PURDUE UNIVERSITY

DEPARTMENT OF BIOCHEMISTRY

BCHM 49900 Syllabus
Fall/Spring

Honors Thesis in Biochemistry

INSTRUCTOR

Any faculty member in the Department of Biochemistry may assume responsibility for guiding a BCHM 49900 research project. In addition, Purdue faculty in science-related departments outside of the Department of Biochemistry may assume responsibility for supervising a BCHM 49900 project with the approval of the project by the student's academic advisor.

PREREQUISITES

BCHM 36100 or equivalent, BCHM 49800 or BCHM 49801, and consent of instructor.

COURSE OBJECTIVES

BCHM 49900 is intended to provide the opportunity for in-depth, independent, undergraduate research. The students enrolled in this course will learn how to devise hypotheses, design experiments that test their hypotheses, record their data in laboratory notebooks, critically analyze the results of their analyses, and present their findings to others in written form.

- Students are strongly encouraged to engage in an appropriate and *independent* research project.
    - Students and faculty mentors should work together to identify a project that is commensurate with the student's ability.
    - Students are expected to participate in experimental design, including formulating a hypothesis, generating an experiment to test the hypothesis, formulating appropriate controls, troubleshooting unexpected results and interpreting the final conclusions.
    - Through this experience, students will gain appreciation for discovering knowledge firsthand rather than reading from a textbook.

- Students will gain experience in critical thinking through their undergraduate research project.
    - Students will critically analyze their data for accuracy.
    - Students will critically analyze their research to determine if it appropriately tested their hypothesis.
    - Students will gain analytical and communication skills that are important for most professions that directly and peripherally involve life sciences.

- Students will gain experience communicating the results of their research project in the form of an undergraduate thesis.

DEPARTMENTAL LEARNING OUTCOMES ADDRESSED BY THIS COURSE

BCHM 49900 students will understand the scientific method. They will be able to develop hypotheses, design experiments, and critically analyze results to create new knowledge.

BCHM 49900 students will communicate scientific knowledge, experiments and conclusions effectively as speakers and writers.

BCHM 49900 students will use scientific instrumentation to evaluate the activity or function of biological macromolecules.

BCHM 49900 students will demonstrate knowledge of analytical and preparative methods that can be applied to biochemistry.

BCHM 49900 students will demonstrate knowledge of accepted safe laboratory practices.

BCHM 49900 students will demonstrate laboratory experience working with a diverse group of individuals as part of a research team.

BCHM 49900 students will demonstrate the ability to organize and document laboratory procedures and results.

BCHM 49900 students will describe research projects in an oral presentation that can be readily understood by a general scientific audience.

BCHM 49900 students will appreciate the ethical issues facing professionals in the life sciences.

TEXTBOOK

There is no assigned textbook for this course. Background information will be largely derived from reviews and the primary scientific literature.

LABORATORY TIME AND PLACE

To be arranged with the course instructor.

CREDIT HOURS AND ATTENDANCE

BCHM 49900 is a 3 credit hour course consisting of two components. The first component is 2 credit hours of research in a laboratory. The second component is 1 credit hour of independent study in which the student will write an honors thesis. A minimum of 10 hours per week in the lab corresponds to 2 units of credit during a regular 15-week semester. In general, 2 credit hours requires approximately 150 hours of research. Any activity relevant to the student's research experience (e.g. attending lab meetings, reading necessary literature, etc.) will count toward the approximately150 hours of work.

Specific hours in the lab should be worked out between the course instructor and the student. In general, students should strive to commit to large blocks of time in the lab (>3 hours) to increase productivity. It is understood that students may sometimes need to change their schedule and make up hours at another time. Advance notice of change of schedule should be given to the course instructor and where applicable, the graduate student, post-doctoral research associate, technician, or research associate who directly supervises the student as a matter of common courtesy. Failure to meet these attendance policies will affect the grade associated with BCHM 49900. BCHM 49900 may not be added after the first week of the semester except with explicit permission of the course instructor. Students who enter the laboratory after the first week are still expected to participate in ~ 150 hours of research.

The course instructor will meet with BCHM 49900 students at least once per week to discuss research progress and provide guidance for the next week.

Students may not repeat BCHM 49900 for credit.

SPECIAL NEEDS

If you will require special accommodations in BCHM 49900 because of diagnosed disabilities, you are expected to notify the course instructor prior to initiating project so that appropriate arrangements may be made.

GRADING

The grade for BCHM 49900 are based on both research and thesis components as follows.

Research	200 points
Thesis	100 points
Total	300 points

A: 270 – 300 points
B: 240 – 270 points
C: 210 – 240 points
D: 180 – 210 points
F: 180 points or below

Research

The assigned grade for BCHM 49900 will necessarily reflect the priorities and expectations of the supervising faculty member. Some suggested guidelines for assigning grades are provided below.

