

General Education Course Information Sheet*Please submit this sheet for each proposed course*

Department & Course Number

Ecology & Evolutionary Biology 98T

Course Title

Flexible Phenotypes & Adaptive Evolution

1 Check the recommended GE foundation area(s) and subgroups(s) for this course

Foundations of the Arts and Humanities

- Literary and Cultural Analysis _____
- Philosophic and Linguistic Analysis _____
- Visual and Performance Arts Analysis and Practice _____

Foundations of Society and Culture

- Historical Analysis _____
- Social Analysis _____

Foundations of Scientific Inquiry

- Physical Science _____
With Laboratory or Demonstration Component must be 5 units (or more)
- Life Science _____ **X** _____
With Laboratory or Demonstration Component must be 5 units (or more)

2. Briefly describe the rationale for assignment to foundation area(s) and subgroup(s) chosen.

In this course, students will learn the tools that scientists use to test hypotheses about the natural world, which places the seminar in the “Foundations of Scientific Inquiry” area. As a course on an emerging field within evolutionary biology, this seminar fits well in the “Life Science” subgroup.

3. List faculty member(s) who will serve as instructor (give academic rank):

Professor Greg Grether, faculty mentor; Jonathan Drury, teaching fellow

4. Indicate when do you anticipate teaching this course:

	2013-2014	Winter	<u>X</u>	Spring	_____
GE Course Units	<u>5</u>	Enrollment	16	Enrollment	_____

5. Please present concise arguments for the GE principles applicable to this course.

❑ General Knowledge	Central to this seminar will be an ongoing discussion of the methods of science and the ways that scientists empirically evaluate hypotheses of adaptive evolution. These general methods are the same across scientific disciplines.
❑ Integrative Learning	Since incorporating developmental flexibility into evolutionary theory requires mechanistic understanding of development, this seminar will rely on research on developmental biology into an evolutionary framework, making it inherently integrative.
❑ Ethical Implications	Evolutionary arguments are often co-opted by lay-people to make claims about human nature. In this seminar, we will discuss why using evolutionary biology to make prescriptive claims about ethics is wrong.
❑ Cultural Diversity	A perspective of evolution that includes the interaction, over evolutionary time, of environmental cues and phenotypes allows for a richer understanding of variation in all kinds of traits, and although this seminar does not deal directly with cultural phenomena, we will discuss how an understanding of variation can debunk static, deterministic views of human variation.
❑ Critical Thinking	As students develop the arguments for their final papers, they will need to engage in critical thinking to imagine new ways of testing hypotheses that can incorporate developmental plasticity into existing research on adaptation.
❑ Rhetorical Effectiveness	The two main assignments for the class are a group presentation, where students will present research findings from the primary literature, and a written research report, where they will work independently to develop a research program, rely on developing rhetorical effectiveness.
❑ Problem-solving	Students will write a research paper describing research on an evolutionary question and then, with assistance from the instructor, extend that research in new directions using the tools learned in the seminar, which will require problem-solving skills.
❑ Library & Information Literacy	Students will synthesize research in the field by consulting primary literature using various means of access (e.g., Google Scholar, Web of Knowledge).

(A) STUDENT CONTACT PER WEEK (if not applicable write N/A)

1. Lecture:	<u>3</u>	(hours)
2. Discussion Section:	<u>N/A</u>	(hours)
3. labs	<u>N/A</u>	(hours)
4. Experiential (service learning, internships, other):	<u>N/A</u>	(hours)
5. Field Trips:	<u>N/A</u>	(hours)

(A) TOTAL Student Contact Per Week **3** **(HOURS)**

(B) OUT-OF-CLASS HOURS PER WEEK (if not applicable write N/A)

1. General Review & Preparation:	<u>2</u>	(hours)
2. Reading	<u>5</u>	(hours)
3. Group Projects:	<u>2</u>	(hours)
4. Preparation for Quizzes & Exams:	<u>NA</u>	(hours)
5. Information Literacy Exercises:	<u>NA</u>	(hours)
6. Written Assignments:	<u>1</u>	(hours)

