Evolution and Ecology of Development
PMB C109/IB C109
Location: TBD
Time: TBD
Course Materials on bCourses
Prerequisites: BIOLOGY 1A and 1B

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Office: Koshland Hall 361
Office Hours: TBD or by appointment

Course Description
Phenotypic variation is rampant in nature at all scales. Species differ: i.e., you would not be confused with a dandelion. Individuals within species differ: i.e., you and your neighbor are each unique. Individuals even differ with themselves over time: i.e., your summer tan will be a distant memory by the end of term. Much of this variation helps adapt organisms to their environments and over time has fostered major evolutionary transitions like the origin of vertebrates or the colonization of land from water. In this course, we will discover how and why such a remarkable and vast diversity of forms and functions has evolved. We will also consider why all possible forms do not exist: i.e., don’t blame your parents for being born without wings.

To gain a comprehensive understanding of how biodiversity arises, we will explore the intersection of concepts and mechanisms from development, evolution, and ecology, as these processes are inextricably linked. The developmental systems by which seeds turn into trees or larvae turn into butterflies are the products of past evolution. However, as the palette upon which new mutations appear, developmental systems can bias or constrain what mutations are beneficial or even visible to natural selection and thus what new forms can arise. Finally, because the environment acts both as a source of cues that guide how development proceeds and as the source of selective pressures that drive or frustrate evolutionary change, a consideration of the ecological context is frequently critical to understanding both processes.

Learning Objectives
By fully engaging with the material and class assignments, at the end of the semester you will be able to:

• Explain how an interdisciplinary approach involving genetics, development, evolutionary biology, and ecology can be used to understand the processes that generate patterns of biodiversity.
• List and describe major questions, findings, and experimental approaches in the field of ecological and evolutionary developmental biology.
• Discuss biological research using specialized terminology and defend your opinions.
• Critically evaluate and interpret the primary scientific literature.
• Combine factual material with deductive reasoning to propose hypotheses and future research directions.
**Course Format**
This course is a hybrid lecture and seminar course. Tuesday class meetings will be in lecture format, though these classes may often involve breakout group activities in the course of the lecture as appropriate. The goals of the lectures will be to introduce you to conceptual frameworks, historical context, and biological information relevant to the week’s theme(s). Because many experimental approaches from diverse fields will be relevant, at the end of several Tuesday lectures, a graduate student will present on an experimental approach relevant to the week’s reading. Thursday class meetings will be focused on discussions of the classic and recent papers from the scientific literature on the week’s theme(s).


**Recommended Additional Texts:**


**Activities and Assignments:**
There will be no midterms and no final exam in this course. Instead, you will be asked to demonstrate your mastery of learning objectives through a combination of weekly and capstone assignments. The goal of the weekly assignments is to help prepare you and the class for engaging the lecture material and participating in the group discussions each week. The goal of the capstone assignments is to flex and strengthen your scientific muscles and to model what biologists do in their careers by applying the biology, methods, and conceptual frameworks you will learn throughout the term to subjects and questions that fascinate you. In this spirit, the final capstone assignment, a grant proposal that will be completed in lieu of the final exam, will be on an individually chosen topic.

**Weekly Assignments**
Weekly Reading Responses and Activities: Every week, there will be a set of assigned readings. With the exception of the required textbook, the readings will be posted through the course bCourses site. These readings will be the foundation for understanding the Tuesday lectures and Thursday discussions. In preparation for Tuesday’s class, you will be asked to complete a series
of questions or activities designed to aid or extend your comprehension of the subject material. These will be due electronically (by bCourses or e-mail depending on the assignment) by noon on Tuesday each week.

Participation in Group Discussions: During the Thursday group discussions, all students are expected to contribute questions, answers, and insights. This is a small class, and it will be most successful if everyone is actively involved. Discussion will involve going through one or more of the week’s assigned readings figure by figure and will often be centered on the discussion questions provided before class. However, the discussion may also move into unexpected but related topics. The selected papers cover a huge range of biology. It is perfectly fine, in fact, it is assumed that you will not understand every part of every paper we will read. In this case, please bring this up in discussion. Chances are many of us will have the same problem. For guidelines about what constitutes A-, B-, or C-level participation, please refer to the attached handout.

Discussion Questions: Each week, a subset of the class will help the rest of the class prepare for discussion by writing discussion questions and posting them on the course bCourses site. Given the size of the class, each person will be responsible for posting discussion questions 4 times during the course. Questions should be posted by Thursday at 2pm to receive full credit.

Additional Reading Blurbs (undergraduate students only): Undergraduates assigned to provide discussion questions for a week will also be required to identify additional papers on the same theme that would be interesting to the class. Students will be responsible for posting a one-paragraph description of one article (also by Thursday, 2pm), and they should be prepared to briefly highlight the article at the end of the Thursday discussion period.

Experimental Approach Presentation (graduate students only): At the end of several Tuesday lectures, a graduate student will give a 5-10 minute presentation on one of the molecular, genetic, developmental, or computational techniques from an empirical paper to be discussed on Thursday. The presentation should cover the experimental goal of the technique, the technique’s history and merit relative to older or alternative methods, the step-by-step process of the method, and caveats to interpretation. Each graduate student will give two such presentations during the term. To give you guidance in developing the presentation, I request that you schedule an appointment with me to go over your slides in the week prior to your presentation.

