

# Advanced Evolution Seminar

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- **Level of course:** Graduate students and advanced undergraduates
- **Approximate size of enrollment:** 5-10 students
- **Class times:** Thursdays 3-4:50 pm
- **Room:** Clapp Hall L-1

## Course overview

We are increasingly grasping the importance of evolutionary theory in agriculture, ecology and medicine, and as we learn more about the evolution of organisms it becomes clear that while simple population genetic models are powerful explanatory tools, the ecological and developmental context play a large role in evolutionary dynamics. Through small lectures, paper discussions and student led presentations, in this seminar we will explore some of those eco-developmental dimensions of evolutionary biology. Hopefully, we will highlight exciting avenues of research and open questions.

## About this syllabus

This syllabus is meant to be a roadmap of this course. It is not only a way to communicate expectations, describe course and assignments and explain grading policies, but it is a document that provides explanations for the different assignments and what is their role in knowledge, how do assignments build of each other and relate to the outcomes of the class. It also should set the tone for what you can expect from me and what are my expectations with respect to the class dynamics. For me students are not passive receptacles of knowledge, but collaborators and active knowledge producers. Thus, this syllabus should be a tool for reflection about the class, and our learning.

## Outcomes

In this class, I expect that you:

- Are able to make connections between classical and more current papers.
- Are able to apply the concepts learned here to your own questions and systems.
- Will learn some of the central ideas in evolution and will be able to apply ideas and theory to different contexts.
- Will have a comprehension of different methods to study evolution.

## Context for the class

This class is meant to be collaborative and a space for community learning and serves as an interdisciplinary space to integrate ideas from across the biological sciences (e.g. developmental biology, ecology and evolution) as well as different scales (from genes to communities). Lastly, this class is meant for graduate students to develop some skills that I have found particularly useful as a PhD student: efficient reading and processing of scientific papers, critical thinking and effective communication. I hope that this class will help to bridge collaborations among students and faculty in Ecology and Evolution as well as between them and other students within the biology department or other programs (e.g. microbiology and molecular genetics) at the University.

## Course goals

The main idea behind this class is to learn classical ideas in evolution, development and ecology and how they might apply (or need to be expanded) in understanding still open questions in evolutionary biology. Throughout the topics I hope to emphasize the importance of context on evolutionary processes.

## Learn central ideas in evolutionary theory

The structure of this class is designed to increase integration of subjects. In the first class of each topic we will cover important concepts with a mini-lecture and then discuss a classic or illustrative paper. The following week 1 or 2 students will present a paper of their choice (within the topic) and lead the discussion.

## Practice communication skills

Doing good science is not enough, you have to be able to present your results clearly and in a larger context. In this class students will present a paper, I will meet with students before class to help with the topic and paper selection and will talk through some important points on communication. At the end of each student led talk I will provide thorough feedback. In addition, the final assignment of the course will be to write a blog entry or a publication for a broad audience explaining an evolution topic of their choice. Students will be encouraged to submit their writing to a magazine or blog of their choice.

## Improve effective reading of scientific literature

Each week students have to read 2 to 3 papers, write a question that is situated in a larger background, and make connections between the different readings. This will help to develop the skills of reading quickly and effectively, and build habits of keeping up with the literature on a topic.

## Assignments and grading

Participation including reading questions (20%)  
Paper presentation and discussion (30%)  
Science communication paper first draft (15%)  
Science communication paper final draft (35%)

## Reading questions

Each week before class students should submit a one paragraph question of the papers assigned that week (papers will be posted on a class dropbox folder). The question can be only about one of the papers. This question should be structured as follows:

- 1-5 sentences setting up the question and contextualizing in a bigger framework (either by briefly summarizing the paper or by looking at even broader context)

- Question
- 1-5 Sentences with hypotheses, possible responses or other ways to start addressing the question

EXAMPLE:

Moreno-Gamez et al. (2015) developed a model to understand evolution of multi-drug resistance within the organism. Therapies with multiple drugs have been developed to slow down the evolution of resistance. However, if drugs have different penetration, they can have a heterogeneous distribution in the body. They show that this heterogeneity coupled with migration between parts of the body can lead to increased multi-drug resistance. Their model assumed asexual reproduction and no-recombination. However, **I wonder how would sexual reproduction affect their prediction?** It seems to me that the role of recombination would depend on the size of the single vs. combination treatments. If single drug compartment are larger (and there is a cost of double resistance in those compartments), then I would expect that heterozygotes would not be favored and double mutants will be selected against. However, this would depend on the migration rates which could increase the number of heterozygotes, eventually leading to the invasion of the double drug compartment.

## Paper presentation

Each of you will lead one paper discussion a semester. In preparing for this discussion you are expected to meet with me and agree on the paper and presentation points. For your presentation you will have to: choose and send the paper (with at least four days), write three potential discussion questions and make a presentation introducing the paper and explaining the overall findings.

## Science communication assignment

The idea is to write a 1-3 page blog or paper for a broad audience explaining some ideas or recent papers in evolutionary biology. You are encouraged to submit your paper/blog for publication. Some potential targets are: [Evolution digests](#), [the conversation](#), [Nature Ecology and Evolution community](#), [Evo-bites](#).

The format of the assignment will depend a little on what do you want to do with the piece, but I will grade based on clarity, broad interest and your ability to situate the paper or topic in a larger context. You will have two opportunities to turn in your paper: first you will submit a draft and after feedback from me and your peers you will have the opportunity to revise and re-submit.

## Schedule

- Mutation and the evolution of mutation rates.
  - (W1-Aug 28) Introduction to class. Quick evolution review highlighting the role of mutation.
  - (W2-Sep 6) Evolution of mutation rate.
    - \* Sniegowski et al. (1997)
    - \* Wilke et al. (2001)
- Natural selection, convergence and local adaptation.
  - (W3-Sep 13) Natural selection and convergence. (Nathan Clark, Maria out of town)- NO QUESTIONS DUE
    - \* Chikina et al. (2016)
    - \* *Optional: Meyer et al. (2018)*
  - (W4-Sep 20) Local adaptation.
  - (W5-Sep 27) Eco-evolutionary dynamics
- Historical contingency
  - (W6-Oct 4) Epistasis, adaptive landscapes and historical contingency.

- (W7-Oct 11) Importance of ecology and historical contingency.
- Host-parasite dynamics and evolutionary medicine.
  - (W8- Oct 18) Peer review session for final details (Maria out of town). *No questions due. First drafts due by e-mail on Oct 23.*
  - (W9- Oct 25) Host-parasite dynamics. *No questions due.*
- Co-evolution, host-microbiomes.
  - (W10-Nov 1) Co-evolution.
  - (W11-Nov 8) Host microbiome interactions.
- Evolution in community context.
  - (W11- Nov 15) Evolution in community context. *Nov 27 slides for karaoke due- one slide with one figure.*
  - (W13- Nov 29) Slide Karaoke. MELD: Vaughn Cooper. *No questions due.*
- Major transitions in Evolution.
  - (W13- Dec 6) Major transitions and evolution of individuality. *Final drafts due.*
  - (W14- Dec 13) Evolution of sex.