
OEB125: Genome Analysis, Ecology and Evolution, Fall 2023

Instructor: Scott V. Edwards, Professor, OEB/MCZ

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Office hours: Fri, 3 pm, MCZ 111A

Teaching Assistants: Kelsie Lopez kelsielopez@g.harvard.edu (3rd year OEB grad student)

Shuzhe (â€˜Jerryâ€™) Guan sguan@g.harvard.edu (2nd year OEB grad student)

Office hours: Fri, 12 noon or by appointment

Lectures will be held on Tuesdays and Thursdays from 12:00 â€“ 1:15 pm in MCZ 202 (2nd floor)

Laboratories to be scheduled; tentatively Wednesdays or Fridays 10-12 or 3-5 PM. Location to be determined.

Lecture Schedule

Week	Date	Section title/topic	Reading*
		Principles of Molecular Evolution	
1	Sept. 5	Course Introduction	MGE, chapter 1
	Sept. 7	Gene structure, genetic code	MGE, chapter 8

			MPG chapter 2
2	Sept. 12	Genes and genomes	MGE, chapter 9
	Sept. 14	Population Genetics I: mutation, genetic drift	MGE, chapter 2 MPG, chapter 1
3	Sept. 19	Population Genetics II: drift continued, fixation	MGE, chapter 2
	Sept. 21	Genetic drift continued	MGE, chapter 4
4	Sept. 26	Molecular clocks, neutral theory	MGE, chapter 2
	Sept. 28	Nearly neutral theory; linkage and selection	MPG, chs. 4, 7 & 8
5	Oct. 3	Phylogenetic methods: parsimony, distance and likelihood methods	MGE, chapters 3,5
	Oct. 5	Phylogenetic methods continued	
6	Oct. 10	**DEBATE**: The Neutral Theory of Molecular Evolution Lecture: Phylogenetic methods continued	
	Oct. 12	Gene regulation, duplication and adaptation	MGE, chapter 7
7	Oct. 17	**Midterm Exam**	
		The Tree of Life	
	Oct. 19	Genes trees and coalescent theory	MPG, ch. 6
8	Oct. 24	Gene trees and species trees	Paper handout
	Oct. 26	Phylogenomics and the Tree of Life	MGE, chapter 10

		DEBATE: Coalescence vs. concatenation in phylogenomics	
9	Oct. 31	Guest lecture: Dr. Xuhua Xia. Microbial genome evolution	Paper handout
	Nov. 2	Guest lecture. Dr. Liming Cai: Plant phylogenetics and horizontal transfer	Paper handout
		Genomic diversity within species and speciation	
10	Nov. 7	Principles of phylogeography	handouts
	Nov. 9	Phylogeography in the next-gen era	MPG ch. 10
11	Nov. 14	Human evolution I	MPG ch. 9
	Nov. 16	Human evolution II	Handout
12	Nov. 21	Human evolution III	handouts
		DEBATE: Genomics and human population variation	
	Nov. 28	Conservation genetics	handouts
13	Nov. 30	Genome variation in health and disease	
	Dec. 5	**In-class Final exam**	
	Dec. 10	**Final projects due**	

*Course textbooks, available for purchase online, at the Coop and elsewhere (we will also have pdfs of each chapter available for temporary â€œloanâ€ from the Ernst Mayr library):

Abbreviations: MGE = *Molecular and Genome Evolution;* MPG = Molecular Population Genetics.

1) *Molecular and Genome Evolution*

(Dan Graur, 2016); Sinaur Associates/Oxford University Press (ISBN 9781605354699).

Library e-link here.

2) *Molecular Population Genetics*. Matthew Hahn. 352 Pages. Oxford University Press (ISBN: 9780878939657)

Library e-link here.

Additional background reading:

3) *An Introduction to Molecular Ecology* 3rd edition. 2017. Graham Rowe, Michael Sweet and Trevor Beebee. ISBN: 9780198716990. Publisher: Oxford U. Press.

Library e-link here.

Review sessions can be arranged with the instructors, and will be held before the midterm and final exams at times to be arranged.

OEB125 Computer labs â€“ tentatively Wednesdays/Fridays 10-12 or 3-5 PM (location to be determined)

Week	Topic	Software	Homework due this week
1	No meeting	-	No assignment
2	Discussion	-	Short reading/writing assignment
3	Genome assembly, transposable	Repatmasker,	2-page paper contrasting Kimura's view of

	elements	BLAST	organismal and molecular evolution
4	Genome assembly, quality assessment	Hifiasm, seqtk	Blast analysis and GC content
5	Measuring selection on proteins	PAML	Genome assembly and quast
6	Maximum likelihood phylogenies	Iqtree/phylip	Adaptive protein evolution
7	Parsimony and bootstrapping	Phylip - DNApars	none
8	Species trees and coalescence	Phybase (R); MP-EST	Mini-project: substitution models and phylogeny
9	Coalescence and Bayesian phylogenetics	MP-EST and bpp	Model selection and molecular clocks
10	Gene flow and genetic diversity within species	PopGenome (R) and MIGRATE	Answer questions outlining final project and providing a citation and sources of sequence data (due Friday Nov. 3)
11	Genetic diversity II/Species delimitation	Gene flow within species	Lab homework: gene flow
12	Consult on final projects	Individual meetings	Work on final projects
12	Work on projects	Open lab	-

13		Final projects due Dec 7

Collaboration Policy Statement

Discussion and the exchange of ideas are essential to doing academic work. For assignments in this course, you are encouraged to consult with your classmates as you work on problem sets. However, after discussions with peers, make sure that you can work through the problem yourself and ensure that any answers you submit for evaluation are the result of your own efforts. In addition, you must cite any books, articles, websites, or lectures that have helped you with your work using appropriate citation practices. Similarly, you must list and acknowledge the names of students with whom you have consulted on problem sets. This policy applies both to weekly problem sets as well as to final projects.

Grading:

Activity	**Percent of final grade**
Laboratories, Homework and Discussion	25
Midterm Exam	25
Final Project	25
Final Exam	25