

Course Description

- The course is an advanced laboratory course that focuses on techniques for the preparation and quantitative analysis of proteins and other macromolecules, presenting students with a broad spectrum of techniques, approaches and concepts of contemporary biochemistry. You will learn DNA purification and analysis, protein expression and quantification, enzyme purification, enzymatic characterization, chromatography, electrophoresis, and spectroscopic analysis. While you become skilled in all of these techniques, you will be designing your own experimental procedures and continually analyzing and evaluating your results. You will do all of this while demonstrating safe laboratory practices and keeping a complete and organized lab notebook.
- The ability to think critically and independently in both the design and execution of an experiment is crucial for scientists. The best way that this can be learned is through hands-on research. This semester is designed to give students this experience all while learning crucial biochemical skills



Goals of the Semester

- Semester-long research style project
- Analyze, Design, Purify and Test!
- Learn to develop critical skills and thinking
- Learn structural protein modeling
- You will be given more responsibility to plan and design your own experiment
- Be ready for the next step!
- Have fun doing biochemistry

"There must be no barriers for freedom of inquiry. There is no place for dogma in science. The scientist is free, and must be free to ask any question, to doubt any assertion, to seek for any evidence, to correct any errors."

Robert Oppenheimer

- You will be assigned to a team for the semester. In this team, you will develop a hypothesis, then design and complete experiments to test the group's hypothesis.
- As part of your team work, you will evaluate your team and your team will evaluate you. Your group work reflects the real-world experience of scientists – that is - team-based studies and interdisciplinary cohorts.
- From your group work, you will gain experience working with peers to evaluate, interpret, and debate data/ethical issues pertaining to the course materials.

Advanced Writing CORE flag

- This is a writing course and fulfills the advanced writing requirement in the major. In this course, you will develop a formal research paper based upon your research project. The components of the paper: Introduction and Hypothesis, Results, and Discussion, will be written over the course of the semester.
- The Materials and Methods component will be evaluated in the context of your laboratory notebook.
- Through instructor feedback, revision, and peer review, you will hone your scientific writing skills. You will also learn how to prepare publication quality figures and figure legends, prepare a literature review of relevant primary literature, and master proper usage of references.

Semester Organization

- **Block I:** Basic Lab Skills (lab math, buffers, pipetting, dilutions, lab notebook)
- **Block II:** Introduction to MDH, CS, protein-protein interactions/metabolons
- **Block III:** Bioinformatics and Protein Modeling MDH-CS Interaction
- **Block IV:** Recombinant CS and MDH protein purification and characterization
- **Block V:** Experimental Design and Assay Development – mini presentation
- **Block VI:** Determination of MDH specific activity K_m and V_{max} determination of wild-type and mutant MDH using plate assay
- **Block VII:** Project – Assay development of MDH-CS interactions and investigation of MDH-CS regulation.

Assignments/Grading

Homework, Prelabs, Quizzes 200 pts (20% of total grade)

Homework and pre-lab assignments will be turned in throughout the first half of the semester and must be completed on time to be adequately prepared for the next lab period. Late homework and assignments will not be accepted for a grade. Notice of quizzes is not provided in advance.

Laboratory Notebook 200 pts (20% of total grade)

Your laboratory notebook should be an accurate record of what you do in the lab, and should contain notes and calculations as well as appropriate comments to the lab you're working on..

NOT MAINTAINING A LAB NOTEBOOK WILL RESULT IN AN AUTOMATIC "F."

Assignments/Grading

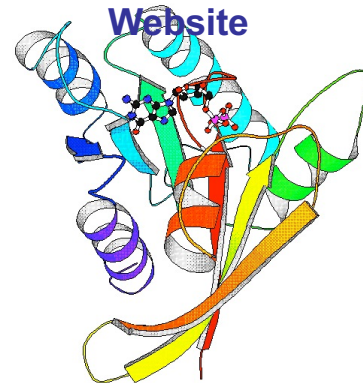
Research Project 300 pts (30% of total grade)

For the project, you will work in groups of 2-4 to learn the structure, function protein-protein interactions and important characteristics of human mitochondrial malate dehydrogenase (hMDH2).

Writing Assignments 300 pts (30% of total grade)

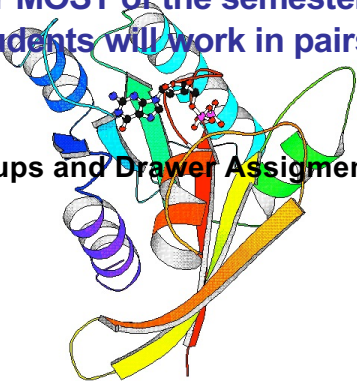
This is a writing course and fulfills the advanced writing requirement in the major. In this course, you will develop a formal research paper based upon your research project.

