

Syllabus **Chemistry 491/492: Independent Study**

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Location: SCIE 441

Goals and Objectives

This course will involve carrying out scientific research in an academic setting. Students will learn how to develop and test a hypothesis, how to collect and interpret scientific data, and how to troubleshoot when things go awry. They will become acquainted with a variety of analytical methods, including liquid chromatography and mass spectrometry.

Lab Rules

- Wash and put away your glassware when you are finished with it.
- Always leave the lab in as good (or better) condition when you are finished working.
- CLEAN UP your work space.
- Return all materials (pipets, glassware, reagents) to their storage location when you are finished
- Never leave used pipet tips on the pipets.
- Observe safety rules
- Dispose of waste safely
- Never hesitate to ask me or a senior student if you have a question.
- Perform your weekly lab duties

Safety Policies

Goggles and closed toed shoes must always be worn in the laboratory. Long pants and shirts that cover the shoulders and the midriff or laboratory coats are also required. All chemical waste must be disposed in the appropriate *labeled* containers in the cabinets under the hood. All students must also attend annual chemical hazard and biohazard safety training sessions. Please ask for assistance if you are unsure of how to dispose of chemicals. Please do not leave any solvent or other bottles uncapped at any time, even if they are under the hood. No student may work alone in the building at any time.

Individual and Group Meetings

Group meetings will be held on Friday afternoons, and individual (or small group) meetings will be held every other Monday (Graduate and Undergraduate students alternating). Attendance at and participation in these meetings is mandatory, and I expect you to let me know *in advance* if you will be unable to attend. We have ~3-4 presentations/meeting, which means each of you presents about once a month. Presentations are about 15 minutes in length, with plenty of discussion during and afterward. Typically, we use powerpoint to present data, but it can be casual (i.e. not particularly polished). The main idea is to let the group know what you are currently working on, and allow other members to give suggestions. It is necessary that you present data, however, not just talk about what you did in lab. Graphs with error bars are very much appreciated!

Grading

Grades will be based on attendance at laboratory meetings and at scheduled laboratory times, the laboratory notebook, and the final research report. Details on preparation of the research report are included at the end of this message.

Lab Hours

Each independent study credit for which you register corresponds to 4 hours of weekly lab associated work. This will generally be carried out in the lab, but time spent researching at home or in the library counts as well. Please fill out the attached schedule form with all of your free blocks of time throughout the week. Long blocks of time are necessary to run experiments. Your schedule may be adjusted to accommodate other students who will be working with you and instrument availability. It is OK to put in more hours some weeks and less other weeks, but I generally prefer steady progress on research. It is not possible to cram your results in at the end of the semester. Research doesn't work that way! Please note that I consider what you accomplish to be more important than the actual hours you spend in the lab. Students who are very successful in the lab usually spend more than their allotted 4-8 hours per week.

Receiving Training

In many cases, you will be trained by senior students in the laboratory. Please respect the time of the people who are doing the training. Prepare and show up on time, and inform the person who is training you in advance if you will be late or unable to attend. **As the trainee, it is your responsibility to schedule and reschedule training sessions.** Please let me know if you are having trouble scheduling sessions.

Instrument Time

Sign up for time on the online calendar before you intend to use the mass spectrometer. Everyone needs the instrument, so please be courteous and observe the following rules:

- Have all of your samples prepared and your lab work done *ahead of time* so that instrument time is not spent preparing samples.
- Always show up for the time that you have reserved. If you are unable to come in for your assigned time, remove your name from the calendar.
- Sign up for only the hours that you absolutely need, and clearly indicate the time that you will be arriving and finishing.
- Leave enough time to clean the column and your work area when you are finished, so that the instrument is ready for the next student.

Laboratory Notebooks

Record all of your calculations, observations, and data in your lab book. Do **not use loose paper or paper towels for this purpose.** Use a lab book with attached pages. Number and date all of the pages.

Guidelines for Independent Study Lab Reports

General

Lab reports for this course will be in the format of a scholarly research article. They should include an abstract, introduction, experimental section, results and discussion, and conclusion section. All data should be included in tabular or graphical form and be fully labeled. One example calculation should be included for each type of manipulation.

