

# **Biol 290/390 – Science Careers & Effective Practice**

## **Course Syllabus**

### **Spring 2016**

#### **Instructor**

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Office hours: TBA, or by Appointment

#### **Meeting Times**

Monday & Wednesday

12:00-1:15pm

Place: Lasry 355

#### **Textbook:**

None. Readings will be available on Moodle.

#### **Prerequisites**

- Senior undergraduate students or graduate students
- Students should be in a natural science discipline and research active
- Permission

#### **Learning Objectives**

Students will consider what science is, how it works, and what it means to be a scientist. The goal of the course is to teach students about the rarely-discussed, but critically important aspects of being a successful scientist, preparing them for a career in science. In the context of the LEEP learning outcomes, students will:

1. *Knowledge of the Natural World and Human Cultures* – Learn how we use science to find out about the natural world.
2. *Intellectual and Practical Skills* – Grapple with deep issues of how science works. They will gain the practical skills needed to become a productive and successful scientist, including hypothesis formulation and testing, communicating science, writing grant proposals, and considering career options in their fields.
3. *Personal and Social Responsibility* – Consider professional ethics in science. These will include traditional issues such as the use of animals in research and data falsification, but also more subtle issues such as determining authorship of work and considerations about publishing.
4. *Ability to Integrate Knowledge and Skills* – Students will integrate knowledge through small group and whole class discussions, exposing expose them to a diversity of ideas and viewpoints in most sessions. Students will write a grant proposal and present it orally. This semester-long activity will allow them to apply the skills and knowledge gained throughout

the semester. The scientific method will be integrated with science writing skills, and oral presentation skills.

5. *Capacities of Effective Practice* – Senior undergraduate, fifth year Masters, and PhD students will interact with each other and the professor, resulting in interaction among individuals of many stages of intellectual and academic development. The community of effective practice will be emphasized throughout because the majority of in-class time will be spent working in groups composed of students at different stages of their training and from different fields.

## Course Website

All course information and material will be available on Moodle, including announcements, handouts, and readings. Check Moodle regularly – it contains information and materials you will need for this course.

## Grading, Components and Expectations

Biol 290/390 will be graded based on the following components:

|                                |             |                |
|--------------------------------|-------------|----------------|
| Student Profiles               | 2%          | Jan 20         |
| Research Topic Bibliography    | 8%          | Feb 10         |
| Experimental Design Assignment | 15%         | Feb 24         |
| CV or Resume                   | 10%         | Apr 13, Apr 18 |
| Grant Proposal                 | 25%         | Apr 20         |
| Peer Review Assignment         | 10%         | May 2          |
| Oral Presentation              | 10%         | Apr 24, 25, 27 |
| Class Participation            | 20%         | Ongoing        |
| <b>Total</b>                   | <b>100%</b> |                |

### Student Profiles | 2% of course grade | January 20

In the first session, students will be given an index card to do this assignment. On the card, they should place their **name**, the **degree** they are pursuing, their **program** (major and any minors), their **specialization** (which should be a one or two word description of their general field; for example, “Population Ecology”, “Functional Morphology”, “Genomics”, or “Cell Biology”), the professor’s **lab** that they are involved with, their **research interest** (which should be a one sentence description of the research that they are involved in), their **career goals** (which should be a few words outlining where they are headed; for example, professor, conservation biologist, biotechnology, medicine, etc.). The words that are in bold in this description should serve as headings that are left justified on the index card. This assignment should be hand-written and handed in at the end of class.

### Research Topic Bibliography | 8% of course grade | February 10

Later in the semester, students will write a grant proposal as the main assignment for the course (see below). Early in the semester, students will identify their topic and compile a bibliography of relevant primary literature that they will draw on to write their grant proposal. Students are encouraged to choose the topic of the research that they are involved in at Clark as part of their

program – the goal of these assignments is to help students be successful in their chosen work, not to make extra work of tangential relevance. It is probable that students will already have at least a basic bibliography from the research they are doing.

The topic and bibliography should start with a descriptive **title**, followed by a brief **description of the topic**. The description should be a single paragraph. This should then be followed by a listing of primary literature sources that the student has located. The bibliography should be as complete as possible. BA students should include **at least 20 references**, MA students should include **at least 30 references**, and PhD students should include **at least 40 references**. The references in the bibliography should be **listed alphabetically by first author's last name and formatted exactly as follows**:

For a journal article:

Bergmann, P.J., Meyers, J.J., & Irschick, D.J. 2009. Directional evolution of stockiness coevolves with ecology and locomotion in lizards. *Evolution* 63: 215-227.

