EVOLUTION

"Nothing in biology makes sense except in the light of evolution."
--- Theodosius Dobzhansky

“Everything in biology makes more sense in the light of evolution.”
--- Peter Wimberger

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**Lectures:** Tu Th 1100 - 1220
**Lab** We 1330 – 1720*
**Office Hours:** M 3-4, Tu 4-5, Th 2-3 or by appointment

This syllabus outlines the course requirements and provides a tentative schedule of lectures. Tentative means tentative because we may spend more or less time on different topics depending on your interest and understanding. And sometimes I get carried away… I will inform you of changes when they occur. Please read the syllabus carefully, as you are responsible for all of the information in it. If you have questions, make sure to ask me.

**Course Description**

Evolution is the best scientific explanation for the diversity of life. Using an evolutionary lens to examine biological questions has led to deeper understandings of problems in every area of biology. The reach of evolutionary ideas has now reached many other academic fields as well e.g. psychology, english, politics, religion, urban planning and education. Darwin's initial formulation of evolution by natural selection has become more complex and powerful as our understanding of inheritance and population processes has become more sophisticated. Despite the theory's simplicity, it is difficult to quickly reach an intuitive understanding of the process. My three broad learning objectives are: 1) to lead you to a more intuitive and nuanced understanding of how evolution works (the mechanisms leading to evolutionary change), 2) to examine how evolutionary scientists infer what has happened in the past (how do we know what we know?) and 3) to provide you with the ability to apply an evolutionary lens to a wide variety of topics, both inside and outside biology.

This course will focus on the theory, mechanisms and patterns of evolution. It is not a course describing the history of life on earth. The course considers scientific explanations for patterns of diversity and for the apparent "good fit" of organisms to the environment. Topics will include the theory of evolution by natural selection, population genetics, concepts of fitness and adaptation, modes of speciation, phylogenetics, molecular evolution, behavioral evolution, long-term trends in evolution and applications of evolution to human health. The course will consist of lecture, lab and discussion. Readings will be from our primary text, *Evolution* by Bergstrom and Dugatkin, the primary and secondary literature, and Richard Dawkin's classic book, *The Selfish Gene*. You will be able to access most non-text readings on Moodle. We will have discussions of primary literature in lecture and lab.
COURSE REQUIREMENTS

**Texts:**
- Bergstrom, C and Dugatkin, L. *Evolution*
- Dawkins, R. *The Selfish Gene*

Assignments from the text are listed on the course schedule. Any additional readings for lectures and discussion will be announced in advance, and placed on Moodle. Evaluated work will consist of exams, problem sets, short written assignments, labs, class presentations, a research proposal, and discussion participation. If you need help accessing Moodle, talk to me or one of your classmates.

**Evaluated Work**

1) **Exams:** The exams will consist of short answer questions, population genetics and other types of problems, and longer essays. The Midterm is part in-class and part take-home, and the Final will be cumulative and take-home. The take-home exam will have more and longer questions. By the end of the course I will be looking for synthesis of the different material that we covered in the course. Some of the shorter answer questions will either come from, or be adaptations of the end of chapter questions in your text.

2) **Readings:** We will briefly discuss chapters from *The Selfish Gene* at the beginning of class sessions. These discussions will be student-led. People not leading the discussion will be responsible for posting thoughts and questions to a Moodle Forum **by 5 PM the evening before class.** The student-led class discussions should raise difficult or controversial questions and issues raised by the readings, and they should be discussions, not lectures. Your presentations of *The Selfish Gene* should **briefly** summarize the main points of the chapters and use the summary as a jumping off point for class discussion. The discussions will be limited to 10 minutes. Presenters have 5 minutes to set the stage. The second 5 minutes is for the class to ask questions or deal with thorny issues. Your presentation, your work as commentators, and your participation in these short discussions will be evaluated. If it seems the reading isn’t getting done I will give quizzes or add a written component. Powerpoint does not usually add to the quality of the discussions unless you have material that complements the reading.

When you present to the class – you are the teacher. Be prepared. Use these opportunities to practice or try out what you believe to be the best practices in teaching. Be aware of your language – we all have idiosyncratic tendencies – “like,” “uh,” “so,” “and so forth,” etc. Use these sessions to be aware what you do when making oral presentations.