A: Student assumes responsibility for directing project. Demonstrates clear understanding of hypothesis tested and of experimental approaches used to test hypothesis. Student keeps an accurate record of experiments neatly written in a laboratory notebook. Student has no issues with attendance. (180-200 points)

B: Student has modest understanding of hypothesis tested and of experimental approaches used to test hypothesis. Student keeps an accurate record of experiments neatly written in a laboratory notebook. Student has no issues with attendance. (160-180 points)

C: Student has modest understanding of hypothesis tested and of experimental approaches used to test hypothesis. Student is not reliable regarding hours in lab or is not reliable in maintaining an accurate lab notebook. (140-160 points)

D: Student has poor understanding of research project. Student is not reliable regarding hours in lab or is not reliable in maintaining an accurate lab notebook. (120-140 points)

F: Student fails to grasp basic concepts driving research project. Student has substantial issues regarding hours in lab or in maintaining an accurate lab notebook. (120 points or below)

Thesis

Expectations for the thesis content are listed below under Course Requirements.

A: Student completes written assignments in a timely manner and the thesis meets or exceeds expectations. (90 – 100 points)

B: Student completes written assignments in a timely manner and the thesis meets expectations. (80 – 90 points)

C: Student does not complete written assignments by the suggested deadlines and the thesis fails to meet expectations. (70 – 80 points)

D: Student does not complete written assignments and the thesis contains significant flaws. (60 – 70 points)

F: Student fails to complete the undergraduate thesis. (60 points or lower).

Students are strongly advised to ask the course instructor what their expectations are of a BCHM 49900 student. Please keep in mind that expectations are likely to reflect curricular and lab experience of the student.

COURSE REQUIREMENTS

At the end of the semester, students will submit an honors thesis describing their research project. The thesis need not be limited to description of research during the semester, but may span previous research experiences.

The honors thesis consists of a 20-50 page document (1.5 spaced, 11 point Arial or 12 point Times or equivalent font). This page limit includes figures and their legends, but not the Literature Cited. An honors thesis must contain the following sections.

I. Introduction
The introduction should include a description of the scientific background of the project and the significance of the project. The hypothesis being tested should be clearly stated. A working model for the experimental system should be described with both text and a figure.

II. Experimental Design
This section should describe the experiments performed in sufficient detail to allow others to repeat the original experiments and reproduce the results.

III. Results
This section should state the rationale for each experiment and its design. Each experiment should be described separately. Where possible, the order of experiments in the Results section should correspond to the order of experiments in the Experimental Design section. Experimental controls and error analyses should be described in detail. The outcome of the experiments should be explicitly described. This section should have a narrow focus on experimental outcomes and is the appropriate place to describe any technical issues, limitations or caveats. If the research did not provide conclusive results, the methods used to trouble-shoot the experiments should be described.

IV. Discussion
This section should focus on the meaning and the broader context of the experimental results. The Discussion should be clearly distinguished from the results and should not reiterate experimental findings presented in the results section. It should include analysis of whether the experiments supported or disproved the working model and hypothesis. As an example, the results of the experiments may indicate that a protein-protein interaction is taking place in a cell. The discussion would then describe the consequences of the protein-protein interaction to cellular function.

V. Conclusions and Opportunities for Future Research
This section should provide a brief description of where the research has led. What experiments could next be pursued? If the hypothesis has been supported, what additional experiments could be designed to test it further? If the hypothesis has been disproved, a modified hypothesis could be described and experiments to test it could be suggested.

VI. Literature Cited

When referring to the work of others, it is important to cite their research with a suitable reference. The cited reference should be from primary literature and not from secondary literature. Primary literature is considered the original research published for the first time. Secondary literature contains information that has been reinterpreted or cited by someone who has read the primary literature. A document of this size will typically cite 20-50 references. The reasons for this are twofold. First, it directs the reader to a source that may be useful for understanding the project and provides evidence that the statements being made in the thesis are valid. Second, it provides credit to the authors of the study. Formatting of this section is at the discretion of the student, however a standard and specific journal citation format (e.g. Journal of Biological Chemistry, Genes and Development, Plant Cell) should be adopted.

Due dates*:

Week 1: Students will submit a brief 1 page description of the proposed research project to the BCHM 49900 instructor. This description should include a brief background that illuminates the problem of interest, the hypothesis to be tested and a brief summary of the experiments to be used to test the hypothesis. This paper can form the basis of the Introduction

Week 2: The student should provide an outline of the undergraduate thesis to their BCHM 49900 instructor

Week 4: The student should provide a rough draft of the Introduction section of their thesis to their course instructor

Week 6: The student should submit a rough draft of the Experimental Design section of their thesis to their course instructor.