7. Research Activity:

2 (hours)

(B) TOTAL Out-of-class time per week

12 (HOURS)

GRAND TOTAL (A) + (B) must equal at least 15 hours/week

15 (HOURS)

Flexible Phenotypes and Adaptive Evolution

Sample syllabus

Jonathan Drury

Course overview: While most biologists decry genetic determinism, the role of the environment in shaping the outcome of both developmental and evolutionary processes is relegated to the back seat of evolutionary biology textbooks and classrooms. In this seminar, we will bring it to the forefront, reading both classic texts that were set aside during the modern synthesis and contemporary theoretical and empirical texts to explore how the evolution of reactive phenotypes, rather than genomes alone, is the new frontier of evolutionary biology. We will also go in-depth into the methodologies used by evolutionary biologists to test hypotheses of adaptive evolution and think of ways to use these methodologies to study the evolution of flexible phenotypes.

Seminar objectives:

1. To examine the role of the environment in adaptive evolution by reading about non-genetic mechanisms of inheritance and genetic accommodation.
2. To understand the particular way that evolutionary biologists use the scientific method to infer the evolutionary history of traits.
3. To explore contemporary scientific literature and think critically about new, testable hypotheses that could improve upon existing research.
4. To practice spoken communication and public speaking in both classroom discussions and a formal, group presentation
5. To practice clear written communication by creating a written research proposal.

Grading:

Participation:	30%
Student presentations:	20%
Lab exercise:	5%
Outline of final paper:	5%
Rough draft of final paper:	10%
Final papers:	30%

Participation: While attendance is necessary for participation, points are *not* for simply attending; rather, I will award these points to students demonstrating independent, reflective, and integrative thought. Participation entails contributing to brainstorming exercises in small groups and sharing opinions and analyses of assigned readings during class discussion.

Student presentations: Students will give a 20-minute presentation in small groups on an empirical paper that investigates the role of phenotypic plasticity in adaptive evolution. I will award maximum points to presentations that contain (a) a clear formulation of the hypothesis and predictions that the investigators evaluated, (b) a demonstration of the conceptual background linking the paper to the course material, and (c) a developed

discussion of how the findings of the study relate to the hypothesis and point to new empirical means of testing said hypothesis.

I will randomly assign groups of 2-3 students. Groups should send me the empirical paper they have chosen by the end of week 7. We will discuss strategies for finding papers using library tools (such as Web of Science and Google Scholar) in class. For the presentation, students will use PowerPoint or similar software to compile slides so that the class can easily follow along.

Lab exercise: In-class, students will form small groups and use the computer program R to simulate Waddington's classic experiment on genetic assimilation of the bithorax phenotype in fruit flies (Waddington, C.H. 1956. Genetic assimilation of the bithorax phenotype. *Evolution* 10, 1-13). Students will not need prior experience working with R.

Following the in-class laboratory exercise, students will complete a take-home exercise in which they use modern statistical techniques to analyze data generated in-class.

Final papers: Students will write a paper of between 10-15 double spaced pages examining how developmental plasticity could impact a particular case of adaptive evolution. In the paper, they will synthesize the research of previous investigators and extend this work by designing a research program to probe the role of genetic accommodation as a selective process.

There are different ways to approach this assignment. For example, students may find a paper discussing the evolution of a particular trait and build a case for how knowing about developmental flexibility in that trait could impact our understanding of its evolution. Alternatively, students could find an instance of developmental flexibility and describe how you would examine the role of evolution in shaping the reaction norms of this trait across different populations or different species.

The paper should be a research proposal. Research proposals contain: (1) an abstract (2) an introduction with a summary of previous research on the topic (3) description of new experiments that would extend current knowledge (4) a discussion of alternative outcomes of the experiments and conclusions for each of these outcomes. Additionally, papers should be sure to relate their ideas back to the bigger ideas from class and explain what is gained by including developmental plasticity into studies of adaptation.

