497-01 Advanced Inquiry Lab

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Advanced Inquiry Lab

BIOL 497, XAVIER UNIVERSITY
SYLLABUS, FALL 2014
WF 3:00 – 4:50

Dr. Jennifer R. Robbins
Albers 2, (513) 745 – 3624
robbins@xavier.edu
Office
Hours: MWR 12-1 or by appt

Required Resources:

_A Short Guide to Writing About Biology_, 7th Ed. 2010, by Jan A. Pechenik
(Other recent editions may be acceptable but you must find the relevant material in them if chapter numbers have changed. You were required to purchase this book for Vertebrate Physiology Lab.)

Course Description

This capstone course introduces independent, original research. Here, you are required to work alone or with peers 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.

Biology 497 is currently an experimental course to determine whether and how our students can be mentored in larger research groups through the development of original, meaningful research projects. It will substitute for the traditional senior research experience (BIOL498-499) and includes similar components.

Course 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

The course builds on Xavier Core Curriculum learning objectives; in particular, you will improve your ability to:

- Find, evaluate, and logically convey information and ideas in written and oral presentations.
- Evaluate real-world problems using quantitative methods and arguments.
- Identify and critically assess multiple dimensions of an ethical issue in an attempt to reach a conclusion.
- Describe the evolution of your vocation and aspiration to contribute to the world.
Course Components

Attendance and participation: Active participation in the twice-weekly class meetings is required. Throughout the course, your active questions and input will be rewarded.

Ideas forum: In order to facilitate early development of senior projects, students will participate during the summer and early part of the course in a Blackboard discussion forum. Each student will be expected to comment substantively on others’ research ideas and pose one idea themselves. This will be scored as participation.

Research methods assessments (RMAs): Each “class” meeting will begin with a short lecture, activity and/or discussion on the philosophy, practice or institutions of modern biological research. Your understanding will be enhanced and assessed by short quizzes or homeworks as indicated.

Lab notebooks: All senior research students must keep a detailed record of their activities, in ink, in a notebook that remains in the laboratory post-graduation, as per NIH/NSF guidelines. 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.

Peer presentations: Throughout the course, students will practice talking about their work by presenting to peers in the classroom on a rotating basis. Names will be drawn out of a hat for presentation order; you must be ready to present any day presentations are assigned. Pechenik Ch. 12 discusses helpful tips on preparing oral presentations and we will cover this in class as well. 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 audience (usually another class). 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. We will cover the making of good Powerpoints in class, and you may also refer to Pechenik, Ch. 12, for tips. 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 (CSR): 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 that will be graded for this course. You are also expected to present that poster in April at the CSR. Examples of good scientific posters can be found throughout Albers Hall, in showcases and on walls.

Written thesis: The end of the 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) and our class will cover this well). Draft sections will be due throughout the second half of the semester and redistributed to peers for peer editing. Good-faith efforts on drafts and peer-edits will receive full credit.

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 that 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
Senior research (BIOL 496-499) 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.

Classroom Policies

Attendance is mandatory, and will be reflected in participation. Absences due to university-approved events or job/med/grad interviews must be arranged with me at least 24 hours in advance. For extended absences due to emergencies or medical issues, contact your dean’s office, who will notify me. Homework is still due whether you come to class or not, and may be put into my mailbox (in the department office) or emailed to me up to 24 hours after the class.
**Prepare before class.** Arriving to class unprepared is not fair to your teammates. A high non-compliance rate may get you removed from a team.

**Plagiarism and cheating are not acceptable.** These include copying sentences or phrases from any print or internet source, copying from others, using crib sheets, etc. In accordance with Xavier's Academic Honesty policy, any infraction at all will cause at least a grade of 0 on that assignment and may result in an F for the course, at my discretion. All incidences will be reported to the dean, who will keep them in your college record.

**Canvas** will be used in this class to share course materials and grades. You can share documents with and email your teammates there as well. Login through https://canvas.xavier.edu.

**I will be available.** This is a challenging course—get help when needed. Stop by my office anytime. I will certainly be there during office hours (see above), often at other times, and I can arrange other appointments by email.

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**Grades**

<table>
<thead>
<tr>
<th>Written thesis: 30%</th>
<th>Peer presentations: 5%</th>
<th>Drafts: 5%</th>
<th>Annotated Bib: 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poster: 10%</td>
<td>Oral presentation: 10%</td>
<td>RMAs: 25%</td>
<td>Notebook: 10%</td>
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Participation (judged by peers, me): Force Multiplier—can add or subtract up to 50% of your grade

**Grading Scale:** A standard scale will apply.

<table>
<thead>
<tr>
<th>A: 94.0 – 100</th>
<th>B+: 87.5 – 89.8</th>
<th>C+: 77.5 – 79.8</th>
<th>D+: 67.5 – 69.8</th>
<th>F: &lt; 59.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-: 89.9 – 93.9</td>
<td>B: 82.5 – 87.4</td>
<td>C: 72.5 – 77.4</td>
<td>D: 60.0 – 67.4</td>
<td></td>
</tr>
<tr>
<td>B-: 79.9 – 82.4</td>
<td>C-: 69.9 – 72.4</td>
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**Schedule of Topics & Assignments**

