Bi480/580 Evolution of Development

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Course Description

This course is about how developmental mechanisms have evolved. It thus requires the integration of information from embryology, developmental biology, evolutionary biology, population genetics, molecular genetics, genomics, and other areas of research. It is both an old and a new field, and you are among the first few students anywhere to have a formal course in the Evolution of Development. Hopefully, you will be become better prepared at the interface of these two areas than any of the faculty even a few years ago.

Required Reading

Text: **From DNA to Diversity:** Molecular Genetics and the Evolution of Animal Design by Sean B. Carroll, Scott Wetherbee, Jen Grenier (=CWG)

Papers: Will be available for downloading from the course website or by email.

Assignments:

1. **Journal**. Prepare a one page typed analysis of the readings you do for the course. (Use a spell checker.) For each reading you should enter:

A . Abstract. A short paragraph summarizing the paper. This paragraph should have the following headings:

- **General problem. (**What was the general problem the authors tried to solve?)
- **Specific aim.** What was the specific **question**(s) or hypothesis the authors addressed?)
- **Action. (**What did they do to answer the question?)
- **Results. (**What was the result?)
- **Retrospective significance. (**How does the work help reinterpret past work?)
- **Prospective significance.** (What does the result mean for future work?)
- **Critique on approach.** (Did the authors perform the best experiments for the problem?)
- **Critique on interpretation.** (Did the authors over- or misinterpret their results?)

B. Question. A question that comes to your mind from reading the paper. The purpose of this is to give an opportunity for in class discussion of the items that you may need for background, or to identify future research questions that arise from the work.

C. WOW factor: One point you didn't know that's especially interesting to you. The purpose of this is to find something that connects to you more personally from the work. Different people will have very different entries for this.

2. **Genomics**. We will learn how to search genomic databases to find homologues of developmentally important genes in several species, and to construct and use phylogenetic trees as an aid to determine which homologues are likely to be orthologues.

3. **Presentation**. You will work in groups of two to investigate a live issue in the evolution of

development. The team will make an oral PowerPoint presentation of the issue to the class.

An issue is a question (with an interrogative word at the beginning and question mark at the end) on which informed people disagree. The presentation should suggest experiments that would help resolve the issue. It's often fun if one person advocates one side of the issue and another the opposite side. An alternative is that one person provides general background and the other proposes cutting experiments that should be done to resolve the issue.

We will try to have people with predominantly evolutionary interests paired with people with primarily developmental interests.

4. **Proposal**. You will write a research proposal similar to one you'd send to National Institutes of Health on your Presentation topic, due before the time scheduled for the final exam. The basic outline will be:

Abstract

Background:

Define the issue. Start with a brief definition of the problem to be investigated. Often some background has to be provided (for example, some vocabulary, explanation of morphologies, definition of terms) before the problem can be clearly stated.

Frame the problem. Give historical background. Bring reader up to speed about our current understanding of the developmental and evolutionary biology of the system so that we can appreciate what the problem is and why it is important.

The issue. State the issue in the form of a question. Experts will disagree on the answer to the question, i.e., it is a live issue.

Specific Aim 1

Give briefly why you want to do the first experiment you will propose, tell what you will do, how you will interpret it, what experimental difficulties might frustrate your work, and the significance of the particular experimental result you hope to get. Headings will be:

Rationale, Experimental design, Expected results and interpretation, Potential problems, Significance.

Specific Aim 2

Give briefly why you want to do the second experiment you will propose, tell what you will do, how you will interpret it, what experimental difficulties might frustrate your work, and the significance of the particular experimental result you hope to get. Headings will be:

Rationale, Experimental design, Expected results and interpretation, Potential problems, Significance.

Significance The retro- and prospective significance of the proposed experiments.

References.

The paper should be approximately 3-5 pages long, double spaced. Format of the paper and reference format like the Perspective Articles in the journal *Evolution & Development*. (http://www.blackwellpublishing.com/submit.asp?ref=1520-541X&site=1).

5. **Participation**. We expect active intellectual participation in the class. That means attending class, asking questions, volunteering ideas, and contributing to discussions. For example, you should come to class each day prepared to ask one penetrating question about the reading.

Basis for grading

- Journal of Readings 26% (2% each)
- Genomics 14%

- Presentation Oral 20%
- Presentation Written 22%
- Participation 18% (1% for each class in which student participates in class discussion)

Differentiation of graduate vs. undergrad workload

Each graduate student will mentor two undergraduate presentation groups. This will involve meeting with the team, choosing and clarifying the issue, finding appropriate evidence, helping to understand background, and helping to prepare a PowerPoint presentation. Each graduate student, in addition, will present their own 20 minute presentation on an issue in EvoDevo.