For a book chapter:

Larson, A., & Losos, J.B. 1996. Phylogenetic systematic of adaptation. *In* Adaptation by M.R. Rose & G.V. Lauder, eds. Pp. 187-220. Academic Press: San Diego, USA.

For a book:

Sherbrooke, W.C. 2003. Introduction to Horned Lizards of North America. University of California Press: Berkeley, USA.

Notes on citations:

- Format your citations exactly as they are formatted in the examples above.
- List all of the authors, date, article/chapter title, journal/book title, volume, pages. For book chapters, include names of all editors.
- Do not abbreviate journal titles or publisher names. Do not include issue numbers.
- Do not include other extraneous material; only what you see above.
- Use a format consistent with the examples above for other sources you may want to cite.
- Use 1" margins, Times New Roman 12 pt. font, and single-space the assignment, but put a blank line between each citation. Number your pages.
- This assignment should be submitted by e-mail in Microsoft Word or RTF format.

### **Experimental Design Assignment | 15% of course grade | February 24**

This assignment has two main sections: a question and hypothesis section, and an experimental design section. For the question and hypothesis section, students should articulate **one scientific question** related to their research topic that they are interested in answering. Students should then formulate **two testable hypotheses** that will help address the question, and for each hypothesis, students should present **one or more predictions** that include what each prediction would mean to the question that is being addressed. Please use headings to organize these components.

For the experimental design section, students should select one of their hypotheses from the first section. They should identify the hypothesis that they are using and design one experiment and one mensurative study that would test the hypothesis. In this section, students should outline the approach that they would take, focusing on how it tests the hypothesis, not on details such as sample size. Students should avoid or explain jargon so that a layperson would understand what they write.

The first section should be maximally one page single-spaced, the second section should be 1-2 pages single-spaced. Headings should be used to organize the assignment, and part of the grade will be for having a logical organization. Use 1" margins, Times New Roman 12 pt. font, and number your pages. Submit by e-mail in MS Word or RTF format.

### **CV/Resume Assignment | 10% of course grade | April 13, 18**

Students will write a CV or resume for themselves. PhD students will make CVs. MA and BA students will have a choice of CV or resume. It is suggested that BA/MA students interested in academic careers (i.e., at a college/university) make a CV. This assignment should be formatted in any way the student feels makes the document look the best and creates the most effective CV/resume (we will discuss this in class). Students should bring a hard copy of their CV/resume to our class on "Resumes and CVs revisited" on April 13. After that class, students will have time to revise their resume/CV, and should submit by e-mail to Dr. Bergmann on April 18. Acceptable formats are MS Word or RTF.

### **Grant Proposal | 25% of course grade | April 20**

Students will write a grant proposal for this assignment, and the proposal should build on the research that they are currently involved in. The grant proposals will be modeled on those that are submitted by students to the National Science Foundation (NSF). BA and MA students will write a grant similar to the NSF's Graduate Research Fellowship (this is targeted for students entering a PhD program), and PhD students will write a grant modeled on the Doctoral Dissertation Improvement Grant (DDIG). Both types of grant will be evaluated based on NSF's two review criteria, **Intellectual Merit** and **Broader Impacts**. Refer to the Peer Review Assignment section and [http://www.nsfgrfp.org/applicants/application\\_components/merit\\_review\\_criteria](http://www.nsfgrfp.org/applicants/application_components/merit_review_criteria) for a description of these two criteria. The aim for this assignment is for it to be as realistic as possible so that students have a draft of something they may actually revise and submit to NSF to apply for these grants.

As indicated above, BA and MA students will write a Graduate Research Fellowship proposal. The instructions for the proposal are here: [http://www.nsfgrfp.org/applicants/application\\_components](http://www.nsfgrfp.org/applicants/application_components). For this assignment, students should complete the sections entitled **Personal Statement, Relevant Background, and Future Goals** and **Graduate Research Statement**. Ignore the other sections for this assignment (i.e., Reference Letters and Academic Transcripts). The page limit for each of these two sections is three and two pages each, respectively. This is NSF's limit as well, but while the NSF includes literature cited in this limit, we will not for this assignment – Your **literature cited** should be a

third section with no page limit, formatted as indicated for your bibliography. As a final note of guidance, you should have subsections in the **Proposed Plan of Research** that are entitled **Intellectual Merit** and **Broader Impacts**. Intellectual Merit should represent about 80% of your effort in this assignment.

