2014

498 499 On-Campus Senior Research: Biology

Kathryn Morris
morrisk10@xavier.edu

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Course Description

This capstone, yearlong course introduces independent, original research. Here, you are required to develop a research project that will enhance your understanding of the scientific method of inquiry. In it, you will build on what you have been taught in various Xavier Biology courses by making quantitative observations, developing hypotheses and/or gathering and analyzing data to test these hypotheses. Finally, you will make conclusions based on evidence emanating from your research project. You will also practice and employ common forms of oral and written scientific communication to share your findings with others.

Objectives

By the end of this course, students will:

- Show competence in scientific literature searching and reading
- Demonstrate comprehension of the scientific method through experimentation
- Make observations and/or carry out an experiment to answer an unknown question
- Give evidence of ability to maintain accurate scientific records
- Evince understanding of the need for measurement accuracy, multiple trials and basic scientific statistical methods
- Improve oral and written scientific communication skills in each of the four common venues where scientists present: peer lab meetings, oral presentations, poster presentations and journal articles
- Demonstrate maturity through teamwork, independent work, and initiative

Recommended Text

A Short Guide to Writing About Biology, 7th Ed. by Jan A. Pechenik. You were required to purchase this book for Human/Vertebrate Physiology Lab. It may also be found at the bookstore, in the library, or in your faculty mentor’s office.

Course Requirements

While each faculty member runs his or her research group differently, there are certain common elements that all senior research experiences entail. These include:

Attendance and participation: Active participation in the weekly meetings with your faculty advisor is required. During some weeks, all senior research students will gather in small or large groups to share and/or hear peer research presentations. Participation in these events is also required. Throughout the course, your active questions and input are expected.

Lab notebooks: All senior research students must keep a detailed record of their activities, in ink, in a bound (not spiral or loose leaf) notebook that remains in the laboratory post-graduation, as per NIH/NSF guidelines.
You will be able to photocopy your lab notebook and take a copy with you when you graduate. Every entry must include a date, a legible record of all your activities that day, in detail, the number of hours worked, and your initials or signature. Pechenik, Ch. 9 gives examples. **Under no circumstance should information be recorded and post-dated.** This record protects both you and your work; it helps me as your faculty mentor review your progress as well as ensures a permanent record for the projects' future years, a necessity should publication ever result from your work.

**Peer presentations:** Twice during the fall semester and once in the spring, students will present their research progress to small peer groups facilitated by a faculty member other than your research advisor. These presentations should last no more than 10 minutes, and a computer will not be available unless requested as essential. Pechenik Ch. 12 discusses helpful tips on preparing oral presentations. Each peer presentation must:

- Be organized
- “Hook” the audience’s interest
- Give background information, with reference to published scientific literature on the topic (describe past studies methodologies and their findings)
- If appropriate, give background on past years of the project at Xavier
- Identify a clear hypothesis and the rationale for it
- Discuss the methods used to test that hypothesis
- Demonstrate evidence of advance preparation and general knowledge (asking and answering questions)
- In later presentations, especially in the spring semester, you will be expected to share results in progress and preliminary conclusions, along with any pitfalls your experimentation has revealed.
- Use at least one visual aid (on paper or chalkboard). This visual aid should be made by the individual presenting student, and should include only minimal text. You need not make handouts for other students unless you believe it would be beneficial; handouts will be given to the faculty facilitator and returned to your faculty advisor with his/her evaluation of your talk.
- This presentation should not entail you reading notes off a handout or card. Like your teachers in class, you should be prepared to speak without any notes beyond a few points on an outline. Reading from your notes indicates you don’t understand your topic well enough to discuss it.

**Oral presentations:** Near the end of the spring semester, each student is expected to formally present their work to a larger, non-peer audience (usually a freshman General Biology II class), mediated by a faculty facilitator other than your research mentor. This presentation should include all of the elements from your peer presentations (introduction, methods, results and conclusions), but incorporated into a formal PowerPoint slide show. There are many websites with PowerPoint tips, and you may also refer to Pechenik, Ch. 12, for tips on making PowerPoint slides. PowerPoint shows should include the following elements:

- Good organization, with minimal distracting "effects"
- Graphs with real data
- Visually appealing and clear
- Bulleted text only: again, you should not have to read from your slides.

