2014

498 499 On-Campus Senior Research: Biology

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Course Description
This capstone, year-long 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 learnt 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, by Jan A. Pechenik. You were required to purchase this book for Human 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 learn about research-related topics, prepare for life after graduation, or to share and/or hear peer research presentations. Participation in these events is also required. Throughout the course, your active questions and input will be rewarded.

Lab notebooks: All senior research students must keep a detailed record of their activities, in ink, in a bound (not spiral or looseleaf) notebook that remains in the laboratory post-graduation, as per NIH/NSF guidelines. Some faculty may opt for each student to have his/her own notebook while others may require entries in a common (shared) notebook. Either way, each 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 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.
{for Dr. Farnsworth’s work we will use formal datasheets instead of notebooks}

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 (as mandated by your faculty mentor) 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 an individually 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:

- Scientific title and authors with proper author order
- Abstract that succinctly summarizes the background, hypothesis, methods, results and conclusions
- An introduction, with significant reference to primary literature, culminating logically in your hypothesis
- Materials and methods, described well enough that someone else can repeat them
- 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).
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**

All students engaged in senior research will participate in lab safety training, as per NIH/NSF guidelines. They may also be given keys to their 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.

**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.

**Attendance**

The senior research class time is scheduled for 2 hours. This is to allow for large-group meetings for all students as well as group meeting with your individual faculty mentor. Large-group meetings will usually take place during the first hour. Depending upon your project, expect to spend additional time in the lab or field on your actual project. Your faculty mentor will explain the expectations for your particular project.

**Important Dates**

<table>
<thead>
<tr>
<th>Fall Semester (Wednesdays, 3:00 – 4:50)</th>
<th>Tentative Spring Semester (Wednesdays, 3:00 – 4:50)</th>
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<tr>
<td>Aug. 27</td>
<td>Jan. 14</td>
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<td>Sept. 3</td>
<td>Jan. 21</td>
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<td>Sept. 10</td>
<td>Research Ethics – Data Integrity and Sharing Credit Jan. 28</td>
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<td>Sept. 17</td>
<td>Feb. 4</td>
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<td>Sept. 24</td>
<td>Feb. 11</td>
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<td>Oct. 1</td>
<td>Effective Speaking in Science Feb. 18</td>
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<td>Oct. 8</td>
<td>Literature discussion ← Feb. 25 Peer Presentations III</td>
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<td>Oct. 15</td>
<td>Summer Research Presentations Mar. 4 Spring Break, no meeting</td>
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<td>Oct. 22</td>
<td>Peer Presentations I Mar. 11</td>
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<td>Oct. 29</td>
<td>Annotated Bibliography due ← Mar. 18</td>
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<td>Nov. 5</td>
<td>Writing a Science Resume Mar. 25</td>
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<td>Nov. 12</td>
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<td>Nov. 19</td>
<td>Alumni Panel Apr 1</td>
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<td>Nov. 26</td>
<td>Thanksgiving Break: No Meeting Apr. 8</td>
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<td>Dec. 3</td>
<td>Peer Presentations II Apr. 15 Easter Break</td>
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<td>Dec. 10</td>
<td>BIOL 497 Presentations Apr. 22</td>
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<td>Introduction &amp; Methods due ← Apr. 29 Oral Presentations</td>
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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.

Additionally, your grade will be based on the following:

Depending on the research project you will be involved with you may have to:
(1) formulate a new hypothesis and design an experiment to test that hypothesis, or
(2) use an already existing hypothesis and continue the research of previous students. In either case you must:
    Understand the logic behind hypothesis development
    Learn specific methods / techniques and how to apply them
    Find and analyze relevant literature

Assignments

Fall semester:
    Literature review & discussion
    Draft of Introduction & Methods sections of scientific paper
    Peer-review presentations

Spring semester
    Peer review presentations
    Poster for Celebration of Student Research
    Final research paper

Grading for Fall Semester

    Literature review & discussion: 15%
    Annotated bibliography: 15%
    Attendance and participation: 30%
    Oral presentations: 10%
    Introduction & Methods draft: 30%

Grading for Spring Semester

    Attendance and participation: 30%
    Presentations: 30%
    Final research paper: 40%

A section on late penalties

The worst thing that you can do as a students and a researcher is to falsify data. If you were 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 we are after. You must, however demonstrate motivation and that includes taking part in laboratory research sessions and field research sessions, being present for meeting, etc. If you miss research in the lab and field your grade will suffer accordingly.

As always the possibility exists that the syllabus may change