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Plant Biology/Integrative Biology
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IB 405, Spring 2013
MWF: 11:00-11:50am
101 Transportation Bldg.

Integrative Biology 405: Ecological Genetics
Course Moodle: https://moodle.life.illinois.edu/

In this course, we will focus on the genetic (either classical or molecular) underpinnings of ecologically-relevant (i.e., fitness-related) traits in natural populations. Ecological Genetics is a diffuse field that straddles ecology, evolution, and genetics, and increasingly incorporates molecular biology, bioinformatics, and genomics.

Our course has two goals: first, is to expose you to Ecological Genetics through content (research questions, approaches, and results) typical of this field. Second, is to build your skill set as a scientist. We will work on a theme each week (e.g., "genetic variation"), structuring our week to approach both content and skill-building through book readings, lectures, paper discussions, and various types of in-class work (graded or not), both in groups or individually.

Skills are focused on: 1) doing research science (for example, having Katy's job at a major research university), 2) what will make biology graduate school easier for you (getting in and succeeding), and 3) what employers want from recent college graduates (of all ilks).

Mondays: Lecture
Learning objectives: Lectures and readings are my main avenue for communicating course content. Lecture and book readings are intended to give you an overview of contemporary research questions and approaches, as well as classic knowledge already acquired through research in this field (Conner and Hartl 2004). Lecture will complement and highlight, not duplicate, book readings.

Wednesdays: Paper discussions
Learning objectives: Reading, processing, and discussing the primary literature is intended to engage you in course content, develop critical evaluation skills, develop listening and communication skills, improve intellectual agility, and hopefully inspire you to learn more about this field (Soranno 2010). Critical reviews formalize the process of reading and studying the primary literature (3 per semester).

Fridays: Lecture/Group work/In-class homework
Learning objectives: Friday work hour is intended to teach you to focus and work efficiently towards solving ecological genetics problems and synthesizing course material. In other words – to make you into an ecological geneticist! We don't take exams: we solve problems!

To this end, Fridays will incorporate mini proposals, mini papers, case studies, and/or problem sets – all forms of formative assessment – to get you thinking on your feet and allow me to gauge student learning as we progress through the course. Activities will be performed in groups, individually, or both. Friday activities will often be a surprise and will often be open-book/open-notes. You will be accountable for utilizing Monday and Wednesday's material each Friday. Don't worry: I will grade easy in the beginning, and you get to drop the worst 2 assignments. I hate assigning letter grades. This is a necessary evil, but not the main goal of my assessments.

BUT WHY?! My philosophy: If you are actually accountable for learning and using course content every time you are in class, then I am forcing you to engage with the material every time I see you. Otherwise our human instinct and past training tells us to passively listen until you need to study for an exam, at which point it's too late. This is NOT how adults learn (Handelsman et al. 2007). In this course, I am actively trying to break the cycle of exam cramming followed by immediate purging. While this cycle might be more comfortable and easier for both of us, it does not actually contribute much to learning, has limited value for improving critical thinking, and moreover can never transform you into an ecological geneticist! Huzzah!

References:
Handelsman, J., Miller, S., and Pfund, C. 2007. Scientific teaching. W.H. Freeman and Company. New York, NY.
Soranno., P.A. 2010. Improving student discussions in graduate and undergraduate courses: transforming the discussion leader. J. Nat. Res. Life Sci. Ed. 39: 84-91.

Course text: Conner J.K., and Hartl, D.L. 2004. A primer of ecological genetics. Sinauer Associates, Inc. Sunderland, MA. **http://www.amazon.com/Primer-Ecological-Genetics-Jeffrey-Conner/dp/087893202X**

Assignments:
Critical reviews: 20pts x 3 = 60pts
Discussion attendance: 20pts total
Friday assessments: 20pts x 14 weeks = 240pts (drop worst 2 weeks!)
TOTAL: 320pts

Late assignments: Late assignments will receive 10% deduction for each day late.

Grading scale: These are the guaranteed percentages of total points needed for each grade. I may curve everyone up at the end of the semester, if I believe that the grading scale is too severe. I also may apply two separate grading scales to undergrad/grad students, if need be.

A+ $\geq$ 98%
A $\geq$ 93%
A- $\geq$ 90%
B+ $\geq$ 88%
B $\geq$ 83%
B- $\geq$ 80%
C+ $\geq$ 78%
C $\geq$ 73%
C- $\geq$ 70%
D+ $\geq$ 68%
D $\geq$ 63%
D- $\geq$ 60%
Below 60 = F

This course will follow all policies in the Student Code:
http://www.admin.illinois.edu/policy/code/index.html

Attendance: Attendance at all class sessions is mandatory. You will be responsible for daily assignments and thus cannot afford to miss many class sessions. If you need to be excused for any reason, talk to me. You will need prior approval from me and/or documentation (doctor's note, athletic department note, emergency dean approval) in order to make up any missed assignments or have them prorated. In the case of absences, excused or otherwise, it is your responsibility to 1) get caught up on content that you missed by getting notes from your peers, reading, etc., and 2) contact me about make up assignments and/or prorates, depending on the nature of the missed work and the length of illness within 2 weeks of missing the activity. Travel, weddings, jobs, other courses, etc. are not excused absences.