The grade cut offs are A-90%, B-80%, C-70%, D-60% F-<60%. The +/- grades will be awarded within each range. If revisions are offered: Must be completed within one week of graded work being returned to student



For MOST of the semester, students will work in pairs

- **Groups and Drawer Assignments**



Computer Use and Access

- All lab students will be able to access the biochem lab from 7:30 until 7:00
 - Key card access (5:00 – 7:00)
 - Use space and time responsibly
- All desks and common areas **MUST** be clean or points will be deducted. Store solutions appropriately, clean and put away all material
- Be respectful of other lab sections
 - Biochem Labs Mon-Fri 1:30-5:30
 - Molec Tech Lab T/Th mornings

Required Reading

- No Required Textbooks BUT...
 - Required pages indicated on the handouts and the web
 - Required viewing of video and you tube modules
 - External websites
 - SHARPIES AND E-notebook REQUIRED

Lab Safety and Orientation

- Food & Drink
- Fire
- Acid/Base Storage
- Hazardous Waste
- Water
 - Tap, Distilled
 - Deionized/Milli-Q - Use for most everything



Lab Safety and Orientation

- Stations, Numbering and Policy
- Pipette Tips
- Glassware
- Washing Glassware
- Freezer / Fridge
- Blackboard Communication
- Other



Lab Notebook – General Guide

We will be using LabArchives and electronic notebook.
Basic format – see website linked info and rubric

My bottom line:

*“Your laboratory notebook should be an accurate record of what you do in the lab, and should contain notes and calculations as well as appropriate comments to the lab you’re working on. **A major function of a lab notebook is to allow another competent scientist to reproduce exactly your experiment.**”*

Your notebook will be graded based on the organization, completeness, and the statement in bold above.

Lab Notebook – General Guide

Notes: Make a separate entry and directly place your notes into the LabArchives as a separate note entry.

- Date** – automatically recorded in ELN
- Title / Headings**
 - Use a descriptive title, not just the name of the experiment copied from the laboratory manual. Pick a title that describes the content of your work. Particularly important for multi-day experiments.
- Introduction/Purpose – The big picture**
This section should include a two or three sentence statement of the purpose(s) and objective(s) of the exercises being performed.

Lab Notebook – General Guide

D. Procedure / Protocol or Methods

Write a description of procedures used including any deviations from the information presented in the laboratory handout.

If there is a published exact protocol, then reference the protocol or procedure AND include a simple outline, flow chart or description of the referenced protocol. **DO NOT COPY AND PASTE** the protocol into the notebook.

When you have to repeat a routine operation several times, such as a protein assay, you can skip the details and refer to the specific page in the notebook where the complete procedure was originally described.

The title, introduction/purpose and materials and methods sections should be entered before coming to lab. (Deviations from the information presented in the laboratory handout will be recorded during lab as you perform the experiments.)

Lab Notebook – General Guide

E. Data and Results – Including Analysis

- All raw data and observations that are generated should be recorded in your laboratory notebook at the time of the exercise. This should include uploading any tables, graphs, formulas or other information from the laboratory manual.
- Your data analysis should be performed as soon after the conclusion of an experimental procedure as possible and before the next lab period. Any tables of the data collected that day and graphs of that data should be included if appropriate. This section should include all calculations, averages and corrections to the recorded data.
- All information should be neatly presented with graphs and tables labeled appropriately. Graphs can be prepared on any computer you have access to and then uploaded into your notebook.

Lab Notebook – General Guide

F. Discussion and Conclusions

- This section should include any interpretations, conclusions, or suggestions regarding the results of that day's exercise. A discussion of the expected results (if known) and why they were or were not obtained should be included. THIS IS NOT A SUMMARY OF EVERYTHING THAT HAPPENED DURING THE EXPERIMENT THAT DAY. THIS IS A DISCUSSION OF THE DATA AND FINAL RESULTS.

A good discussion might include:

1. What were the major points illustrated by the data?
2. Do the results agree with previously published works?
3. Is the data contradictory in itself?
4. Does your research have potential for follow-up experiments?
5. Do your results support or disprove your hypothesis?
6. Are your results dramatically different than what was anticipated and if so why?

Lab Notebook – General Guide

G. References

- Include any references that were consulted for the experiment or cited in the report. Minimally, this should include your laboratory manual.
- References should be presented in alphabetical order by the last name of the first author.

Other Notes:

- This is not a personal diary and notes to that effect should not be included!
- Show your calculations in the data/results section. Often if an experiment does not work as anticipated, it can be traced to a miscalculation.
- Remember your results from the exercise are important. You are not being graded on the outcome of experiments therefore you should strive for the most accurate and intelligent representation of your data possible.
- I can't stress this enough, copying and pasting methods from the lab manual or the internet does not count as a written protocol. You can