3) **Labs:** Many of the labs will be used to illustrate concepts using computer simulations or small projects. Some labs will have short write-ups.

4) **RESEARCH PROPOSAL**

To fund their research biologists have to write grant proposals. The major writing assignment in this course is to write a grant proposal on an evolutionary topic of your choice. Based on your general interests you will write a full-fledged research proposal of your own design. **The proposal must have an evolutionary question at its core.** If you’re not sure whether it does, talk with me. I highly recommend reading generally to get an idea of something that excites you whether it’s behavior, ecology, physiology, development, microbiology, biochemistry, etc. The ability to write grants – really it’s about selling a question or an idea - is important whether you work in the sciences, business, government, or the non-profit sector. Science is a collaborative process.

**Literature/Ideas Exploration:**
The first step in constructing the research proposal is to find a question that interests you. To expedite writing a proposal you will need to start perusing your books and the literature now (that is now, like today or tomorrow) and examine the kinds of questions that evolutionary biologists ask and that interest you.

You might start by looking through your textbook and considering the topics that are covered. These are by no means the only topics from which you can choose. If you find a topic that interests you, look at the citations at the end of the chapter and pick out an article that sounds interesting (perhaps even fun to read!). Many of the articles can be found using the databases at the library. Other sources of good ideas are the Table of Contents in journals like Trends and Reviews in Evolution and Ecology, Evolution, Evolutionary Biology, Proceedings of the Royal Society B. Look at titles and if the article is interesting, read the abstract. In Trends and Proceedings the articles are short; often just reading the title will be enough to let you know whether the topic is something that interests you. Look at the Biology 360 library webpage for links to databases and some journals. We will have a library session to help you get started. Once you’re using a database, plug in keywords about your interests. Read the abstracts of articles that sound interesting. This project, although a lot of work, should be fun for you to do. The freedom of the assignment allows people to pursue their interests.

A couple of caveats: 1) Some of us have favorite organisms. It is more difficult to write good proposals from an interest in a specific organism than from conceptual questions. 2) Because we are human, we are interested in humans. There are many scintillating evolutionary questions that can be asked and answered about humans. However, it is difficult to propose good studies on humans. Because of subjectivity and ethical concerns, it becomes very challenging to take an interesting question about humans and turn it into a compelling study. This is not to say that you should not propose a study on your favorite organisms or humans, but these will be more difficult.

1) EVOLUTIONARY QUESTIONS, ~3 pages - 10 pts

Identify three evolutionary questions that interest you. Explain what makes each question an evolutionary question. Explain why the question is interesting to you. What kind of approaches would you like to use to answer your questions (what combination of experimental methods, phylogenetic methods, molecular methods, field observations, etc. would you use?). Find an article that provides some background or stimulated the question.

2) PROJECT PREPROPOSAL, ~3 pp, 20 points

For this assignment you will have narrowed your topic down to a specific topic, set of questions, organism and approaches about which you want to write your proposal. This assignment is really a preproposal for the proposal. In this proposal you will need to present the specific questions you want to ask and how they fit into a larger evolutionary context, what organism/s you are going to use, the experimental/observational approaches you are going to use and how answering this question will shed light on other evolutionary/biological questions. This mini-proposal needs to be accompanied by at least 6 references (properly cited) relevant to your project proposal. The more detail the better.

3) LITERATURE REVIEW, 30 pts

One of the things that sells a proposal is the ability to place the question and study in a larger theoretical framework and in the context of work that has already been done. What is the larger theoretical context for your study? What are the big questions that researchers are trying to answer? How does your study fit into this work? This paper is essentially a draft of your introduction for the proposal. For this assignment you will need at least 10 papers relevant to your proposal. At the beginning of this assignment include a paragraph abstract describing your proposed project.
4) **FULL PROPOSAL DRAFT for Peer Review. 50 pts.** Up to 15 pp not including Literature Cited section. Turn in 3 copies with only your UPS ID # as an identifier. Please double space, use standard margins, and Times 12 pt font. Send me a digital copy as well.

