BIOL 60.1: Winter 2017
(Calsbeek) **Tues & Thurs, 10-11:50**

BIOL 60.1: Advanced Topics in Ecology and Evolution I

General Course Description: This is an advanced undergraduate/graduate student level course geared towards building breadth and depth of understanding of the theoretical and empirical basis for current areas of importance in ecological and evolutionary research, while tracing the historical foundations of these areas. Students will read key papers and texts and assimilate this information through written assignments and in-class discussions. Important subfields of modern ecology and evolutionary biology covered in this class will include (but not be limited to): microevolution and quantitative genetics, speciation and developmental genetics, integrative biology and phenotypic evolution, mating systems, life-history evolution, molecular population genetics, genomics, and phylogenetics.

Course Expectations: All students are expected to participate actively in class and elevate the level of discussion on topics in modern ecology and evolutionary biology. Students are expected to read *extensively* outside of class, including numerous scientific papers and any core text assignments. Students will complete individual projects such as mock grant proposals and review or perspective articles specific to each topic.

Educational Goals: Improve breadth and depth of understanding of classic and modern areas of focus in ecology and, in particular, evolutionary biology. Develop critical thinking skills and identify connections between topics of broad importance in ecology and evolutionary biology (and for graduate students, the more specific areas of Ph.D research). Become a well-read and well-rounded evolutionary ecologist with focus in areas of research that overlap with typical projects in the Biology department and with emerging areas of importance in modern ecology and evolution.

Grading: Based on class participation and performance on assignments.

Class Times and Locations: 10A Tuesdays and Thursdays from 10a.m. through 11:50 a.m.

Integrative Organismal Biology: Phenotypes as links between genes and environments

Specific Course Description (yr. 2017): Phenotypes are what selection acts upon, thereby determining which underlying genes are passed on in a particular environment. As such, the phenotype is a point of integration for linking genetics, development, behavior, physiology, life history, and ecology. This course will explore these areas from the standpoint of integrative organismal biology, which combines the study of the proximate genetic, developmental, and physiological mechanisms that give rise to phenotypic variation with the study of the ultimate evolutionary and ecological forces that determine the consequences of this variation. This course will also integrate different methodological approaches – descriptive, comparative, and experimental – that are commonly employed in evolutionary ecology, while exploring the strengths and limitations of each.

Learning objectives: At the end of this course, you will have strengthened your ability to:

- empirically and conceptually link genetics, development, physiology, behavior, life history, and ecology as they relate to phenotypic evolution
- identify the historical foundations of and emerging research areas in evolutionary ecology

- recognize the strengths and limitations of inferences derived from descriptive, comparative, and experimental approaches in evolutionary ecology
- critically read, interpret, evaluate, and synthesize peer-reviewed scientific literature
- ask important and exciting questions and propose appropriate studies to test hypotheses using an integrative framework that spans methodologies and levels of biological organization

Course Materials: No primary text. Readings, lectures, and assignments are posted on Canvas.

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Academic honesty is essential. The following is quoted directly from the Dartmouth College Student Handbook : "Students who submit work that is not their own or who commit other acts of academic dishonesty forfeit the opportunity to continue at Dartmouth." The complete text of the Academic Honor Principle is in the Student Handbook or at (http://www.dartmouth.edu/~deancoll/documents/handbook/conduct/standards/honor.html). Please read the Honor Principle carefully; ***you*** are responsible for knowing and understanding the Honor Principle, and adhering to its letter and spirit. Any violations of the Honor Principle in this course must be referred to the Committee on Standards and can result in your suspension for multiple terms, or, in the most extreme cases, separation from the College.

Special Circumstances I encourage students with learning, physical, or psychiatric disabilities that may need special classroom accommodations to make an appointment to see me by the end of the second week of the term. All discussions will be confidential, although we may need to consult the Student Accessibility Services office to discuss implementation of special requests.