**Poster Presentation, Celebration of Student Research:** A scientific poster (discussed in Pechenik, Ch. 12) is the most common mode of data presentation at professional science conferences. Each April, Xavier College of Arts and Sciences hosts a conference to showcase senior research. You will work individually or in groups to prepare a formal poster and present it. Examples of good scientific posters can be found throughout Albers Hall, in showcases and on walls.

**Written thesis:** The end of the spring semester culminates in a written senior thesis that describes your work in the format of a scientific paper (as taught in General Biology I & II, Genetics, Vertebrate Physiology and other courses; Pechenik (Ch. 1-9) covers this well). Faculty mentors may require advance drafts of various sections and may give more specific rubrics, but all papers should include:
o Scientific title and authors with proper author order
o Abstract that succinctly summarizes the background, hypothesis, methods, results and conclusions
o An introduction, including the Research Questions to be answered and the Hypothesis to be tested
o A Background section that includes a review of the significant primary literature with reference culminating logically in your hypothesis
o Materials and methods, described well enough that someone else can repeat them
o Results, with figures and tables properly used and labeled, and discussed/referenced properly in results text. Results should include multiple trials and appropriate statistical analysis to assess their validity (see your Stats text, Pechenik Ch. 4).
o Conclusions or Discussion section which contextualizes results in the body of primary literature, discusses possible caveats and identifies future experiments.

References, using mostly primary sources (limited textbooks or review articles, no Wikipedia), in proper scientific format (see Pechenik Ch. 5)

The author must have participated actively in the experiments in order to write about them. While work in teams is common and good in science, the author cannot claim credit for work that s/he shared no part in.

Course Policies
We will have regular lab meetings during the scheduled class time Wed 3:00-4:50. Occasionally there will be guest speakers on campus during this time offering insights on topics from research ethics to tips for giving good oral presentations. You are expected to attend all of these guest lectures, and all weekly lab meetings. This means that your actual research must be conducted on your own time. Helping you all through your senior research projects is one of the best parts of my job, and I will be available to meet with you as often as needed both in and outside of class time.

At each weekly lab meeting you will explain to the group what you have been up to that week that contributes to your project, and outline your project plans for the upcoming week. You will have the opportunity to ask for feedback from other lab members about any and all aspects of your project. Scientists at all levels regularly meet with colleagues to brainstorm ideas and talk through in-progress projects in an attempt to identify and correct any issues before project completion. As you near the end of your project, you will use lab meeting time to practice your research talks.

All students engaged in senior research will participate in lab safety training, as per NIH/NSF guidelines. You will also be given a key to my research laboratory. These keys are a privilege and should not be misused for purposes other than senior research. If keys are not returned by the end of the year, an academic hold will be placed on your record and graduation will be blocked. For safety purposes, do not plan to come to the laboratory alone after-hours. If you make a non-hazardous mess, you are responsible for cleaning it up.

After you decide on a project, you will need to learn new techniques (experimental and statistical) in order to complete your project. By Oct 6, I will post a schedule of 'Technique Development' sessions, which will take place during our regular class time. You must attend all sessions that we both agree are relevant for your project, and you are welcome to attend any other sessions as well.

Universal Grading Policy
Your faculty mentor will share his/her particular grading requirements. However, senior research is designed around the assumption that students who complete all requirements will earn a grade of C (satisfactory). In order to earn a B (good), students must show high quality effort, participation, oral and written work. The grade of A (excellent) is reserved for students who demonstrate outstanding ability and effort in all these areas. Students who fail to complete any item to the instructor’s satisfaction will receive a grade of D (enough to graduate). Students who fail to complete multiple items, show poor effort and/or attendance, and/or cannot adequately meet the objectives listed above will receive a grade of F. Any student not completing a thesis will receive grade of F.
During the final two weeks of spring semester you will be assigned an oral presentation venue that does not conflict with your class schedule.