Capstone Projects
The specific details for each project will be covered in other handouts, but here are the basics.

1) Field Trip and Wiki Project. The class will take a field trip to the UC Botanical Garden on Saturday September 17. The observations made during this trip will serve as the starting point for a midterm project where you will be asked to create a team wiki on the novelties of a focal set of species. The goal will be to demonstrate your grasp of the foundational concepts—phylogeny, adaptation, development, and gene regulation—introduced in the initial part of the course by considering the evolution of several derived traits in a fascinating taxonomic group of your team’s choice. This will be a team project completed in assigned groups of three, but grading will be largely based on individual contributions. (Field Trip Sat. 9/20; Project Due Fri. 9/30, staggered times)
2) **News and Views Article.** A short paper assignment will allow you to demonstrate your abilities to explain and critically evaluate the scientific literature in writing. Modeled after a News and Views piece in *Nature* or a Perspective in *Science*, the goal of the short paper is to convey to a broad scientific audience why you find an article of your choice so exciting in terms of what it tells us about the ecology and evolution of development. Articles in this format do so by relating the context, findings, and significance of a scientific publication. We will read several articles of this format during the first part of the term, and therefore you will quickly become familiar with the more conversational style of this format as well as its purpose in providing additional historical and forward looking context to the findings of the paper at hand. (Maximum of 3 pages, double spaced; Due Fri. 10/21, 5pm)

3) **Grant Proposal.** The final assignment of the semester, which is assigned in lieu of a final exam, will give you the opportunity to synthesize what you have learned and apply it to a question and system of your choosing by writing a grant proposal. Like many investigators in the fields of eco-devo and evo-devo, you will develop and pitch a compelling research program in the format of a National Science Foundation pre-proposal (1 page project summary and 4 page project description, single spaced). This assignment will be completed in several stages to guide you toward generating a polished final draft. A half-page description of the research question and project objectives will be due Tue. 11/1, 2pm. This stage allows me to ensure you have chosen a productive, exciting topic within the scope of the course as well as unique from the topics chosen by your peers, preventing opportunity for academic misconduct. A first draft of the proposal will be circulated to two peer reviewers by Tue. 11/22, 2pm. Everyone will review two proposals and return their comments by Tue. 11/29, 2pm. The final draft of the proposal is due Mon. 12/12, 5pm.

Ten points (on a 100 point scale) per day after the deadline will be deducted for late capstone projects. Extensions will be allowed only in the event of a family or medical emergency.

**How to Succeed in this Class:**

1) Finish the reading assignments before lecture, and make ample notes while reading.
2) While reading papers for discussion, make ample notes while reading, summarizing the question being addressed and the take home message of each figure in your own words.
3) Reconsider the readings in light of discussion questions posted by your classmates before class so you will be prepared to talk about them.
4) Make connections with others in the class so you can work together to understand the assigned readings and swap notes in the event of an absence from class.
5) Take advantage of the framework provided by the capstone assignments to dig deep into one or more systems that excite you.
6) Help me (and the rest of the class), help you (and each other)! Bring your questions about the material to class, and if they go unanswered, post them on bCourses or come to office hours.
7) Seek out additional resources as necessary to improve your research, writing and well being
   a. Berkeley Student Learning Center Writing Program
      ([http://slc.berkeley.edu/writing](http://slc.berkeley.edu/writing))
b. UC Berkeley Library (including document delivery and interlibrary loan services; [http://lib.berkeley.edu](http://lib.berkeley.edu))
c. Counseling and Psychological Services ([http://www.uhs.berkeley.edu/students/counseling/cps.shtml](http://www.uhs.berkeley.edu/students/counseling/cps.shtml))

**Grade Composition:**

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<td>Experimental Approach Presentations (grad students)</td>
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<td>News and Views Article</td>
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1 Grading will be on a check (full credit) / check-minus (half credit) / no credit system. You may miss or drop one assignment over the course of the term. Assignments turned in late but within a week of the deadline will be eligible for half credit.

2 Because the aim is for everyone to learn from each other’s insights, successful lecture activities and discussions depend on everyone’s attendance and participation. If you have to miss a class, I request notification at least two classes prior to the planned absence. Unplanned absences from discussion will not be eligible for makeup credit except in the case of illness, injury, or family emergency. Participation credit for excused absences will be earned through completion of a makeup written assignment.

**Academic Integrity**

Placing your name on all assignments affirms that you have neither received nor given aid in completing the assignment or test and, especially in the case of written assignments, have acknowledged properly the scholarship of others. All students are expected to comply with the provisions on the UC Berkeley Campus Code of Student Conduct.

Plagiarism is not acceptable. This includes both direct excerpts without quotes and citation as well as paraphrasing without attribution. For a better understanding of what constitutes plagiarism, please visit this site and the links therein: [http://writing.berkeley.edu/students/academic-honesty](http://writing.berkeley.edu/students/academic-honesty)
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