CHEM 152L COURSE SYLLABUS

CRN 1196, Section 09, Thursday 8:00 am – 12:00 pm lab in SCST 332

Contact Information

Instructor: Dr. Joseph Provost Office: SCST 487 Email: josephprovost@sandiego.edu

Office Hours

Mon 10-9 am, Tues 3:30 -4:30 pm, Wed 3:30-4:30 pm, Fri -11:15 am – 12:15 pm

Course Design

Chemistry 152L is the second semester of a two-semester sequence which is designed to introduce you to the fundamental concepts, techniques, and methods of experimental chemistry. This is accomplished through a series of experiments that build upon each other. Many of the theoretical concepts and basic mathematical skills upon which the experiments depend are covered in Chemistry 152, so previous or concurrent registration in that course is required of students in 152L. Chemistry 152L builds upon the foundation we laid in Chemistry 151L, so successful completion of Chemistry 151L is a prerequisite for this course. The course is divided into two modules, and each module emphasizes a main theme that we believe a student should learn in a first-year chemistry course:

Module 1 – Synthesis and Analysis
Module 2 – MDH and Cancer Metabolism Research

Each module contains a specific set of goals. The first weeks of a given module are designed to teach you the techniques and concepts needed in order to reach the module's goals.

In the second module students will gain both technical expertise & research experience through a possible mechanism of metabolism that could support tumor cells during cancer progression. During the semester they will develop a research project using a variety of classic chemistry techniques (titration, kinetics, spectroscopy, molecular modeling) in the context of experiments to explore structure function relationships of potential antimalarial drugs targeted towards a specific enzyme. Students will develop and test research ideas related their project.

During the semester students explore prior knowledge, formulate a hypothesis to be tested, design and perform a combination of computational and wet-lab experiments to explore Malate Dehydrogenase. Students collect and quantitatively analyze data to test their hypothesis using molecular modeling and docking studies and wet-lab techniques such as spectroscopy, kinetics, binding and titration studies, allowing them to draw evidence-based conclusions. The project concludes with a formal presentation describing their project.

Course Goals. This course will give you experience with how a chemist approaches a given chemical question, so where Chem 151L can be described as a "fundamentals and techniques" course, Chem 152L is more of an "approach" course. Your background in Chem 151L will come in handy because you will use techniques from that course as tools to answer complex chemical questions. In this course you will learn how to:

1. Maintain a safe work environment by following general laboratory protocol (applied to more corrosive/toxic materials than were used in Chem 151L): proper handling and disposal of hazardous chemicals; maintaining a safe work environment; what to do in case of a lab emergency
2. Assess the factors that need to be considered when designing an experiment and use them to:
    a. Understand why we performed the experiment the way we did (Module 1)
    b. Design and carry out procedures of our own (Module 2)
3. Perform simple tests to either characterize an unknown or to determine its identity.
4. Organize a wide array of data for a series of unknowns using a qualitative analysis scheme
5. Use observations to guide you through your experiment.
6. Link your observations to written chemical reactions taking place.
7. Propose reasonable sources of error and their likely impact on experimental results.
8. Perform three new separation techniques: gravity filtration, vacuum filtration, and decantation.
9. Further develop/refine laboratory notebook writing skills.

Learning Outcomes for Chem 152L*

Upon completion of this course, you should be able to:

1) Design a simple experiment that can answer a given chemical question.

Determine what needs to be done and in what order, determine what types of glassware should be used in the experiment, assess the major sources of error and how to modify procedure to eliminate these errors if possible.

2) *Qualitatively analyze a given chemical or physical process.*
   Observe a chemical and/or the changes that take place in a chemical reaction, perform a flame test or a precipitate test, test for acidity/basicity, identify an unknown from qualitative tests.
3) *Quantitatively analyze a chemical or chemical process.*
   Generate and interpret a standard curve, interpret titration results, calculate percent yield for a synthesis, apply kinetics and weak acid/base equilibria concepts in calculations, write a balanced chemical equation to describe an observed chemical change.

