact Number: 713-500-9813</p> <p>Course Co-Director/s: (if any)</p> <p>Name and Degree:</p> <p>Title:</p> <p>Department:</p> <p>Institution: <i>UTH</i> <i>MDACC</i></p> <p>Email Address:</p>	<p>Instructor/s (Use additional page as needed)</p> <p>1.</p> <p style="padding-left: 20px;">Name and Degree</p> <p style="padding-left: 20px;">Institution:</p> <p style="padding-left: 20px;">Email Address :</p> <p>2.</p> <p style="padding-left: 20px;">Name and Degree</p> <p style="padding-left: 20px;">Institution:</p> <p style="padding-left: 20px;">Email Address :</p> <p>3.</p> <p style="padding-left: 20px;">Name and Degree</p> <p style="padding-left: 20px;">Institution:</p> <p style="padding-left: 20px;">Email Address</p>
---	--

<p>Contact Number:</p> <p>NOTE: Office hours are available by request. Please email me and cc: Sara.A.Barton@uth.tmc.edu to arrange a time to meet.</p> <p>Teaching Assistant: (if any)</p> <p style="padding-left: 40px;">Name and Email Address</p> <p style="padding-left: 40px;">Name and Email Address</p>	<p>4.</p> <p style="padding-left: 20px;">Name and Degree</p> <p style="padding-left: 20px;">Institution:</p> <p style="padding-left: 20px;">Email Address</p> <p>Cont. Instructor/s</p> <p>5.</p> <p style="padding-left: 20px;">Name and Degree</p> <p style="padding-left: 20px;">Institution:</p> <p style="padding-left: 20px;">Email Address</p>
--	--

Course description: This course will provide basic principles for understanding factors that govern the evolution of DNA and protein sequences. Students will be provided with the opportunity to learn about the formation and evolution of multigene families, application of phylogenetics for outbreak investigations, epidemiological samples and other evolutionary phenomena. They will also be introduced to statistical methods and computational methods for analyzing DNA and protein sequence data and for reconstructing phylogenies. There will be computer demonstrations of some topics, notably phylogenetic analysis. The application of these principles and methods to genomics, genetic epidemiology, genetic engineering and other issues of practical importance will be discussed.

Textbook/Supplemental Reading Materials (if any)

DO NOT purchase these books as they are on reserve in the UTHealth School of Public Health Library, RAS Building, 1st floor

- Main text: W.-H. Li (1997) Molecular Evolution. Sinauer, Sunderland, MA; is out of print, weekly handouts will be distributed via email to all students or provided in class.
- Secondary texts:
M. Nei and S. Kumar (2000) Molecular Evolution and Phylogenies. Oxford University Press, Oxford and New York.

J. Felsenstein (2003) Inferring Phylogenies. Sinauer, Sunderland, MA.

DA Baum and SD Stacey (2013) Tree Thinking: An Introduction to Phylogenetic Biology. Roberts and Company Publishers. Greenwood Village, Colorado. <http://www.amazon.com/Tree-Thinking-Introduction-Phylogenetic-Biology/dp/1936221160>

- Phylogenetic analysis software (free):
*MEGA (Molecular Evolutionary Genetics Analysis) Version 6.0 (<http://www.megasoftware.net/>)
cf. Nei/Kumar book.
*PHYLIP(<http://evolution.genetics.washington.edu/phylip.html>) cf. Felsenstein book.

* PAUP (Phylogenetic Analysis Under Parsimony* and other methods)

*Other free phylogenetic software is available and can be found at

<http://evolution.genetics.washington.edu/phylip/software.html>.

If you would like to use another phylogenetic analysis package for a specific assignment please speak with the instructor.

* Students with a more advanced background may benefit from use of the Felsenstein text & software instead of Nei & Kumar (please discuss with Instructors)

Course Objective/s:

Upon successful completion of this course, students should be able to understand the key evolutionary processes on both micro- and macro- levels and be able to apply the theory and methods for real data analysis, as reflected in both exams and the course projects.

Specific Learning Objectives:

1. Students will be able to perform intermediate level of evolutionary analyses of DNA and protein sequences.
2. Students will have and will have a broad, comprehensive understanding of molecular evolution --- both qualitative and quantitative.

Student responsibilities and expectations

Students are expected to have basic molecular biology and genetics and adequate math and computer skills.

Handouts will be in either Power Point or PDF format; students are expected to have access to computers with Power Point and Adobe Acrobat reader.

Software: see above. Hardware: having your laptop in class with you would help, but is not essential.

Students enrolled in this course will be expected to attend and participate in all classes lectures and complete homework assignments which will be graded and returned to the student.

Homework will be assigned as well as a "take-home project" which entails reconstructing a phylogeny from the real sequence data (no computer programming skills required) and a polymorphism and molecular clock project.

Homework will be graded and projects will be presented by students in classes and critiqued by the instructors.

Students may work and discuss all course materials and assignments in groups, all writing assignments must be your own. Plagiarism and failure to properly cite scientific literature and other sources will not be tolerated and are grounds for dismissal from the course and further GSBS disciplinary action. Cheating or engaging in unethical behavior during examinations (mid-term and final) will be grounds for dismissal from the course without credit and further GSBS disciplinary action.

Students are expected to prepare for and take an open book mid-term and final examination.

Students enrolled in this course will be expected to perform the following activities each week.