Week 9: This is the last week in which a student can drop BCHM 49900.

Week 10: The student should submit a rough draft of the Results section of their thesis to their course instructor.

Week 12: The student should submit a rough draft of the Discussion section of their thesis to their course instructor.

Week 14: The student should submit a rough draft of the Conclusions and Opportunities for future research to their course.

Finals week: Final draft of the undergraduate thesis is due.

*The BCHM 49900 instructor will provide written feedback to rough drafts within a week of submission.

ACADEMIC MISCONDUCT

Academic misconduct of any kind will not be tolerated in BCHM 49900. Information on Purdue's policies can be found at http://www.purdue.edu/ODOS/osrr/integrity.htm.

To provide you with an unambiguous definition of academic misconduct, the following text has been excerpted from "Academic Integrity: A Guide for Students", written by Stephen Akers, Ph.D., Executive Associate Dean of Students (1995, Revised 1999, 2003), and published by the Office of the Dean of Students in cooperation with Purdue Student Government, Schleman Hall of Student Services, Room 207, 475 Stadium Mall Drive West Lafayette, IN 47907-2050.

"Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Part 5, Section III-B-2-a, *University Regulations*] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72-18, December 15, 1972]

More specifically, the following are a few examples of academic dishonesty which have been discovered at Purdue University.

- substituting on an exam for another student
- substituting in a course for another student
- paying someone else to write a paper and submitting it as one's own work
- giving or receiving answers by use of signals during an exam
- copying with or without the other person's knowledge during an exam
- doing class assignments for someone else
- plagiarizing published material, class assignments, or lab reports
- turning in a paper that has been purchased from a commercial research firm or obtained from the internet
- padding items of a bibliography
- obtaining an unauthorized copy of a test in advance of its scheduled administration
- using unauthorized notes during an exam
- collaborating with other students on assignments when it is not allowed
- obtaining a test from the exam site, completing and submitting it later
- altering answers on a scored test and submitting it for a regrade
- accessing and altering grade records
- stealing class assignments from other students and submitting them as one's own
- fabricating data
- destroying or stealing the work of other students

Plagiarism is a special kind of academic dishonesty in which one person steals another person's ideas or words and falsely presents them as the plagiarist's own product. This is most likely to occur in the following ways:

- using the exact language of someone else without the use of quotation marks and without giving proper credit to the author
- presenting the sequence of ideas or arranging the material of someone else even though such is expressed in one's own words, without giving appropriate acknowledgment
- submitting a document written by someone else but representing it as one's own"

EMERGENCY PREPAREDNESS

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. To get information about changes in this course consult the class Blackboard site or e-mail or phone the instructor.

NON-DISCRIMINATION POLICY STATEMENT

Purdue University's non-discrimination policy will be upheld in this course. Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue University views, evaluates, and treats all persons in any University related activity or circumstance in which they may be involved, solely as individuals on the basis of their own personal abilities, qualifications, and other relevant characteristics.

For more information, see
http://www.purdue.edu/policies/pages/human_resources/nondisc_pol.html

IDENTIFICATION OF SUPERVISING FACULTY MEMBERS

Please see http://www.ag.purdue.edu/biochem/undergrad/Pages/ResearchOps.aspx for suggestions on how to identify a supervising faculty research mentor.

SAFETY TRAINING

If you have not already done so, you must complete safety training before you can enroll in BCHM 29800, 49800 or 49900, or work in a lab for pay. Review the University's Chemical Hygiene Plan manual, then meet with your labs' principle investigator (PI) or his/her designee to be trained on laboratory specific safety and personal protective equipment:

Chemical Hygiene Plan (Two parts)
Part 1: Basic Lab Safety Fundamentals:
a. Go to https://www.purdue.edu/ehps/rem/training/training.html#L
b. Register to create a new account and login
c. Complete the 3 modules and take the exam
d. Print the certificate and bring it to BCHM 120.

Part 2: Laboratory Specific Chemical Hygiene Plan:
a. Read the CHP manual : https://www.purdue.edu/ehps/rem/documents/programs/chp2014.pdf
b. Print out the form under Appendix A and take it to your research lab's principal investigator (PI) to discuss laboratory-specific safety. Sign the form and bring it to BCHM 120.

Personal Protective Equipment:
https://www.chem.purdue.edu/chemsafety/Training/PPETrain/PPEtrainCert.pdf
This training should be performed by your research lab's principal investigator (PI) or your immediate supervisor. Complete and sign the form. Your PI must also sign the form.
Deliver the completed forms to the BCHM Main Office (120).