I expect students to meet with me independently to develop their theses and to send me drafts for feedback along the way, by the end of week 7th at the latest. During this meeting, students are expected to bring a bibliography with 5-10 sources and an outline of their final paper. By class time on week 9, students must submit a fully written rough draft. I will return these drafts by class time on week 10 with feedback. Final drafts are due on the day of the final exam.

Academic integrity: I expect students to follow UCLA's academic integrity policies. This means that students must explicitly cite individuals responsible for originating ideas and

methodology in written papers and in classroom presentations. I will report any incidents of plagiarism to the office of the dean of students. Please carefully review the information available at <http://www.studentgroups.ucla.edu/dos/students/integrity/> **before** beginning work on either presentations or final papers.

Weekly schedule

Week 1 Orientation and introduction to the course

- Presentation explaining how evolutionary biologists test hypotheses and discussing phenotypic plasticity
- Pre-course questionnaire
- Group activity: brainstorming experiments to test adaptive hypotheses

Week 2 Introduction to phenotypic plasticity

- Group activity: experimental design for measuring reaction norms

Reading:

Jablonka, E. & Lamb, M. 2005. "From Genes to Characters" from *Evolution in Four Dimensions*. MIT Press: Cambridge, MA. pp. 47-78.

Schlichting, C. & Pigliucci, M. 1998. "Reaction Norms and Phenotypic Plasticity" from *Phenotypic Evolution: A Reaction Norm Perspective*. Sinauer Associates: Sunderland, MA. pp. 51-84.

Week 3 A case for the importance of developmental plasticity in evolution

- Class activity: mini-presentations of important terms and concepts

Reading:

Jablonka, E. & Lamb, M. 2005. "The Transformations of Darwinism" from *Evolution in Four Dimensions*. MIT Press: Cambridge, MA. pp. 9-46.

Schlichting, C. & Pigliucci, M. 1998. "A Brief History of an Alternative Evolutionary Synthesis" from *Phenotypic Evolution: A Reaction Norm Perspective*. Sinauer Associates: Sunderland, MA. pp. 29-50.

Week 4 Non-genetic mechanisms of inheritance

- Web activity: <http://learn.genetics.utah.edu/content/epigenetics/rats/>
- Group activity: brainstorm ways to test the hypothesis that maternally-mediated plasticity has evolved via natural selection

Readings:

Jablonka, E. & Lamb, M. 2005. "The Epigenetic Inheritance Systems" from *Evolution in Four Dimensions*. MIT Press: Cambridge, MA. pp. 113-154.

Jablonka, E. & Lamb, M. 2005. "The Behavioral Inheritance Systems" from *Evolution in Four Dimensions*. MIT Press: Cambridge, MA. pp. 155-192.

Weaver, I.C.G, Cervoni, N., Champagne, F.A., D'Alessio, A.C., Sharma, S., Seckl, J.R., Dymov, S., Szyf, M., & Meaney, M. 2004. Epigenetic programming by maternal behavior. *Nature Neuroscience*, 7, 847-854

Week 5 The Baldwin effect

- Discussion of using library resources for conducting literature searches.
- Group activity: experimental design for testing for the Baldwin effect

Reading:

Baldwin, J. 1896. A new factor in evolution. *Am. Nat.* 30, 441-451.

Badyaev, A. 2009. Evolutionary significance of phenotypic accommodation in novel environments: an empirical test of the Baldwin effect. *Phil. Trans. Roy. Soc. B.* 364, 1125-1141.

Week 6 Waddington's genetic assimilation

- In class-lab exercise: genetic assimilation in (electronic) fruit flies

Readings:

Aubret, F. & Shine, R. 2009. Genetic assimilation and the post-colonization erosion of phenotypic plasticity in island tiger snakes. *Current Biology* 19, 1932-1936.