I recognize that some students may wish to take part in religious observances that fall during the term. Should you have a religious observance that conflicts with your participation in the course, please speak with me by then end of the second week of the term to discuss appropriate accommodations.

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Class Format: Each class will begin with a **brief lecture** setting the topic in historical context, introducing relevant terminology and ideas, and providing appropriate background. This will segue into a **discussion of an important historical paper** in the field ("something old"). I will lead this portion of class. After a short break, we will reconvene to **critically discuss a recent paper** ("something new"). For each class, one of you will lead this discussion, which will draw heavily upon questions and ideas submitted to Canvas by other students prior to class.

Leading Discussion: Each of you will lead discussion once in the quarter. This will include walking the class authoritatively through the reading and integrating the ideas and questions submitted by other students (below), and providing a brief slide show that highlights the results of the paper and relevant work. Meet with me in well in advance (>1 day) if you want guidance.

Weekly Assignments: By 10 AM one day prior to each class, you will each submit a succinct, well-reasoned, well-argued question, critique, or idea for discussion in class. I will provide some examples in the first few classes. These submissions should be insightful and demonstrative of familiarity with the readings and topic for class. Each week, half of you will submit questions for Tues class and the other half will submit questions for Thurs class, via "Forum" in Canvas.

Mid-term Assignment: Due half way through the quarter (i.e, **due Feb 2**), you will each submit a short (**4 pages**, **single spaced**, with **1-3 figures or tables**) written assignment. You have two options for this assignment, choose whichever you feel is of greater benefit to you:

1) Critical review/perspective/synthesis article: Write a short article that makes a novel contribution to a topic discussed in class. This can take several forms. You might make a new connection between ideas or systems, one that has not been previously explored, or provide a prospectus for a new direction and/or approach in a particular field, or even synthesize empirical results into a conclusion about the extent to which a particular idea or hypothesis is broadly supported (or not) based on existing empirical work. If theory is your focus, you could even develop a new theoretical or analytical framework. The idea here is that you try to go above and beyond a simple literature review of what others have found and present something novel. If you uncover something that is sufficiently new and interesting that you think there is potential for a peer-reviewed article, then your goal is to convince the class of this and enlist our assistance as friendly peer-reviewers, collaborators, co-authors, or whatever you need to get a paper published. **Check out:** "Reviews and Opinions" format in *Trends in Ecology and Evolution*, or "Ideas and Perspectives" and "Reviews and Syntheses" format in *Ecology Letters* for general templates.

2) Short-format grant proposal: Write a short-format grant proposal that identifies a problem of significance in the field of evolutionary ecology, then proposes a study or set of studies that will solve (or make significant progress toward solving) the problem. For the purposes of this assignment, assume that you are limited to an approximate budget of $20,000 or something in that ballpark, though you do not have to provide a budget or budget justification. Your proposal should begin with a succinct introduction and clear statement of the problem or hypothesis, why it is important, and how you will solve or test it. Then, briefly cover any necessary background and present your study system and research objective(s). Next, describe your study design, the data that you will collect, and how they will meet your objectives and thereby solve or test your problem or hypothesis. You don't have to pick the biggest question in the field, as this is a short proposal. Focus on something novel and important, but something reasonable for a small grant.

Some general guidelines for either option:

- Choose something relevant to the **theme of the course**, or that stems from our discussions or an article that we read. However, this theme of "the phenotype as a link between genes and environments" can be very broadly defined if you want to attempt to blend it with your own research. In fact, I encourage you to tie this assignment in with your own research interests.
- In the spirit of "integrative biology" attempt to combine **proximate mechanism** (genetics, development, physiology) with **ultimate causation** (evolutionary processes and outcomes, selective forces, ecological factors) in a way that is compelling and complementary.
- **Start early!** Identify a topic within the first few weeks of class and channel information from subsequent classes and readings into your outline as you go. Meet with me to discuss ideas.