Reports must follow the rules of standard written English. Reports must contain proper spelling, punctuation and grammar. Each paragraph should have a topic sentence followed by supporting details. Also, they should be reader friendly with each section being well-labeled. All text portions must be type-written.

Abstract

An abstract is a 200-500 word summary of the experiment. A sentence or two should be included describing the purpose of the experiment, the methods used, and the results. Be sure to list specific quantitative results in the abstract if you have them, i.e. specific concentrations (rounded correctly and with appropriate standard deviation) or the identities of specific compounds that were measured, etc.

Introduction

The introduction should include a brief description of the relevant background on the research, including references from the peer reviewed literature. Identify what is currently known about your project (based on literature), and what is not known (what you intend to find out). Be sure to include a statement of the goals of the project. Do not discuss what was accomplished in the past tense. Rather, discuss what you set out to accomplish.

Methods

The methods should give the procedure for the experiment **in paragraph form in past tense**. Do not write as a set of steps. Do not write as a set of instructions. Do not start any sentence with a number. It is not necessary to include the volumes of solutions used in the experiment. Rather, you should refer to solutions by their concentrations.

An example of a good sentence for procedure:

A solution containing 0.2 mg/mL iron was used to measure absorbance vs. wavelength across a range of 495 to 525 nm.

An example of a BAD sentence for a procedure would be:

Place a solution of iron in the spectrophotometer and measure absorbance versus wavelength across a range of 495 to 525 nm.

In the methods section, it is not necessary to describe every step in as much detail as is provided in the laboratory manual. Standard procedures can be abbreviated, with the assumption that an educated reader would know how to do them. It is not necessary to refer to types of glassware used (volumetric flasks, beakers, etc). Concentrations of solutions should be used to describe them, **not volumes**.

An example of a paragraph in the methods with TOO MUCH DETAIL and is written in terms of volumes instead of concentrations is as follows:

To prepare the standard solutions, 5 mL of 1 mg/mL iron stock solution was pipetted into a 500 mL volumetric flask and diluted to the mark. The solution was then transferred to an amber titrator bottle and dispensed into 100 mL volumetric flasks at volumes of 3 mL, 5 mL, 10 mL, 20 mL and 22 mL. To each of these flasks, 1.0 mL of hydroxylammonium chloride, 5.0 mL of 1,10-phenanthroline, and 8.0 mL of sodium acetate were added.

An example of appropriate summarized sentences that includes the necessary detail and are written in terms of concentration are as follows:

A 1 mg/mL iron stock solution was diluted 5-fold and used to prepare 5 dilutions with concentrations of 0.00020 mg/mL, 0.001 mg/mL, 0.002 mg/mL, and 0.005 mg/mL iron. The standard solutions each contained orthophenanthroline, sodium acetate, and hydroxylammonium chloride at final concentrations of XXX, XXX and XXX, respectively.

Results and Discussion

The results should be given in well labeled tables and graphs. The graphs should be inserted into the text, not appended at the end of the report. Each table needs a descriptive title with a number (i.e. Table 1. Absorbance vs. wavelength for a solution of 0.2 mg/mL iron standard). The title goes ABOVE the table. Graphs go in a Figure, and a caption goes BELOW the figure with a descriptive title and a number (i.e. Figure 1. Absorbance spectrum for 0.2 mg/mL iron solution). The axes of each graph should also include the units used (i.e. wavelength (nm)).

A description of the results (discussion) should be included. Expect to put in a few sentences where you describe the data before each figure or table. Don't just paste in the Figures and expect the reader to be able to figure it out. Refer to each figure and table by number in your discussion. Discuss why the figures look the way they do, and what they tell you about the results.

Conclusions

In this section, you should refer back to the introduction, discussing whether you achieved your goal and, if not, why not and what will you do next to enable it to be achieved?

References

Don't forget to include AT LEAST 3 REFERENCES to peer reviewed scientific articles. Be sure that the references are specifically referred to throughout the text, either by author and date or by number. Use the JACS format for references. You can find instructions for how to use that format on this website: <http://www.lib.berkeley.edu/CHEM/acsstyle.html>.