Here is a list of equipment and where each item can be found:

1. Lab Manual and lab notebook – The lab manual will be hosted on an electronic lab notebook. Information is posted on Blackboard for registration. The cost is $15/semester. https://mynotebook.labarchives.com/login
2. Calculator
3. Access to a computer, Chromebook, laptop, Surface or tablet
4. Molecular Model Set – If you do not own one from Chem 151/15L, or information will be distributed during the first week of lab on how to purchase during torero hours in Shiley or you may order a similar kit at the following link: https://www.darlingmodels.com/Individual-Orders-Molecular-Model-Kits/KIT-1-ISBN-978-09648837-1-0-Plastic-Box-Organic-Inorg/prod_2.html
5. Lab Coat – USD Bookstore
6. Safety Spectacles – From Chem 151L, or information will be distributed during the first week of lab on how to purchase

USD UPDATED FALL 2022 COVID-19 HEALTH AND SAFETY MEASURES

- The university requires the COVID-19 vaccination and booster for the campus community. Waivers for medical and religious reasons may be submitted.
- The university continues to support and encourage campus community members to wear face coverings when they feel the need to do so.
- Faculty may require face coverings to be worn during their classes.
- All members of the USD community will continue to be required to contact covidsupport@sandiego.edu if they test positive for COVID-19.
- **In the event we experience a significant resurgence of COVID-19 infections, USD may choose to implement other health and safety measures.**

Breakage You will be financially responsible for any cumulative glassware breakages/losses totaling over $10.

Attendance Policy Attendance at your regularly scheduled lab section is **mandatory.** Labs will begin promptly at 8:am (Thursday). All the lab sections are full this semester and there is **no option to attend another section**. Do no schedule another class, work or personal vacations during this time. It is unexcused and cannot be made up. You must let your instructor know in advance otherwise it is an unexcused absence. Keep the lines of communications open.
Reasons for an excused absence:

1) Serious illness with proper documentation (i.e. doctor's note) or
2) Required attendance at an official University event.
3) Please work with you instructor if you are experience symptoms of COVID-19 or have been exposed and must quarantine or isolate. This may affect your attendance to any of the in-person labs and you will need to work with your instructor to make arrangements for an excused absence.

If you have an excused absence, please read the make-up protocol section. Unexcused absences cannot be made up.

Make-up Protocol

If you have an excused absence, you will be required to complete the remote lab in its place. Work with your instructor to attend the prelab lecture and obtain the "remote lab" assignment. ***You are only allowed two make-up assignments in the course.***

Grade Details

Course grades will be assigned based on this scale, and plus and minus grades will be assigned within each category.

A = 90 – 100% B = 78 – 89% C = 65 – 77% D = 52 – 64%

This course contains a total of 350 possible points. The point breakdown in the course is:

Category	Points (out of 330)	Percentage of the grade
8 Prelab (10 pts ea)	80	~24%
4 Experiment Assignments (10 pts ea)	40	~12%
3 Post-lab conclusions (10 pts ea)	30	~10%
4 Quiz (20 pts ea)	80	~24%
Presentation	100	~20%

Notes

- Please note that it is a violation of the Academic Integrity Policy to possess and otherwise use course materials (i.e. lab reports, problem sets, exams) from previous semesters of Chem 152L. https://www.sandiego.edu/conduct/documents/HonorCode.pdf
- Arrive to class on time – no make-up quizzes.
- A maximum of 50% credit will be given to any pre-lab assignment or notebook work submitted after the deadline, but before the class' graded work is distributed. After that, the late work cannot be accepted.
- No assignments, including "remote lab" make-ups will be accepted seven days past the due date.

Safety Training

All students must review the safety rules from Chem 151L prior to beginning work in the lab. The safety rules will be posted on Blackboard and the ELN. The knowledge will be demonstrated by passing a Safety Quiz on Blackboard.

Safety Policy

Your safety and that of your classmates is of paramount importance during laboratory. Safety regulations must always be observed as it only takes one accident to cause a serious permanent injury. Be sure to thoroughly review the department's safety regulations.

The #1 safety concern in any lab is eye protection. For this reason, **safety spectacles must be worn at all times in the laboratory when anyone is doing lab work.** If you need to remove your spectacles during an experiment you will need to stop your lab work, notify your instructor, and excuse yourself from the room before removing the spectacles. Most lab-related eye injuries result from a spill that was generated **not** by the injured person, but by someone else in the nearby vicinity, so it is imperative that you keep your eyes covered when in the lab. Bring spectacles with you to the first lab experiment and store them in your locker for the semester. You will be asked to leave the lab and will receive a grade of zero for the experiment if you repeatedly violate the eye-protection policy.

Another important safety concern is proper laboratory attire. You will need to wear a lab coat and closed-toed shoes during each experiment, and be sure to secure long hair back.

No food or drink are allowed in lab or in the hall outside of lab at any time.

Lab Notebook Policy

Since the lab notebook is an integral part of the experiment, instruction will be focused maintaining a clear and concise notebook. While discussion and exchange of ideas is encouraged, your lab write-up must be done in your own words. All experimental procedures must be written into the lab notebook prior to actually performing the experiment. *Note: you will not have time during the experiment to write out your procedure – all procedure information MUST be in your notebook prior to the start of class. This is due the same time as your prelab is due.*

Please see the *Laboratory Notebook Orientation* in the Electronic Lab Notebook (ELN) for detailed guidelines on keeping a laboratory notebook. The expectations and guidelines will be discussed on the first day of lab.