Course evaluations will be held at the end of BIOL 499. If significant problems occur prior to the end of the year, they should be discussed with the faculty member and, if unresolved, the chair.

**Expectations:**

During the first and second semesters you will be involved in all aspects of experimental design and analysis, and will become very familiar with your chosen topic of research. In the lab you will design your own experiment, become proficient in all the experimental techniques necessary to complete your project, gain experience in the statistical methods needed to analyze your data, and learn some other cool things. You will be required to become familiar with the laboratory computers, programs and equipment. A large percentage of your grade will be based on your participation in the research and your **motivation** with the work. **You will be required to fill out a schedule of lab research dates and times and to stick to this schedule.** If you miss lab scheduled times you will receive a poor grade in the course.

**Additionally, your grade will be based on the following:**

**Fall Semester Paper**
Prior to the end of the fall semester you will be required to submit a working draft of the first part of your final thesis. This preliminary draft will contain the following sections: **Preliminary Abstract, Research question to be addressed, Hypothesis, Introduction including background of the area and a review of the literature,** and at least a preliminary Materials and Methods and an annotated bibliography which is linked to your Introduction section.

**Participation / Attendance**
Regular assessment of lab notebook entries
Peer participation evaluations

**Oral Presentations**
I will grade each of you based on the quality of your oral presentations (as judged by practice prior to your real presentation sessions and also by facilitating faculty) and the quality of your visual aids.

**Celebration of Student Research (CSR) Participation**
Participation in the Xavier CSR, usually by poster, is required by the department. If scheduled sufficiently in advance, posters may be printed in the CLC.

**Section on Grading**
(Grade inflation if not an option!!)
Your final grade will be based on how well you do in your oral presentation and your thesis. Three grading rubrics will be used as part of this grading process. Copies of the rubrics used for this grading process are included in the Senior Research packet (Rubric Oral, Rubric Thesis, Rubric Overall).

### Percentage breakdown method, e.g.:

<table>
<thead>
<tr>
<th></th>
<th>Fall 2014</th>
<th>Spring 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance and participation</td>
<td>20%</td>
<td>15%</td>
</tr>
<tr>
<td>Lab notebook</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Oral presentations</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Annotated Bibliography</td>
<td>5%</td>
<td>Results Draft: 10%</td>
</tr>
<tr>
<td>Project Outline</td>
<td>5%</td>
<td>Discussion Draft: 10%</td>
</tr>
<tr>
<td>Hypothesis Statement</td>
<td>10%</td>
<td>Abstract Draft: 5%</td>
</tr>
<tr>
<td>Materials and Methods Draft</td>
<td>10%</td>
<td>Poster: 20%</td>
</tr>
<tr>
<td>Introduction Draft</td>
<td>10%</td>
<td>Final Paper: 20%</td>
</tr>
</tbody>
</table>

To clarify this further note:

- **A (excellent):** requires original adaptation or design of novel experiment in addition to meeting all requirements below
- **B (good):** commendable completion of all course requirements, including original insights and/or especial effort in data collection and experimental modification when necessary, in addition to all requirements below
- **C (satisfactory):** completion of all course requirements, including attendance and participation
- **D (poor; but will still graduate):**
- **F will not graduate**

**A section on late penalties**
The worst thing that you can do as a students and a researcher is to falsify data. If you are to do this then you will receive a grade of F from me with no option for graduation. Plagiarism in writing your thesis will also result in an F in the course with no option for graduation. Remember that negative results are still results and will not impact your grade in the course. If you do good work, put in the time, make your presentations and demonstrate motivation, you will receive a good grade even if your data is all negative. Accuracy is what I am after. You must, however demonstrate motivation and that includes taking part in laboratory research sessions, being present for meetings, etc. If you miss research in the lab your grade will suffer accordingly.

**Possible syllabus changes**
As new information becomes available it may become necessary to make changes in the syllabus. If such changes have to be made then they will be announced in as timely a fashion as possible.