

## **BIO 493 Independent Research in Biology II**

### **Background**

Course description: Independent Research in Biology II is an experience typically offered to students in their junior or senior years. Under the direct supervision of a faculty member, students engage in original research projects, generating new knowledge in the laboratory and/or the field. Given that it takes considerable time to fully develop a research project, a two-semester experience is suggested. During this time, students are expected to become engaged in literature review, experimental design, evaluation of protocols and hypotheses, and data acquisition and analysis. At the completion of the experience students are required to produce a final product that summarizes the research experience. This requirement is automatically fulfilled for those students who enroll in Bio495/496. Furthermore, students participating in Independent Research in Biology II are encouraged to become involved in professional activities outside of The College. In any given year, approximately 5 to 10 students from the department present their original research at regional or national conferences, and many more are coauthors on published abstracts or manuscripts submitted to peer-reviewed journals.

How this course fits into the Biology Program: Independent Research in Biology II is a rich, deeply engaging opportunity that, for many students, constitutes the ultimate learning experience within the major. Biology, as with any other scientific discipline, is based on experimentation, data acquisition and analysis. While most of the courses in the Biology Program offer laboratory components, and in fact, many provide students with the opportunity to engage in open-ended inquiry-based experimentation, Independent Research in Biology II gives students a completely unique exposure to the discipline. Students involved in Independent Research II are able to experience research science in a laboratory as it truly exists: they learn how to identify biologically relevant problems, determine the best experimental approach to address these issues, design and carry out experiments, collect and analyze data, and finally take their results and put them into the context of a larger biologic question or problem. In addition to developing these skills, students must learn to take responsibility for their experiments, to display initiative and creativity, and to work collaboratively and productively with a supervisor and their peers. These skills translate well beyond the major and prepare students for any science related career option that they may pursue after graduation. In sum, Independent Research in Biology II is an incredibly valuable educational experience, and one that will have a long-lasting impact on the student's future.

### **Learning Goals**

The ultimate goal of Independent Research in Biology II is to provide students with a real-life exposure to original biological research. Students are expected to be actively engaged in the experience, on both practical and intellectual levels. As part of the learning experience, students will be involved in experimental design, data acquisition and analysis. Under the supervision of a faculty member, it is expected that students will gain independence in these processes, and will show an increasing ability to direct their day to day activities and in "trouble shooting" their own experiments. In addition to the learning goals associated with the actual hands-on work in the lab, students also have significant intellectual learning goals. These include understanding the theoretical relevance of the experimental problem and how their experiments fit into a larger

biological context. To that end, students are expected to become adept at finding appropriate and relevant published studies, as well as critically reading and evaluating these works.

### **Student Assessment**

In order to ensure that common standards for evaluating student performance are adopted by all faculty involved in Independent Research, detailed guidelines outlining performance goals and expectations have been developed and are shown below.

### **Performance Goals and Guidelines for Independent Research in Biology II:**

Basic requirements include:

- 1) attendance at laboratory meetings
- 2) maintenance of a laboratory notebook
- 3) attendance at all departmental seminars
- 4) final product that summarizes the research experience and could take the form of a paper, presentation (COSA or lab meeting presentation), or other product deemed appropriate by the research advisor. If the student continues to Bio495/496, this requirement will be fulfilled by the objectives of that course.

For students that wish to continue Independent Research to fulfill their senior capstone requirement, please refer to syllabi for Bio495/496 for additional requirements to meet the guidelines for a 'W' (writing intensive) course at the advanced level.

## **Independent Research in Biology II: Performance Criteria**

### **A Excellent Performance**

- engages in persistent, hard work
- displays independent intellectual and technical involvement in work
- has an excellent grasp of technical and theoretical aspects of research
- makes project their own; makes creative contribution to design and analysis of experiments
- maintains an excellent lab notebook with up-to-date recording, tabulating, and analysis of data
- displays critical thinking in lab meetings
- final product is of excellent to outstanding quality

### **B Good Performance**

- engages in persistent, hard work
- exhibits ability to work independently and demonstrates technical independence
- delivers a very solid performance and completely reliable and reproducible experimental work
- gives competent presentations in lab meetings
- maintains a clear, organized lab notebook
- final product is of good to very good quality

### **C Average performance**

- engages in persistent, hard work
- performance in experimental work is fair to poor
- demonstrates an ability to work with limited supervision
- lab notebook displays evidence of confusion and is inadequately maintained
- participation in lab and lab meetings is of low quality
- final product is of fair quality

### **D Poor Performance**

- performance is inadequate or sloppy
- displays inability to work without direct supervision
- has an inadequate grasp of the technical aspects of the work
- does not maintain an organized research notebook
- final product is unclear, poorly organized and does not adequately convey the research conducted