Bi480 Evolution of Development
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Class meets: 12:00am - 13:20am, 111 Lillis Hall

Course Description
This course is about the evolution of developmental mechanisms. It 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, but few students anywhere have had 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.

Course format mimics what scientists do. They study the literature, investigate hypotheses, write research papers, write grant proposals, and give talks at meetings to their peers.

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 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 summary and analysis of the paper with the following headings:
      • General problem. (What was the general issue the authors addressed?)
      • Specific aim. (What was the specific question(s) or hypothesis the authors addressed?)
      • Action. (What did they do to answer the question?)
      • Results. (What happened in the experiments?)
      • 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 address the most important question? Did they perform the best experiments to solve 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: A point you didn't know before 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, to construct and use phylogenetic trees as an aid to determine which homologues are likely to be orthologs, to analyze conserved syntenies, and to investigate conserved non-coding elements. You will need to select a gene family to investigate and send an email message to John on January 20 for his ok. You will need to download some software to your laptop and bring it to class for these sessions, and will hand in a short report on the phylogeny, conserved synten, and conserved non-coding elements for your family.

3. Presentation. You will work in groups of two or three to investigate a live issue in the
evolution of development. The team will make an oral PowerPoint or Keynote presentation of the issue to the class. You will be graded individually.

An issue is a question (a sentence 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.

4. Proposal. You will write a research proposal similar to one you’d send to National Institutes of Health on your Presentation topic, due on or before March 10. A portion of the NIH guide will be on Blackboard for you to follow. The basic outline will be:

Abstract
Background:

Define the issue. Start with a brief definition of the problem you will investigate. 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
Tell 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 Use the format used by the journal Evolution & Development. (http://www.blackwellpublishing.com/submit.asp?ref=1520-541X&site=1 )

The paper should be approximately 4-5 pages long, double-spaced.

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 or answer a question or make a comment about the reading.

6. Mid-term exam. This exam will be on March 10 (last class meeting, ok, a bit past mid-term). You will bring your laptop and will write answers in an MSWord file that you will email to me. So open book, open computer exam. It will be essay exam with several questions, each requiring thought and one-paragraph answers.
Basis for grades

- Journal of Readings 24% (2% each)
- Genomics 12% (3% each)
- Presentation Oral 15%
- Presentation Written 15%
- Participation 19% (1% for each class in which student participates actively)
- Critique of oral pres: 5%
- Exam 10%

Total 100%

Grades (roughly): A >90%, B 80-89%, C 70-79%, D 60-69%, NP <60%.