Genetics 462— Evolutionary Genetics — Course Syllabus — Fall 2014

Instructor: Luke Hoekstra, PhD (office hours: by appt.)
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Course Content: This 3-credit course will focus on genetic and selective processes at the population level that are responsible for the generation and maintenance of biological diversity. We will begin with a discussion of variation and move from there to basic population genetic theory and variations on that theme. We will then discuss applications of the newest high-throughput sequencing technologies to evolutionary genetics. Next we will briefly evaluate the role of population genetics in the fields of molecular evolution and speciation. Afterward we will extend the theory and concepts of population genetics to more complex, quantitative traits. Finally, to tie the discussion of genetic machinery firmly into adaptive evolutionary processes, we will explore and apply the statistical tools of multivariate selection theory.

Course Prerequisite: BIOL 315 or equivalent evolution course. A course in statistics, particularly a STAT 401-type course or higher, will be helpful.

Textbook: ***A Primer of Ecological Genetics*, by Conner & Hartl** and other materials as assigned. Readings for particular topics.

Classes: We will meet in 1012 COOVER from 09:30 sharp to ~10:45 on Tuesdays and Thursdays. I encourage you to ask questions even if they seem simple and you think you just dozed off and missed the point. You will not benefit if you do not understand what we are discussing. I expect you to attend class regularly and promptly. The exams will derive almost entirely from lectures.

Disability accommodation: **If you have a documented disability and anticipate needing accommodations in this course, please make arrangements to meet with me by the end of the first week of class. Please also request that a Disability Resources staff member (1076 Student Services Building, 4-6624) send a SAAR form verifying your disability and specifying the accommodation you will need.**

Academic dishonesty: The class will follow Iowa State University's policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office. http://www.dso.iastate.edu/ja/academic/misconduct.html

Dead week: This class follows the Iowa State University Dead Week guidelines as outlined in http://catalog.iastate.edu/academiclife/#deadweek

Harassment and discrimination: Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. Any student who has concerns about such behavior should contact his/her instructor, Student Assistance at 515-294-1020 or email dso-sas@iastate.edu, or the Office of Equal Opportunity and Compliance at 515-294-7612.

Religious accommodation: If an academic or work requirement conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be in writing, and your instructor or supervisor will review the request. You or your instructor may also seek assistance from the Dean of Students Office or the Office of Equal Opportunity and Compliance.

Contact Information: If you are experiencing, or have experienced, a problem with any of the above issues, email academicissues@iastate.edu.

Course Requirements:

Participation in each of the following 4 areas is mandatory for a passing grade irrespective of the proportion of final course grade based on each area.

1) Take-home and in-class exercises 35%

Assignments will range from problem solving to small group exercises. These will be interspersed throughout lectures. An unexcused absence during the time of the in-class exercise will earn a grade of zero.

2) Midterm exam 25%

The midterm exam will consist of about 10 questions. Coherent writing will be necessary to answer the questions; a calculator may be useful for some questions. An unexcused absence will earn a grade of zero. If you know you will miss the exam, tell me beforehand so I can make arrangements.

3) Take-home final exam 25%

The final exam will focus entirely on problem solving and interpretation, will be comprehensive but emphasize the latter portion of the course, and will be take-home. You can use other resources if you feel they are necessary, but you must work on the exam questions by yourself. I will hand out the exam in class on 11 December. It will be due in Dr. Hoekstra's office by 5 PM on 18 December to permit time for grading.

4) Evolutionary Genetics Application Presentation 15%

To learn about Evolutionary Genetics Applications, the class will form small groups (consisting of 3-4 students), each of which will research and present on a specific topic. The presentations will take place at the end of the semester. Details of the assignment and a grading rubric will be handed out well in advance. Each group member will have the opportunity to evaluate the contributions of the other group members.

Grade Scale:

A	92 – 100%
A-	89 - 91
B+	86 - 88
B	82 - 85
B-	78 - 81
C+	74 - 77
C	69 - 73
C-	65 - 68
D+	62 - 64
D	58 - 61
D-	55 - 57
Fail	<55

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Note: This is the proposed schedule of topics and text book reading assignments. Additional readings will be assigned and topics may deviate from this schedule. Follow the course's Blackboard site for current information on lectures, assignments, and readings.

DATE	TOPIC	READING
Population Genetics:		Conner & Hartl
8/26	Introduction, Overview, Background	pp. 1-8
8/28	Phenotypic and genetic variation, Molecular markers, Populations	pp. 9–24
9/2	Hardy-Weinberg principle	pp. 25-36
9/4	Non-random mating—Assortative mating and inbreeding	pp. 36–43
9/9 & 11	Random genetic drift – Effective population size	pp. 52–66
9/16	Migration – F-statistics, population subdivision,Wahlund principle	Ch9, Halliburton
9/18	Migration Models -- Wright's island model, Stepping-stone model	pp. 48–51,
9/23 & 25	Mutation & the Neutral Theory of Molecular Evolution	pp. 47, 1° literature
9/30	Sex-linkage and linkage disequilibrium	pp. 157–160
10/2	Natural selection--Fitness, selection coefficient Natural selection--overdominance, underdominance, etc.	pp. 66–71 pp. 71–76
10/7	More natural selection--Mutation-selection balance, genetic load, Haldane's Sieve, Fisher's Fundamental Theorem	pp. 76–89
10/9	Molecular evolution & Phylogenetics	Ch7, Hartl & Clark
10/14	Population Genomics	Ch9, Hartl & Clark
10/16	GenBank Lab	
10/21	Population Genomics continued	
10/23	MIDTERM EXAM	

Evolutionary Quantitative Genetics:

10/28	Quantitative genetic traits & statistical measures/methods--phenotypic plasticity, reaction norms, genotype-by-environment interactions	pp. 97–107, 137–145
10/30	Partitioning phenotypic variation; Repeatability Heritability--broad-sense, narrow-sense, estimation, interpretation	pp. 108–111 pp. 112–133
11/4	Genetic covariances and correlations Experimental methods of quantitative genetics -- Selection differentials, response to selection	pp. 150–163. pp. 145–149 pp. 163–170
11/6	Multivariate selection--correlated response, selection gradient, predicting/reconstructing adaptive evolution	pp. 189–210, 216–223
11/11	Association mapping -- QTL/GWAS	pp. 170–180
11/13	GWAS continued	1° literature
11/18	Selected topic	TBD

Evolutionary Genetic Applications:

11/20	In-class project work
11/24	No class - Thanksgiving break
11/27	No class - Thanksgiving break
12/2	In-class project work
12/4	Presentations
12/9	Presentations
12/11	Presentations
12/18	FINAL EXAM DUE BY 5 PM!