Your instructor may penalize you for any violations of the above-mentioned policies.

Pre-lab assignments - Your pre-lab assignments are due by **5:00 pm on the Monday** preceding your lab experiment. Of course, you may submit the pre-lab assignments early if you wish. Instructions for prelab assignments will be in the ELN folder for assignments that contain a prelab. Be sure to record the due dates and times for these assignments.

Chem 152L Spring 2023 Course Calendar

Week of	Prelab	In - Class
Classes Begin Thursday January 26th		No Lab
Module 1 Feb 2nd		W1: Orientation ELN Locker Check-in **Synthesis of a Complex Nickel Salt** **Guided Inquiry Nickel Salt**
Module 1 Feb 9th	PL2: Beer's Law and Nickel Salt Analysis and Lab Notebook Prep	W2: Nickel Salt Spectroscopy – Determination of % Mass Ni^{2+} and SO_4^{2-} in complex Nickel Salt **Guided Inquiry Nickel Salt Part 2**
Module 1 Feb 16th	PL3: Titration Complex Salt Prelab and Lab Notebook Prep	W3: Nickel Salt Back Titration -Determination of % mass ethylenediamine Determination of empirical formula and % yield of complex Nickel Salt Synthesis
Module 1 Feb 23rd	PL4: Notebook Prep and balanced reactions **Quiz 1:** Copper Cycle	W4: Copper Cycle
Module 2 Week 1 Mar 1st		MDH and Cancer. Introduction to proteins, enzyme action, allosteric regulation, phosphorylation, metabolism, malate dehydrogenase and cancer metabolism. - Intro and protein folding
Spring Break March 6th – 10th		
Module 2 Week 2 March 16th	***Assignment 1***: MDH introduction **Quiz 2:** MDH and Cancer.	MDH Introduction, what is an enzyme and how do enzymes work. - Protein structure, reaction mechanism, substrate/product, active site, subunit, enzyme inhibitors - Protein kinase/phosphomimic Pipetting Basics - Video - Pipetting Practice. Experiment – Protein Assay - Given standard proteins and a diluted unknowns (wt hMDH1V3 and mutants) create a std curve and determine the protein concentration

Module 2 Week 3 March 23rd	**PL5**: MDH activity and MDH inhibitors. ***Assignment 2***: report on 1 MDH pathway	Introduction to enzyme kinetics and enzyme assay basics. Experiment - What absorbs in my cuvette (beers law and rate determination introduction) Hypothesis Development: Choosing MDH regulators and examining the role of protein phosphorylation. - List of possible allosteric regulators and discuss the structure and possible mimic.
Module 2 Week 4 March 30th	**PL6**: dilution and enzyme assay protocol ***Assignment 3***: Calculation, student T test and graph of specific activity. **Post Lab Conclusion 1**: Specific activity for wild-type MDH and phosphomimic (pH 8.0)	MDH Assay – Range Finder (achieving first order kinetics). Wild type MDH1 and phosphomimic MDH1. - How do a dilution - How to use and record data on Vernier, experimental procedure and calculations - Initial conclusion: how much MDH goes in a cuvette. Final 30 min work on hypothesis. How to create and present a hypothesis.
Module 2 Week 5 April 13th	**PL7**: Hypothesis (support with structure comparison with substrate/product)	Flash Hypothesis Presentation: Mini-one slide presentation. Experimentation: Enzyme assay Wild type, phosphomimic with and without an allosteric regulator at pH 8.0 - Purpose and procedure, protocol. - Determining Km and Vmax
Module 2 Week 6 April 20th	**Quiz 3:** Enzyme kinetics **Post Lab Conclusion 2**: How do phosphomimics alter Km and Vmax?	Continue Experimentation: Enzyme assay Wild type, phosphomimic with and without an allosteric regulator at pH 8.0
Module 2 Week 7 April 27th	**PL8**: Buffers ***Assignment 4***: Km and Vmax. Graph and calculations. Wild-type vs phosphomimic	Introduction to Biochemical pH of Cell: Hypoxia, Warburg hypothesis - What is pH and a buffer Experimental - Test pH of three buffers: mini titration. - Enzyme Assay of wild-type and phosphomimic at three pH **Post Lab Conclusion 3**: Impact of pH on MDH activity
Module 2 Week 8 May 4th	**Quiz 4:** What is a buffer and amino acids changed by pH.	Continue Experimental Biochemical pH of Cell: Enzyme Assay Data analysis, hypothesis testing Poster presentation preparation
Module 2 Week 9 May 11th		Presentations