PhD students will write a DDIG proposal. The complete instructions are available here: <http://www.nsf.gov/pubs/2013/nsf13568/nsf13568.htm>. These are more for your information as to how an NSF Program Solicitation looks. For this assignment, you will only write the **Project Description**. This is where the details of your proposal are described. *The page limit is 8 pages single spaced, including any figures and tables, but excluding literature cited. The proposal should start with a brief description of your overall dissertation project, including its design, scientific significance, and how it provides a context for the new work to be supported by the DDIG. It should then provide a detailed description of the question(s) to be addressed by the DDIG, what new data would be collected, and details on experimental design, analysis and interpretation. The scope of the broader impacts should be appropriate for the size and scope of the DDIG project, keeping in mind that providing improved graduate student training is in and of itself a broader impact.* Note that the italicized section is taken directly from the instructions on the linked NSF website. It is suggested that you have an explicit section for the overall description, the new work to be supported by the DDIG, and the broader impacts. Use of figures and tables, particularly presenting preliminary data that you have collected is particularly encouraged. The organization other than what is mentioned here is completely up to you. The task is to sell your research – convince the reader that you should be given \$13,000 to help with your research.

Students should keep in mind that the bibliography and experimental design assignments done earlier in the semester should help them in completing this assignment. They may even take portions of those assignments and incorporate them into this one. Finally, students should be aware that the page limits are absolute. Just as when submitting something to the NSF, if you go over the page limit, the assignment will not be graded. You must use 1" margins, and 12 pt. Times New Roman font, and number your pages. Also include a title page with a project title, the name of the grant you are applying for, and your name. Students should submit this assignment by e-mail in MS Word or RTF format.

### **Peer Review Assignment | 10% of course grade | May 2**

Students will be randomly assigned two grant proposals written by their colleagues to read and review. For each of these grant proposals, students should evaluate the quality of the proposal and the proposed research. Reviews will be modeled on the format of those done for the National Science Foundation (NSF). Each review should have two main sections: **Intellectual Merit** and **Broader Impacts**. Within each of these section, should be a subsection on **Strengths** and another on **Weaknesses**. At least one paragraph for each of these subsections is required, more is permissible. The intellectual merit section should address how successful the proposal is in finding out new knowledge, moving the field forward, and how rigorously the proposed research is designed. The broader impacts section should address how the proposal contributes to training young scientists, improving society or the world, and disseminating knowledge. Although today the NSF places equal weight on these two criteria, we will focus on intellectual

merit. Consider intellectual merit to be worth 80% of the proposal and broader impacts to be 20%. You can find more information about these review criteria at: [http://www.nsfgrfp.org/applicants/application\\_components/merit\\_review\\_criteria](http://www.nsfgrfp.org/applicants/application_components/merit_review_criteria). End this assignment with a section on **rating**. Ratings given to NSF proposals are: Excellent, Very Good, Good, Fair, or Poor. Choose the one that is most appropriate in your opinion. Follow this with a short paragraph explaining your choice. Please bring two hard copies of this assignment to class on the due date.

### **Oral Presentations | 10% of course grade | April 24, 25, 27**

At the end of the course, students will give 8-10 minute oral/PowerPoint presentations on their topics. These presentations should be informative and should aim to teach the class what they learned about their topic. Students have a lot of flexibility in how to structure their presentations. If they have data from their research, they can give a presentation of those data, analyzed and interpreted. If they are in the very early stages of their research, then it is fine to give an informative presentation about their topic of interest. A good rule of thumb is to have one slide per minute of presentation. Practice your presentation ahead of time so that you know it is the right length and so that you feel comfortable presenting. Part of the presentation grade will be for asking questions of the presenters, and for answering questions in a thoughtful way. Students will submit the presentation to Dr. Bergmann by e-mail on or before April 24 (this is a Sunday). Presentations will take place on April 25 and 27, during class time.

### **Participation | 20% of course grade | Ongoing**

Since considerable parts of this course will be discussion-based, students are expected to take part in discussions. Since this is 20% of the course grade, this is an important component, needed to do well in the course.

