

BIO 195 Upper Division Undergraduate Research

Advisor: Prof. Stephanie Woo

Office Hours: TBA

Course Description

Undergraduate research experience involves students in an original research project. Using one or a variety of methods, students will collect original data and contribute to problem solving in the Biological Sciences. As a first research experience, emphasis will be placed on the process of scientific research, including formulation of a research plan, data collection, assessment of data quality, interpretation based on available data, and communication of results.

Learning Outcomes

By the end of the course you will be able to:

- Define the “scientific method” and describe how it operates in biological research.
- Construct a testable hypothesis and design appropriate experiments to test your hypothesis.
- Collect high-quality original data by one or several commonly used molecular biology methods.
- Read and interpret primary research articles
- Present the results of your research by oral presentation.
- Write a report of your research in research article format (last semester of senior year only).

Prerequisites*

You are expected to have completed the following courses with a letter grade of “B” or better: BIO 001, BIO 002, BIO 110, CHEM 002/002H, CHEM 010/010H

Co-requisites*

You are expected to have completed or be concurrently enrolled in the following courses: BIO 140, BIO 150

*Exceptions may be granted at Prof. Woo’s discretion

Suggested Reading

You will be assigned readings from research articles, review articles, and/or textbook chapters as needed. It is expected that you will eventually seek out appropriate background literature on your own.

Expectations of Time, Involvement and Effort

Weekly time commitment: It is expected that you will be engaged in the project at an appropriate level. As a rule-of-thumb, one credit hour is equal to 3 hours of class contact. *If you enroll in BIO 195 for 3 credit hours, then you are committing to spend an average of 9 hours on the project per week.* Budget your time accordingly. Failure to budget your time wisely usually leads to less-than-beneficial experiences.

Lab meeting attendance and participation: Attendance at the weekly Woo Lab group meetings is *mandatory*. Each lab member is required to present at lab meeting approximately twice per semester. You can present either a progress report on your project or a published research article relevant to your project topic.

Lab notebook: You will be provided with a lab notebook in which you will record all of your experimental plans, protocols, and results. The lab notebook is a very important part of scientific research and needs to be taken seriously. Be thorough and up-to-date in your record keeping, and avoid being sloppy. Ideally, other lab members should be able to interpret your data and repeat your experiments based off of your notebook alone. Use of electronic lab notebooks (e.g., Benchling, etc.) is allowed if you receive prior approval from Dr. Woo.

Your lab notebook will remain the property of the UC Merced School of Natural Sciences once you have completed the project.

Collegiality: You should approach the laboratory as a professional work setting. You are expected to treat your colleagues, advisor, members of neighboring labs, and support staff with respect and professionalism. Challenging ideas and being skeptical is a normal and important part of scientific research. However, you are expected to offer constructive criticism without invoking personal attacks. Harassment and bullying of any kind will not be tolerated and may result in a failing or zero grade for the course and a report submitted to the Office of Student Conduct.

Misconduct and plagiarism: Scientific misconduct in any form will not be tolerated. Scientific misconduct includes, but is not limited to, falsification or manipulation of data, plagiarism, misrepresentation or failure to acknowledge others' work, failure to follow safety and animal protocols. Evidence of misconduct will automatically result in a failing or zero grade for the course and a report submitted to the Office of Student Conduct.

Lab Responsibilities

All lab members have the following responsibilities when working in the laboratory:

- Follow all safety procedures
- Complete and stay up-to-date on all required training
- Wear appropriate clothing and personal protective equipment (PPE)
- Clean up after yourself and replace items in the correct place
- Immediately communicate any broken or inoperable apparatus or equipment
- Frequently communicate on the status of consumables (chemicals, glassware, tissues, etc.)
- Follow all established protocols when working with animals

Assessment and Grading

You will receive a letter grade at the end of each semester based on the assessment criteria outlined on the following page. Note that a final written report will only be required at the end of the last semester of your senior year.

Publication of Results

Your aim should be to do high-quality work and collect publishable data even if your project may not be publishable as a stand-alone contribution. If your data are publishable, you may be a co-author on a paper. This will be discussed when appropriate.

	Assessment Criteria	Excellent	Good	Satisfactory	Unsatisfactory
1	Time management	Shows evidence and planning of time management. Spends at least 3 contact hours per credit per week on project. Works efficiently. Sets realistic goals and meets all on time.	Spends about 3 contact hours per credit per week on project. Works efficiently. Sets goals and meets most on time.	Spends 2–3 contact hours per credit per week on project. Sets goals and meets some on time.	Does not manage time well; attempts to make up lost time in final weeks of project. Fails to set and/or meet goals on time.
6	Lab work	Independently and enthusiastically collects high-quality original data and demonstrates a full understanding of the uncertainty associated with each datum. Always follows safety protocols.	Diligently collects high-quality original data and demonstrates good understanding of the uncertainty associated with each datum. Commonly follows safety protocols	Collects original data under regular supervision yet has an incomplete understanding of the uncertainty associated with data. Shows little understanding of project. Must be reminded of safety protocols.	Does not work independently and has not demonstrated an understanding of the project or data uncertainty. Ignores safety protocols and endangers self or others
3	Lab notebook	Regular, tidy, and full documentation of planning, activity, and raw results. All new work entered and dated at the time work was done.	Neatly documents planning, activity, and raw results.	Documents planning, activity, and raw results with minimum detail and frequency.	Poor and incomplete documentation of process and results; illegible in places.
4	Lab meeting attendance	Attends and willingly participates.	Attends and participates.	Attends, but is unprepared and tends not to participate.	Poor attendance and preparation.
	Lab meeting presentation	Gives a clear, structured, and illustrated presentation that demonstrates an excellent understanding of the project topic.	Gives a clear and illustrated presentation that demonstrates a good understanding of the project topic.	Gives a satisfactory presentation that demonstrates some understanding of the project topic	Failure to meet satisfactory requirements.
5	Creativity, initiative, literature	Constructs a testable hypothesis and clearly designs appropriate tests and/or data collection strategies. Actively seeks pertinent literature. Suggests new experiments. Offers independent interpretation of data.	Constructs a testable hypothesis and designs appropriate tests and/or data collection strategies. Is familiar with literature supplied by advisor.	Constructs a testable hypothesis and designs appropriate tests and/or data collection strategies. Is familiar with only one or two supplied papers.	Demonstrates little independent thought and remains uninformed on the relevant literature.
8	Final report (Final semester senior year)	Submits a typed, structured, and coherent report in the format of a typical research article (Introduction, Materials and Methods, Results, Discussion, References). Report goes beyond simple conclusions and demonstrates a depth of understanding.	Submits a typed, structured, and coherent report in the format of a typical research article (Introduction, Materials and Methods, Results, Discussion, References).	Submits a typed and structured scientific report that makes justified conclusions based on data.	A short report with little detail or no report submitted.