Waddington, C.H. 1942. The canalization of development and the inheritance of acquired characters. *Nature* 150, 563-565.

Week 7 West-Eberhard's genetic accommodation

- Deadline for meeting with J.P. to discuss final paper with bibliography and outline
- Deadline submitting empirical paper on which group presentation will be based to J.P.
- Group activity: designing studies of genetic accommodation in populations

Readings:

Suzuki, Y. & Nijhout, H. F., 2006. Evolution of a polyphenism by genetic accommodation. *Science* 311, 650-652.

West-Eberhard, M. J. 2005. Phenotypic accommodation: Adaptive innovation due to developmental plasticity. *J Exp Zoology* 304B, 610-618.

Week 8 Synthesis and implications for the future of evolutionary biology

- Presentation: A brief synopsis of modern phylogenetic methods
- Group activity: designing studies of genetic accommodation in phylogenies

Readings:

Schlichting, C. & Pigliucci, M. 1998. "Evolution of Developmental Reaction Norms and Phenotypes" from *Phenotypic Evolution: A Reaction Norm Perspective*. Sinauer Associates: Sunderland, MA. pp. 259-308.

Schlichting, C. & Pigliucci, M. 1998. "Implications and Projections" from *Phenotypic Evolution: A Reaction Norm Perspective*. Sinauer Associates: Sunderland, MA. pp. 309-342.

Crispo, E. 2007. The Baldwin effect and genetic assimilation: Revisiting two mechanisms of evolutionary change mediated by phenotypic plasticity. *Evolution* 61, 2469-2479.

Week 9 Student Presentations

Deadline for submitting rough drafts of final papers

Week 10 Student Presentations

- Post-course questionnaire

Day of final exam: Final papers due

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New Course Proposal

Ecology and Evolutionary Biology 98T Flexible Phenotypes and Adaptive Evolution

Course Number Ecology and Evolutionary Biology 98T**Title** Flexible Phenotypes and Adaptive Evolution**Short Title** FLEX PHENOTP&EVOLTN**Units** Fixed: 5**Grading Basis** Letter grade only**Instructional Format** Seminar - 3 hours per week**TIE Code** SEMT - Seminar (Topical) [T]**GE Requirement** Yes**Major or Minor Requirement** No**Requisites** Enforced: Satisfaction of entry-level Writing requirement. Freshmen and sophomores preferred.**Course Description** Seminar, three hours. Enforced requisite: satisfaction of Entry-Level Writing requirement. Freshmen/sophomores preferred. Through readings of both classic and contemporary theoretical and empirical texts, exploration of ways in which developmental plasticity influences adaptation and flexible phenotypes are themselves evolving through genetic accommodation. Letter grading.**Justification** Part of the series of seminars offered through the Collegium of University Teaching Fellows.**Syllabus** File [EEB 98T syllabus.pdf](#) was previously uploaded. You may view the file by clicking on the file name.**Supplemental Information** Professor Greg Grether is the faculty mentor for this seminar**Grading Structure**
Participation: 30%
Student presentations: 20%
Lab exercise: 5%
Outline of final paper: 5%
Rough draft of final paper: 10%
Final papers: 30%**Effective Date** Winter 2014**Discontinue Date** Summer 1 2014**Instructor**

Name	Title
Jonathan P. Drury	Teaching Fellow

Quarters Taught

Fall	Winter	Spring	Summer

Department Ecology and Evolutionary Biology**Contact**

Name	E-mail
CATHERINE GENTILE	cgentile@oid.ucla.edu

Routing Help

ROUTING STATUS

Role: Registrar's Office

Status: Processing Completed

Role: Registrar's Publications Office - Hennig, Leann Jean (LHENNIG@REGISTRAR.UCLA.EDU) - 56704

Status: Added to SRS on 8/29/2013 12:44:01 PM

Changes: No Changes Made

Comments: All done!!