- Class 1 - INTRODUCTION: Gene structure, Genetic Code, Mutation, pre-DNA era analyses of amino acid sequences - Preface & Chapter 1 (Li); Chapters 1-2 (Nei & Kumar)
- Class 2 - DYNAMICS of GENES in POPULATIONS - Chapter 2 (Li)
- Class 3 - EVOLUTIONARY CHANGES in NUCLEOTIDE SEQUENCES - Chapter 3 (Li); Chapter 3 (Nei & Kumar)
- Class 4 - ESTIMATING the NUMBER of NUCLEOTIDE SUBSTITUTIONS BETWEEN SEQUENCES - Chapter 4 (Li); Chapter 4 (Nei & Kumar)*
- Class 5 - MOLECULAR PHYLOGENETICS: METHODS I - Chapters 5-6 (Li); Chapters 7-8 (Nei & Kumar)*
- Class 6 - MOLECULAR PHYLOGENETICS: METHODS II (Applications) - Chapters 5-6; Chapters 7-8 (Nei & Kumar)*
- Class 7 - MOLECULAR PHYLOGENETICS: METHODS III (Project) - Chapters 5-6; Chapters 7-8 (Nei & Kumar)*
- Class 8 - MID-TERM EXAMINATION (In class, open book)
- Class 9 - EVOLUTION by RECOMBINATION, TRANSPOSITION & HORIZONTAL TRANSFER - Chapter 12 (Li)
- Class 10 - DNA POLYMORPHISM in POPULATIONS and POLYMORPHISMS - Chapter 9 (Li) Take home project
- Class 11 - MOLECULAR CLOCKS; SUBSTITUTION PATTERNS IN GENES - Chapter 8 (Li) & Chapter 10 (Nei & Kumar); Chapter 7 (Li)
- Class 12 - EVOLUTION by GENE DUPLICATION; DOMAIN SHUFFLING; CONCERTED EVOLUTION of MULTIGENE FAMILIES; PSEUDOGENES - Chapters 10-11 (Li)
- Class 13 - PRESENT PROJECTS AND DISCUSSIONS
- Class 14 - GENOME ORGANIZATION and EVOLUTION - Chapter 13 (Li)
- Class 15 - FINAL EXAMINATION (In class, open book)

Grading System: X Letter Grade (A-F) Pass/Fail	
Student Assessment and Grading Criteria : (May include the following:)	
Homework (25 %)	Description: A number of graded home work assignments will be given
Quiz (%)	
Presentation (10 %)	Description: Students are expected to give a presentation on at least one homework assignment
Midterm Exams (30 %)	Descriptio: Open book
Final Exam (30 %)	Description: Open book
Workshop or Breakout-Session (%)	
Participation and/or Attendance (5 %)	Description: Students are expected to attend class

CLASS SCHEDULE

Day/Date	Duration (Hr)	Lecture Topic	Lecturer/s
Sept 2	1:00 - 3:50 pm	GENE STRUCTURE, GENETIC CODE, MUTATION, PRE-DNA ERA ANALYSES OF AMINO ACID SEQUENCES	Yun-xin Fu, PhD
Sept 9	1:00 - 3:50 pm	DYNAMICS OF GENES IN POPULATIONS	Yun-xin Fu, PhD
Sept 16	1:00 - 3:50 pm	EVOLUTIONARY CHANGES IN NUCLEOTIDE SEQUENCES	Yun-xin Fu, PhD
Sept 23	1:00 - 3:50 pm	ESTIMATING the NUMBER of NUCLEOTIDE SUBSTITUTIONS BETWEEN SEQUENCES	Yun-xin Fu, PhD
Sept 30	1:00 - 3:50 pm	MOLECULAR PHYLOGENETICS: METHODS I	Yun-xin Fu, PhD
Oct 7	1:00 - 3:50 pm	MOLECULAR PHYLOGENETICS: METHODS II (Applications)	Yun-xin Fu, PhD
Oct 14	1:00 - 3:50 pm	MOLECULAR PHYLOGENETICS: METHODS III (Project)	Yun-xin Fu, PhD

Oct 21	1:00 - 3:50 pm	MID-TERM EXAMINATION (In class, open book)	Yun-xin Fu, PhD
Oct 28	1:00 - 3:50 pm	EVOLUTION BY RECOMBINATION, TRANSPOSITION & HORIZONTAL TRANSFER	Yun-xin Fu, PhD
Nov 4	1:00 - 3:50 pm	DNA POLYMORPHISM in POPULATIONS and POLYMORPHISMS	Yun-xin Fu, PhD
Nov 11	1:00 - 3:50 pm	MOLECULAR CLOCKS; SUBSTITUTION PATTERNS IN GENES	Yun-xin Fu, PhD
Nov 18	1:00 - 3:50 pm	EVOLUTION by GENE DUPLICATION; DOMAIN SHUFFLING; CONCERTED EVOLUTION of MULTIGENE FAMILIES; PSEUDOGENES	Yun-xin Fu, PhD
Nov 25	No class	Thanksgiving Day Holiday	--
Dec 2	1:00 - 3:50 pm	PRESENT PROJECTS AND DISCUSSIONS	Yun-xin Fu, PhD
Dec 9	1:00 - 3:50 pm	GENOME ORGANIZATION AND EVOLUTION	Yun-xin Fu, PhD
Dec 16	1:00 - 3:50 pm	FINAL EXAMINATION (In class, open book)	Yun-xin Fu, PhD

NOTE: GS11 1103 is cross listed with UHealth SPH PH1982

jal/04.21