### **Course Rules & Time Commitment**

- All components of the course are mandatory to receive a passing grade. Because much of the work is oral, it is imperative that readings and presentations are completed on time.
- Late assignments are not accepted without discussing the matter with Dr. Bergmann **prior** to the assignment being due. Accepting late assignments at that point is at the discretion of Dr. Bergmann.
- The time commitment expected of students in this course each week is as follows:
  - 2.5 hours of class meetings, plus 5 hours of preparation and review
  - 2 hours of literature reading for writing the grant proposal assignment
  - 3.5 hours for doing the assignments for the class
  - Over a 14 week semester, this amounts to approximately 182 hours

## **Academic Integrity, Honesty, and Plagiarism**

Academic dishonesty includes any effort to circumvent the evaluation procedures of the course to improve a grade for yourself or other students (“cheating”). Academic dishonesty includes but is not limited to unauthorized copying of another person’s work, and not citing sources whose information you use in your assignments. Due to the nature of this course, most “typical” forms of academic dishonesty would be of no benefit, but students should give credit for ideas in written work through the use of citations, and give credit for graphics used in written and visual work (e.g. Powerpoint presentations). All students are expected to adhere to Clark University’s rules of Academic Integrity, available at: <http://www.clarku.edu/offices/aac/integrity.cfm>.

## **Students with Disabilities**

Clark University is committed to providing students with documented disabilities equal access to all university programs and facilities. If you have or think you have a disability and require academic accommodations, you must register with Student Accessibility Services (SAS), which is located in room 430 on the fourth floor of the Goddard Library. If you have questions about the process, please contact The Director of Accessibility Services, Emily Tarconish, at [etarconish@clarku.edu](mailto:etarconish@clarku.edu) or (508)798-4368. If you are registered with SAS, and qualify for accommodations that you would like to utilize in this course, please request those accommodations through SAS in a timely manner.

## Course Schedule

| <b>Dates</b>      | <b>Topics</b>  |
|-------------------|--|
| Jan 18 (M)        | <b>No Classes – Martin Luther King Day</b>   |
| Jan 20 (W)        | Introduction, <b>Student Profiles Due</b>  |
| Jan 25            | What is science and what are its limits?   |
| Jan 27            | <i>Unit I – Scientific Method</i> : What is the scientific method?   |
| Feb 1             | <i>Unit I</i> : Questions, Hypotheses, and Predictions   |
| Feb 3             | <i>Unit I</i> : Logic, Inductive & Deductive Reasoning   |
| Feb 8             | <i>Unit I</i> : Parsimony  |
| Feb 10            | <i>Unit I</i> : Experimental Design, <b>Bibliography Due</b>   |
| Feb 15            | <i>Unit I</i> : Experimental Design  |
| Feb 17            | <i>Unit I</i> : Statistics & Probability 1: Null Hypothesis Testing  |
| Feb 22            | <i>Unit I</i> : Statistics & Probability 2: Model Selection & Bayesian Inference   |
| Feb 24            | <i>Unit II – Science Writing</i> : What sorts of documents do scientists write?<br><b>Experimental Design Assignment Due</b> |
| Feb 29            | <i>Unit II</i> : Introductions and Literature Reviews  |
| Mar 2             | <i>Unit II</i> : Methods, Results, and Discussion  |
| <b>March 7-11</b> | <b>Semester Break – No Class</b>   |
| Mar 14            | <i>Unit II</i> : Grant Writing   |
| Mar 16            | <i>Unit III – Ethics &amp; Publishing</i> : Philosophical & Professional Ethics  |
| Mar 21            | <i>Unit III</i> : Choosing a Journal to Publish in, Open Access  |
| Mar 23            | <i>Unit III</i> : What is peer review and how does it work?  |
| Mar 28            | <i>Unit III</i> : A closer look at peer review   |
| Mar 30            | <i>Unit III</i> : Oral Presentations and Posters   |
| Apr 4             | <i>Unit IV – Careers in Science</i> : Make a Resume or Curriculum Vitae  |
| Apr 6             | <i>Unit IV</i> : Academic Career Paths and Applying for Graduate School  |
| Apr 11            | <i>Unit IV</i> : Applying for a Postdoc and a Faculty Position   |
| Apr 13            | <i>Unit IV</i> : Resumes and CVs Revisited, <b>Bring completed CV or Resume</b>  |
| Apr 18            | <i>Unit IV</i> : Non-Academic Science Career Options I, <b>CV/Resume Due</b>   |
| Apr 20            | <i>Unit IV</i> : Non-Academic Science Career Options II, <b>Grant Proposals Due</b>  |
| Apr 24 (Sun)      | <b>PowerPoint Presentations Due</b>  |
| Apr 25            | Student Oral Presentations   |
| Apr 27            | Student Oral Presentations   |
| May 2             | Grant Review Panel, <b>Grant Peer Reviews Due</b>  |

**Note:** This schedule can be modified as the course progresses. Check Moodle regularly.