

Course Syllabus: EEOB 561: Evolutionary and Ecological Genomics

Instructor: Matthew Hufford

Offered: Spring Term 2018, WF, 1:10-2:30pm

Location: 203 Bessey Hall

Email: mhufford@iastate.edu; please begin all email subjects with "EEOB 561"

Office Hours: by appointment

******All course materials will be posted on Blackboard Learn******

Rationale for EEOB 561:

Until recently, high density, "omic" data have been limited to model systems. As the cost of data has fallen and data quality and analysis pipelines have improved, genomic data are increasingly being used to address evolutionary and ecological questions across a range of non-model study systems. In this course we will survey recent advances and consider how researchers working in the realms of ecology and evolution can utilize omic data in their research.

Overview of Course:

Following an overview of omic data generation platforms and computational tools, the course will focus on how these data are being (or could be) applied to answer novel questions in evolution and ecology. Initial lectures will survey sequencing methods (*e.g.*, Sanger, HiSeq, MiSeq, Ion Torrent, PacBio, Nanopore) and the manner in which data are generated to study various fractions of the genome (*e.g.*, RNASeq to evaluate the transcriptome, bisulfite sequencing to evaluate the methylome, MNase and ATAC-Seq to survey open chromatin). This will be followed with a brief overview of computational tools and pipelines for analysis of large, genomic data sets. The course will then progress through ten weeklong modules, each tackling a different topic in evolution or ecology. Modules will begin with a lecture overviewing longstanding questions in these fields followed by discussion of 1-2 recent scientific studies (each registered student will be responsible for facilitating the discussion of one paper) and will conclude with consideration of how omic data will continue to contribute to each field. The final week of the semester will consist of student presentations describing the potential application of omic data to an evolutionary or ecological question of interest.

Course Schedule:

Section 1: Genome Sequencing & Analysis:

Date	Instructor	Topic
Wed., Jan. 10	Hufford	Course Introduction, Genome Sequence & Assembly
Fri., Jan. 12	Hufford	Genome Sequence & Assembly
Wed., Jan. 17	Hufford	Genotyping Methods

Fri., Jan. 19	Hufford	Transcriptomics, Methylomics, Profiling Open Chromatin
Wed., Jan. 24	Hufford	Intro. to scripting and coding best practices
Fri., Jan. 26	Hufford	Quality control, Data deposition, Utilizing Published data
Wed., Jan. 31	Hufford	Intro. to HPC, Computational Exercise
Fri., Feb. 2	Hufford	Computational Exercise

Section 2: Evolutionary Genomics

Wed., Feb. 7	Hufford	Experimental Evolution Take Home Exam #1 DUE by 5:00 PM
Fri., Feb. 9	Hufford	Experimental Evolution
Wed., Feb. 14	Hufford	Genome Structure and Evolution
Fri., Feb. 16	Hufford	Genome Structure and Evolution
Wed., Feb. 21	Hufford	Speciation, Hybridization & Introgression
Fri., Feb. 23	Hufford	Speciation, Hybridization & Introgression
Wed., Feb. 28	Hufford	Domestication
Fri., Mar. 2	Hufford	Domestication
Wed., Mar. 7	Hufford	Phylogenomics
Fri., Mar. 9	Hufford	Phylogenomics

Section 3: Ecological Genomics

Wed., Mar. 21	Guest	Topic TBD Take Home Exam #2 DUE by 5:00 PM
Fri., Mar. 23	Guest	Topic TBD
Wed., Mar. 28	Hufford	Conservation Genomics
Fri., Mar. 30	Hufford	Conservation Genomics
Wed., Apr. 4	Hufford	Biological Invasions
Fri., Apr. 6	Hufford	Biological Invasions
Wed., Apr. 11	Hufford	Rapid Environmental Change
Fri., Apr. 13	Hufford	Rapid Environmental Change
Wed., Apr. 18	Hufford	Local Adaptation
Fri., Apr. 20	Hufford	Local Adaptation
Wed., Apr. 25	Hufford	IN-CLASS PRESENTATIONS
Fri., Apr. 27	Hufford	IN-CLASS PRESENTATIONS
Fri., May 4		Take Home Exam #3 DUE by 5:00 PM

Student Evaluation:

Exam 1	20%
Exam 2	20%
Exam 3	20%
Paper Presentation	10%
Final Presentation	10%
Applying Omic Data	10%
Participation	10%

Late work and plagiarism/other forms of academic misconduct will result in a zero grade for the relevant assignment. Students suspected of academic misconduct will be referred to the Dean of Students Office. For information on ISU's Standards of Academic Integrity, please see the following website:

<http://www.dso.iastate.edu/ja/academic/students>

Grading Scale:

<u>Grade</u>	<u>Score (=s)</u>
A	$s \geq 92$
A-	$90 \leq s < 92$
B+	$88 \leq s < 90$
B	$82 \leq s < 88$
B-	$80 \leq s < 82$
C+	$78 \leq s < 80$
C	$72 \leq s < 78$
C-	$70 \leq s < 72$
D+	$68 \leq s < 70$
D	$62 \leq s < 68$
D-	$60 \leq s < 62$
F	$s < 60$

Grades will not be curved.

Assignment Details:

1) Paper Presentation:

During Sections 2 & 3 of the course, each Friday will be largely comprised of discussion of recent primary literature. Each student will be responsible for presenting one paper during the course of the semester. Presentations should describe: 1) The omic methods used and whether they are appropriate given the research question; 2) the main findings and whether they are truly supported by the analyses; 3) suggestions for appropriate next steps given the authors' findings. Presentations should encourage class discussion. Topic assignment will be on a first-come, first-served basis and preferences

should be emailed to Dr. Hufford. Paper selections should be made in consultation with Dr. Hufford.

2) Final Presentation:

During the final week of the course, each student will give a 15-20 minute presentation in which they describe how an omic approach could be implemented to answer a relevant question in ecology or evolution. The presentation should include: 1) Background on the topic; 2) A list of hypotheses and/or objectives; 3) Summary of omic methods that could be applied; 4) Anticipated results.

3) Applying Omic Data:

During Sections 2 & 3 of the course, students will be asked to describe a potential research direction for each module topic. By noon each Friday, students should email Dr. Hufford a short paragraph (3-5 sentences) describing a potential research direction. We will discuss these submissions during the final portion of class on Friday.