Final Presentation: On the final classroom day of the term, you will each present a short (7-8 min, plus 7-8 min for questions) Powerpoint presentation of your final proposal (<10 slides). If you choose Option 1, your goal is to present your perspective or synthesis as a conference talk. If you choose Option 2, your goal is to convince the audience that you have selected an appropriate set of studies for an integrative assessment of an important question in evolutionary ecology. Use feedback from the class to preparing your final paper or grant proposal due the following week.

Schedule of lecture topics and list of assigned readings:

Background = optional but highly recommended; **Something old/new** = mandatory reading

Introduction: Why focus on phenotypes? What is integrative biology? Proximate and ultimate causation. Principles of phenotypic design. Individual-based framework.

Tues 1/10. Phenotypic selection: quantitatively linking phenotypic variation to fitness
Background: Kingsolver & Pfennig (2007)
Something old: Lande & Arnold (1983)
Something new: Kuchta & Svensson (2014)

Thurs 1/12 Phenotypic evolution: phylogenetic methods for inferring phenotypic adaptation
Background: Pennell & Harmon (2013)
Something old: Felsenstein (1985)
Something new: Whittall & Hodges (2007)
TBD

Tues 1/17. Phenotypic engineering: what experiments tell us about phenotypic adaptation
Background: Wade & Kalisz (1990)
Something old: Sinervo et al. (1992)
Something new: Calsbeek & Cox (2010)
TBD

Thurs 1/19. Phenotype to genotype: linking phenotypic selection with genetic evolution
Background: Barrett & Hoekstra (2011)
Something old(er): Rosenblum et al. (2010)
Something new: Linnen et al. (2013)
Discussion leader: TBD

Tues 1/24. Genotype to phenotype: the mechanistic basis of phenotypic integration
Background: Murren (2012)
Something old: Cheverud (1996)
Something new: Ketterson et al. (2009)
Discussion leader: TBD

Thurs 1/26 Phenotypic integration: principles and patterns of integration and modularity
Background: Pigliucci (2003)
Something old: Berg (1960); also optional short Connor & Lande (2014) essay on Berg
Something new: Connor et al. (2014)
Discussion leader: TBD

Thurs 1/29. Phenotypic integration: correlational selection and genetic integration
Background: Sinervo & Svensson (2002)
Something old: Brodie (1992)
Something new: McGlothlin et al. (2005)
Discussion leader: TBD

Tues 1/31. Genomic conflict: when one genome serves multiple phenotypic masters
Background: Bonduriansky & Chenoweth (2009)
Something old: Chippindale et al. (2001)
Something new: Harano et al. (2010)
Discussion leader: TBD

Thurs 2/2. Solutions to genomic conflict: producing multiple phenotypes from one genome
Background: Stewart et al. (2010)
Something old: Lande (1980)
Something new: Kijimoto et al. (2012)
Discussion leader: TBD

Tues 2/7 Phenotypic plasticity: the flexible phenotype and induced polyphenisms
Background: Piersma & Drent (2003); Pigliucci (2005)
Something old: Pfennig (1992)
Something new: Leichty et al. (2012)
Discussion leader: TBD

Thurs 2/9. Phenotypic plasticity: costs, benefits, and its potential to drive adaptation
Background: Pfennig et al. (2010); Moczek et al. (2011)
Something old: McCollum & Van Buskirk (1996)
Something new: Schwander & Leimar (2012)
Discussion leader: TBD

Tues 2/14. Adaptation or acclimation? Phenotypic plasticity in the face of climate change
Background: Merila & Hendry (2014); Hoffman & Sgro (2011)
Something new: Nussey et al. (2005); Charmantier et al. (2008)
Discussion leader: TBD

Thurs 2/16. Powerpoint presentations of short papers or grant proposals

Tues 2/21. Writing day in class

Thurs 2/23 Peer review in class

Thurs 3/3. Papers and proposals due

Tues 3/7 Course review and synthesis