Subject to change

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<tr>
<th>Week of…</th>
<th>Wednesday</th>
<th>Friday</th>
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| Aug. 25  | **Reviewing the scientific method**  
Introduction to the course, peers  
Observational vs hypothesis inquiry  
Correlation vs causation  
Reading a science paper  
Literature searches (Ch. 2)  
Research: Round-robin brainstorming | **Philosophy of science**  
Qualities of a scientific hypothesis  
Pseudoscience  
Why are we doing this?  
Research: Round-robin brainstorming |
| Sept. 1  | **MEETS IN ALBERS 103**  
**Research ethics I: Human subjects research and Institutional Review**  
History of human subjects research  
The IRB process  
Privacy  
Research: Round-robin brainstorming  
**RMA Due:** Literature search HW | **Basic statistical analysis I (Ch. 4)**  
Frequency distributions  
Population descriptors  
Research: Round-robin brainstorming  
**RMA Due:** NIH Human Subjects Certification |
Sept. 8

**MEETS IN ALBERS 103**

Research ethics 2: Data integrity & sharing credit (Chuck Grossman)

- The scientific process in the US
- Data integrity and research ethics
- Who gets credit and how?

Due: Project area, team intentions

RMA Due: Stats HW1

Research teams: discuss proposals

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Basic statistical analysis II (Ch. 4)
- Histograms
- P values
- T-test, ANOVA

Research teams: discuss proposals

RMA Due: Paper Analysis (Ch. 3)

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Sept. 15

**Proposals and science funding**

- The grant-making process in-depth
- Research proposals

RMA Due: Stats HW2

Research teams: Draft proposal (Ch. 10)

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Basic statistical analysis III (Ch. 4)
- Regression
- Effect size

RMA Due: Individual proposal drafts (Ch. 10)

Research teams: Draft proposal (Ch. 10)

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Sept. 22

**Oral Presentation Basics (Ch. 12),**

- Information and engagement
- Good speaking skills
- Taking and asking questions

RMA Due: Stats HW3

Research teams: Critique proposals (Ch. 6)

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Basic statistical analysis IV (Ch. 4)
- Experimental design: devising a testable hypothesis

Research teams: Plan Oral Proposals (Ch. 12)

RMA Due: Team proposal drafts

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Sept. 29

**MEETS IN ALBERS 103**

Effective Speaking in Science

- Narrative construction
- Effective slides

Oral proposal peer-presentations round 1

Due: Annotated Bibliography

Research teams: Design experiments, final proposal

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Scientific writing

- Scientific writing style (Ch. 9)
- Revising bad writing (Ch. 6)

Oral proposal peer-presentations round 2

Due: Final Proposal (Team)

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Oct. 6

Class Will Not Meet, but--

Research teams: Begin experimentation!

- Keep your lab notebook as per Ch. 9

No Class: Fall Break

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Oct. 13

**MEETS IN ALBERS 103**

Peer Presentations

- Listen to summer research students present their work

Three Good Slides round 1

Due: Three Good Slides

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Graph Making I (Ch. 9)

- Graph-making I

Research teams: keep experimenting!

Three Good Slides round 2

Due: Introduction draft for peers

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Oct. 20

**Publishing in Science**

- The publication process in-depth
- The importance of keeping up

Three Good Slides round 3

Research teams: keep experimenting!

RMA Due: Graph HW1

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Graph Making II (Ch. 9)

- Graph-making II

Due: Introduction draft for me

Lab Notebook checkup

Research teams: keep experimenting!
Oct. 27  Figure and table legends (Ch. 9)  Experimental execution
   Figure and table legends
   RMA Due: Graph HW2
   Research teams: keep experimenting!

Nov. 3   Writing a science resume/CV (Ch. 13),
          Guest Beth Zink, XU Career Services Center
          Writing a science resume/CV
          Research teams: start drawing conclusions
          Due: Materials and Methods draft for me

Nov. 10  Interpretation
          Research teams: start drawing conclusions
          Due: Results draft for peers

Nov. 17  MEETS IN ALBERS 103
          XU Biology Recent Alumni Panel:
          Results and conclusions peer presentations round 2
          Due: Results draft for me
          Research teams: begin working on posters

Nov. 24  No class, Thanksgiving Break

Dec. 1   Oral presentations
          Due: Individual oral presentations due
          Oral presentations round 1
          Research teams: continue working on posters

Dec. 8   LOCATIONS TBA
          Oral presentations to 498 students
          Outside of class: presentations
          Due: Conclusions draft for me

Final Exam: Thursday, Dec. 18
          Due: Senior thesis, electronically, by 3 pm + Lab Notebooks (in mailbox okay)