Role: Registrar's Scheduling Office - Hennig, Leann Jean (LHENNIG@REGISTRAR.UCLA.EDU) - 56704

Status: Added to SRS on 8/29/2013 12:43:25 PM

Changes: Title

Comments: Edited course description into official version; corrected title.

Role: Registrar's Office - Hennig, Leann Jean (LHENNIG@REGISTRAR.UCLA.EDU) - 56704

Status: Returned for Additional Info on 8/29/2013 12:42:02 PM

Changes: No Changes Made

Comments: Reroute to Leann to fix title.

Role: Registrar's Publications Office - Hennig, Leann Jean (LHENNIG@REGISTRAR.UCLA.EDU) - 56704

Status: Added to SRS on 8/29/2013 12:41:36 PM

Changes: Description

Comments: Edited course description into official version; corrected title.

Role: Registrar's Scheduling Office - Bartholomew, Janet Gosser (JBARTHOLOMEW@REGISTRAR.UCLA.EDU) - 51441

Status: Added to SRS on 8/20/2013 2:35:35 PM

Changes: Short Title, Discontinue Date

Comments: Added a short title.
Changed the discontinue date to 141.

Role: L&S FEC Coordinator - Castillo, Myrna Dee Figurac (MCASTILLO@COLLEGE.UCLA.EDU) - 45040

Status: Returned for Additional Info on 8/16/2013 11:02:43 AM

Changes: No Changes Made

Comments: Routing to Doug Thomson in the Registrar's Office.

Role: FEC Chair or Designee - Palmer, Christina (CPALMER@MEDNET.UCLA.EDU) - 44796

Status: Approved on 8/15/2013 3:06:58 PM

Changes: No Changes Made

Comments: No Comments

Role: FEC Chair or Designee - Castillo, Myrna Dee Figurac (MCASTILLO@COLLEGE.UCLA.EDU) - 45040

Status: Returned for Additional Info on 8/14/2013 3:18:28 PM

Changes: Requisites

Comments: Routing to Christina Palmer for FEC approval.

Role: Department/School Coordinator - Gentile, Catherine (CGENTILE@OID.UCLA.EDU) - 68998

Status: Approved on 8/14/2013 9:24:20 AM

Changes: No Changes Made

Comments: the CUTF Program has never had to monitor enforcement of the writing requirement. That requirement is addressed by the Registrar's Office.

Role: L&S FEC Coordinator - Castillo, Myrna Dee Figurac (MCASTILLO@COLLEGE.UCLA.EDU) - 45040

Status: Returned for Additional Info on 8/13/2013 10:23:10 AM

Changes: No Changes Made**Comments:** Routing to Cathie. Please see FEC comment below.**Role:** FEC Chair or Designee - Palmer, Christina (CPALMER@MEDNET.UCLA.EDU) - 44796**Status:** Returned for Additional Info on 8/12/2013 11:05:43 AM**Changes:** No Changes Made**Comments:** Please indicate level of enforcement of the entry-level writing requirement requisite**Role:** FEC Chair or Designee - Castillo, Myrna Dee Figurac (MCASTILLO@COLLEGE.UCLA.EDU) - 45040**Status:** Returned for Additional Info on 8/9/2013 4:23:28 PM**Changes:** No Changes Made**Comments:** Routing to Christina Palmer for FEC approval.**Role:** CUTF Coordinator - Gentile, Catherine (CGENTILE@OID.UCLA.EDU) - 68998**Status:** Approved on 8/9/2013 4:17:52 PM**Changes:** No Changes Made**Comments:** on behalf of Professor Kathleen Komar, chair, CUTF Faculty Advisory Committee**Role:** Initiator/Submitter - Gentile, Catherine (CGENTILE@OID.UCLA.EDU) - 68998**Status:** Submitted on 8/9/2013 4:17:12 PM**Comments:** Initiated a New Course Proposal[Back to Course List](#)

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Comments or questions? Contact the Registrar's Office at
cims@registrar.ucla.edu or (310) 206-7045