2014

498 499 On-Campus Senior Research: Biology

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Welcome to the McIntosh Lab!

Dr. Mollie McIntosh
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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

Required Materials:

• Laboratory Notebook (must be bound). See examples provided in class.

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 loose-leaf) 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.

**Assignments:** Multiple assignments/discussions will be due over the course of the semester. Included are the following:

**Primary Literature**
- Required reading from faculty-assigned texts, papers, evaluated via group discussion and/or typed notes on the reading
- Required reading of student-chosen papers, assessed as above.
- Annotated bibliography: a one-paragraph summary of 10 – 30 primary papers, usually due before an introduction draft. May be faculty-chosen and/or student-discovered.

**Project Outline**
- A semi-formal outline/proposal, with background information, significance, hypothesis, rationale, experimental methods.

**Other Homework – Writing, Data, Stats and More**
- Required readings, exercises and discussions on proper methods in writing, data management and analysis and statistical methods, poster development, presentations, etc.

**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”
The objectives listed above will receive a grade of F. Students who fail to complete all requirements will earn a grade of F.

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.

Note: 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.

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.
**Dr. McIntosh Grading Policy**

Your grade (%) will consist of the following:

- **Fall Semester**:
  - Assignments 20%
  - Attendance and participation (class, field and labwork): 25%
  - Peer presentations: 10%
  - Methods Draft: 15%
  - Introduction/Methods draft: 30%

- **Spring Semester**:
  - Assignments 10%
  - Attendance and participation (class, field and labwork): 25%
  - Peer/Oral presentations: 10%
  - Poster Presentation: 10%
  - Results Draft: 15%
  - Final paper: 30%

**Late Policy**: Late assignments will be deducted 5% of the total assignment points for each day the assignment is late.

**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.
Senior Research Important Dates (Tentative)

<table>
<thead>
<tr>
<th>Fall Semester (Wednesdays, 3:00 - 4:50)</th>
<th>3:00-4:00</th>
<th>4:00-4:50</th>
<th>Assignments Due</th>
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<tbody>
<tr>
<td>Aug. 27</td>
<td>ALB4: Introduction, Syllabus, Research Schedules</td>
<td>Project Meetings:</td>
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<td>Sept. 3</td>
<td>ALB4: Article Review, Literature Searching/Citing, Project Outlines</td>
<td>Project Meetings:</td>
<td>Scientific Article Critique</td>
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<td>Sept. 10</td>
<td>ALB103: Research Ethics II – Data Integrity and Sharing Credit</td>
<td>Project Meetings:</td>
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<td>Sept. 17</td>
<td>ALB4: Article Review</td>
<td>Project Meetings:</td>
<td>Project Outline Due</td>
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<td>Sept. 24</td>
<td>ALB4: Topic TBD</td>
<td>Project Meetings:</td>
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<td>Oct. 1</td>
<td>ALB103: Effective Speaking in Science</td>
<td>Project Meetings:</td>
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<td>Oct. 8</td>
<td>ALB4: Peer Presentations Intro, Assignment TBD</td>
<td>Project Meetings:</td>
<td>Annotated Bibliography Due</td>
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<td>Oct. 15</td>
<td>TBD: Summer Research Presentations</td>
<td>Project Meetings:</td>
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<td>Oct. 22</td>
<td>TBD: Peer Presentations I</td>
<td>Project Meetings:</td>
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<td>Oct. 29</td>
<td>ALB4: Topic TBD</td>
<td>Project Meetings:</td>
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<td>Nov. 5</td>
<td>ALB103: Writing a Science Resume</td>
<td>Project Meetings:</td>
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<td>Nov. 12</td>
<td>ALB4: Topic TBD</td>
<td>Project Meetings:</td>
<td>Draft: Methods Due</td>
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<td>Nov. 19</td>
<td>ALB103: Alumni Panel</td>
<td>Project Meetings:</td>
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<td>Nov. 26</td>
<td>Thanksgiving Break: No Meeting</td>
<td>Project Meetings:</td>
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<td>Dec. 3</td>
<td>TBD: Peer Presentations II</td>
<td>Project Meetings:</td>
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<td>Dec. 10</td>
<td>TBD: BIOL 497 Presentations</td>
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<td>Drafts Due: Introduction/Methods</td>
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Tentative Spring Semester (Wednesdays, 3:00 – 4:50)

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<td>Feb. 25</td>
<td>Peer Presentations</td>
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<td>Mar. 4</td>
<td>Spring Break, no meeting</td>
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<td>Celebration of Student Research, usually sometime in April</td>
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<td>Apr. 15</td>
<td>Easter Break</td>
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<td>Apr. 29</td>
<td>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.