Proposal assessment usually is done by a panel of peers who read a batch of proposals, discuss and rate them, and then decide which proposals to fund. We will simulate an NSF panel at the end of April with your proposals. The text of the proposals can be no longer than 15 pages double-spaced. Citations don’t count toward the number of pages. The proposal should frame your questions, providing background and explain how this work will complement or advance our knowledge. The proposal has to suggest a set of experiments and/or observational studies that you will use to answer your questions. A proposal will include the following parts: (1) a brief summary or abstract stating the goals and importance of the project, (2) an introduction providing a review of the conceptual background and previous research that will allow the reader to understand why the work is interesting and important. The introduction should end with a set of questions, or hypotheses and predictions that you are going to be testing, (3) methods and experimental protocols (4) a statement of the feasibility of the project (clearly a 100 year study of insecticide resistance would be nice --- but it's impractical), and (5) a Literature Cited section (this section should include at least 15 references for the draft and 20 references for the final version).

Citation Format:
Since different journals use slightly different formats, below are citations in the format used in the journal, *Evolution*, which is the format we will use in this class. Answer these questions for all five questions.

**Journal Article:** Hellberg, M.E., D.P. Balch and K. Roy. 2001. Climate driven range-expansion and morphological evolution in a marine gastropod. Science 292:1707-1710. (If you access journal articles online you should include the doi and the date accessed.)

*(Note: The first author has last name first but subsequent authors have initials preceding last name although I won’t worry about that much. Only the first word of the journal article is capitalized unless it's a proper noun. You can use accepted abbreviations for journal titles. Only the volume number is listed after the journal name – not the issue)*


**Web Page:** Web pages are not generally used in either journal articles or grant proposals (why not?). If you have to use a web page (and there are some reasons that you might), cite the URL author in the text and the year if you can find it, and the complete URL in the Literature Cited Section.

D)  **PROJECT ASSIGNMENT 5:** Peer Reviews of other proposals, 10 points

Everyone will get three proposals to review. These reviews are designed to give you an opportunity to see other proposals and to get some feedback from your peers.

E)  **PROJECT ASSIGNMENT 6:** Final Version of your Proposal, 100 pts

Only put your Student ID on each copy. Format like the drafts. The proposals need to have 20 references.

I expect that significant work happens between the drafts and the final version. We will simulate a National Science Foundation review panel, review each others’ proposals, and recommend whether they should be funded. I will provide you with instructions for reviewing the proposals. You will need to carefully review the proposals before the lab in which we review the grants. I will sort the proposals on Friday so that you can pick them up to review over the weekend. I will collect the reviewed proposals and comments after lab.
I will grade proposals according to the following scheme:

An "A" proposal is one that is good enough to be funded by the National Science Foundation (the real NSF) for a graduate fellowship. A typical "A" proposal is clearly written and well-organized, and, most importantly, it contains perceptive, original insights, makes connections among the different studies cited and proposes original research that would, if done, be a contribution to the scientific literature. The proposal places the research into its appropriate theoretical context. It demonstrates that the proposer has grappled with the both the issues raised in the literature and the course, synthesized the readings, discussions, and lectures, and formulated or carried out a compelling, independent research idea.

A typical "B" proposal is a solid and well-written work containing flashes of insight demonstrating that the student has wrestled with some of the issues in the literature and the course. Yet a typical "B" proposal might not be appropriate for funding because it mainly provides a summary of ideas and information in the literature. The research is very similar to that already done. Other "B" proposals/projects give evidence of independent thought, but the presentation is not clear or convincing.

A typical "C" proposal demonstrates a decent grasp of the literature but does not provide any independent synthesis and analysis of the topic. It is a mere rehashing of work done by others and doesn't make a concerted attempt to come to "intellectual ownership" of the ideas and methods discussed in the text. The writing and presentation are usually unclear.

A proposal/project that receives a grade lower than "C" typically does not respond adequately to the assignment, is marred by frequent errors, unclear writing, poor organization, lack of background research, or some combination of these problems. I will be happy to discuss ideas or the writing with you, provide suggestions for places to look, people to talk with, analyses and possible experimental protocols.