Academic integrity: See Article 104 (1-401 through 1-406) of the Student Code. This rule defines infractions of academic integrity, which include but are not limited to cheating, fabrication, and plagiarism. To learn more, including possible penalties, see the following website. You are responsible for being knowledgeable about what these infractions are and for following these guidelines. http://www.admin.illinois.edu/policy/code/article1_part4_1-401.html

Accommodations: If you require special accommodations, please tell me ASAP. All accommodations will follow the procedures as stated in Article 1-110 of the Student Code: http://www.admin.illinois.edu/policy/code/article1_part1_1-110.html

Course Schedule:
Unless otherwise stated, chapter readings in parentheses refer to the Connor & Hartl text, and course structure is Monday lecture, Wednesday paper discussion (PDFs will be posted on moodle), and Friday activities (these will vary week by week).

Week of January 14: Genetic variation 1

Monday: Pre-course feedback, introductions, lecture
Wednesday: No class: Katy is in DC at NSF!
Friday: Discussion: this syllabus and Soranno 2010

Readings: Chapter 1 & Chapter 2 (through pg. 22)
Paper: Soranno., P.A. (2010) Improving student discussions in graduate and undergraduate courses: transforming the discussion leader. J. Nat. Res. Life Sci. Ed. 39: 84-91.

Week of January 21: Genetic variation 2

Monday: MLK day - no class!
Wednesday: Discussion: Lasky et al. 2012 and Tonsor 2012 (critical review; use Lasky)
Friday: finish lecture & activities

Readings: no chapter reading
Wed. Papers: Lasky JR, Marais Des DL, McKay JK, Richards JH, Juenger TE, et al. (2012) Characterizing genomic variation of Arabidopsis thaliana: the roles of geography and climate. Mol Ecol 21: 5512–5529. doi:10.1111/j.1365-294X.2012.05709.x.
Tonsor SJ (2012) Population genomics and the causes of local differentiation. Mol Ecol 21: 5393–5395. (a short perspective on the Lasky article)

Week of January 28: Population genetics 1: Hardy-weinberg and nonrandom mating

Readings: finish Chapter 2
Wed. Paper: Boys et al. 2005
Boys J, Cherry M, Dayanandan S (2005) Microsatellite analysis reveals genetically distinct populations of red pine (Pinus resinosa, Pinaceae). American Journal of Botany 92: 833–841. doi:10.3732/ajb.92.5.833.

Week of February 4: Population genetics 2: Mutation and drift

Readings: Chapter 3, through pg. 66
Wed. Paper: Lozier et al. 2011

Week of February 11: Population genetics 3: natural selection and intro to molecular evolution

Readings: finish Chapter 3
Wed. Paper: Tschirren et al. 2011

Week of February 18: Quantitative genetics 1: the additive model and variance partitioning

Readings: Chapter 4
Wed. Paper: Hoffmann & Schiffer 1998

Week of February 25: Quantitative genetics 2: G x E and genetic correlation

Readings: Chapter 5 through “artificial selection” (ends pg. 170)
Wed. Paper: Donohue & Schmitt 1999

Week of March 4: Quantitative genetics 3: mapping

Readings: finish Chapter 5
Wed. Paper: Colosimo et al. 2004

Week of March 11: Measuring selection 1: phenotypes

Readings: Chapter 6 (to middle of pg. 216)
Wed. Paper: Etterson & Shaw 2001

Week of March 18: Spring break!

Week of March 25: Selection and the evolutionary response

Readings: Finish Chapter 6
Wed. Paper: Mojica et al. 2012

Week of April 1: Ecological genomics: molecular tests of selection

Readings: Hohenlohe et al. 2010
Hohenlohe PA, Phillips PC, Cresko WA (2010) Using Population Genomics to Detect Selection in Natural Populations: Key Concepts and Methodological Considerations. Int J Plant Sci 171: 1059–1071. doi:10.1086/656306.
Wed. Paper: Hohenlohe et al. 2010 PloS Genetics

Week of April 8: Coevolutionary genetics

Readings: Thompson 2005 Chapters 1 & 5
Wed. Paper: Newman et al. 2006 PNAS

Week of April 15: Community genetics

Readings: Hersch-Green et al. 2011
Hersch-Green EI, Turley NE, Johnson MTJ (2011) Community genetics: what have we accomplished and where should we be going? Philos T R Soc B 366: 1453–1460. doi:10.1098/rstb.2010.0331.
Wed. Paper: Wise & Rausher 2013 Evolution

Week of April 22: Applied ecological genetics

Readings: Chapter 7
Wed. Paper: Hegreness et al. 2008 PNAS

Week of April 29: TBA

Monday: Student-designed assessment 1
Wednesday: Course reflection & student-designed assessment 2