5) Participation: We will be discussing additional readings during classes and labs. Participation in these discussions is mandatory. Your grade for discussions will be based on your mastery of the material, and the degree to which you contribute to these discussions and bring questions and insights to class. Excessive class and lab absences will lead to withdrawal (WF) from the course. This decision is up to the instructor.

I reserve the right to give unannounced quizzes if it seems as though people haven’t done the reading for class. These quiz scores will be incorporated into your grade.

Turning in assignments: Deadlines, unless otherwise stated, are 5 PM the date something is due. Turn assignments in on Moodle.

Assumed Knowledge: I will assume that you have at some point learned most of the basic genetic and evolution concepts in your Introductory Biology textbook. For this course a fundamental understanding of genetics is essential. You should understand basic Mendelian inheritance and be able to describe recombination and independent assortment and describe their effect on inheritance. You should understand meiosis and mitosis and the difference between ploidy levels. You should be comfortable with calculating allele and genotype frequencies and have a passing acquaintance with Hardy Weinberg equilibrium. You should know what mutations are. You should understand the “central dogma” of molecular biology and the structure of DNA and proteins. You should know the basics about organelles such as mitochondria and chloroplasts. I will assume that you have the evolutionary biology background that appears in the two or three evolution chapters of Introductory Biology texts (basic evolutionary processes and speciation) that you learn in Biology 112. I realize that Biology 112 is not a prerequisite, but for those who have not had it, read the sections in the intro bio text. It is not difficult. I will make an effort to specify what knowledge I expect before each section.

Grading: You will be graded on your performance on a variety of assignments, exams and lab exercises and your participation in class discussions. There will also be a number of small ungraded assignments that will figure into your participation/discussion points. The grading breakdown follows:
### Assignment Points

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<tr>
<th>Assignment</th>
<th>Points</th>
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<tbody>
<tr>
<td>Midterm</td>
<td>100</td>
</tr>
<tr>
<td>Final</td>
<td>150</td>
</tr>
<tr>
<td>Smaller Proposal Project Assignments &amp; Reviews</td>
<td>70</td>
</tr>
<tr>
<td>Proposal Draft</td>
<td>50</td>
</tr>
<tr>
<td>Proposal</td>
<td>100</td>
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<tr>
<td>SG Presentation</td>
<td>10</td>
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<tr>
<td>Short Writing Assignments and Labs</td>
<td>120</td>
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<tr>
<td>Participation (includes paper discussions, etc)</td>
<td>50</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>650</strong></td>
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**Academic Honesty:** Violations of Academic Honesty will result in dismissal from the course with an F. Cheating is unfair to yourself and others. It cheats the cheater of learning and ends up consuming too much time and emotion for everyone. Cheating is a waste of your time and mine. You will learn nothing from doing it. All assignments must be written individually. You are responsible for understanding what constitutes plagiarism and academic dishonesty. Refer to the University of Puget Sound Academic Handbook (in the Logger) for a definition and examples if you are unclear.

**Late Policy:** It is important to get your work in on time. I have tried to space the assignments out to help you get the project done in a timely fashion. For the draft proposal and the final proposal (which are needed for the reviews), late papers will receive half of the full credit score you would have received. If you turn in a grant proposal late it will not be considered for funding. For the final proposal anything that comes in later than the Tuesday prior to the class review will receive a 0.

**Classroom Emergency Response Guidance**

Please review university emergency preparedness, response procedures and a training video posted at www.pugetsound.edu/emergency/. There is a link on the university home page. Familiarize yourself with hall exit doors and the designated gathering area for your class and laboratory buildings.

If building evacuation becomes necessary (e.g. earthquake), meet your instructor at the designated gathering area so she/he can account for your presence. Then wait for further instructions. Do not return to the building or classroom until advised by a university emergency response representative.

If confronted by an act of violence, be prepared to make quick decisions to protect your safety. Flee the area by running away from the source of danger if you can safely do so. If this is not possible, shelter in place by securing classroom or lab doors and windows, closing blinds, and turning off room lights. Lie on the floor out of sight and away from windows and doors. Place cell phones or pagers on vibrate so that you can receive messages quietly. Wait for further instructions.

**Office of Accessibility and Accommodations**

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Peggy Perno, Director of the Office of Accessibility and Accommodations, 105 Howarth, 253.879.3395. She will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

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