

Structure and Properties Laboratory

Chemistry 150 L

Spring 2018

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Office Hours: M, 2-4 pm

F, 1-2 pm

and by appointment

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*“The job of the laboratory course is to provide the experience of doing science. By offering a genuine, unvarnished science experience, a lab course can make a student into a **better observer, a more careful and precise thinker, and a more deliberate problem solver.** And that is what education is all about.”*

- Miles Pickering

“In theory, there is no difference between theory and practice.

In practice, however, there is.”

- Jan van de Snepscheut

Required materials

- Pre-lab reading materials and background information will be made available via Canvas. You should either print out the Canvas material for each lab or bring a device.
- Carbon-copy notebook ISBN 9781930882843
- Safety glasses
- Simple four function calculator

Course Content

1) Stoichiometry, the mole concept, and dimensional analysis.

2) Measurement: Answering the questions “What is in there?” and “How much is in there?” using *direct* and *indirect* forms of measurement

3) Evaluating the quality of data using simple descriptive statistics: accuracy (%), precision (standard deviation), and uncertainty (sig. figures)

4) Solutions: ionic vs covalent dissolution, concentration (calibration curves), and dilution

Fundamental Laboratory Skills

- properly measure the mass of samples - *choose the right tool for the job*
- correctly use volumetric glassware to measure liquids - *choose the right tool for the job*
- report the correct number of significant figures based on glassware/measurements
- prepare solutions
- perform dilutions
- perform titrations using burets
- determine the accuracy and precision of a data set
- calculate percent error, percent yield, percent loss
- predict theoretical yield in a chemical synthesis
- perform dimensional analysis
- demonstrate the ability to use good laboratory practices

Student Learning Outcomes

By the end of the course students should be able to demonstrate the ability to:

- Construct a valid and well supported scientific argument using claims, evidence, and reasoning.
- Demonstrate the ability to use the principles of stoichiometry, the mole concept, and dimensional analysis.
- Demonstrate an understanding of what happens when ionic and covalent substances dissolve, prepare solutions to specific concentrations and perform dilutions.
- Evaluate the quality of laboratory evidence using quantitative reasoning (% error, % loss, % yield, etc.). Analyze data and perform some fundamental aspects of statistical analysis, including the calculation of averages and standard deviations as well as assessing whether it is statistically valid to reject a data point.
- Construct and employ a calibration curve to indirectly determine the concentration of a solution.

Broader Laboratory Program Goals

- Demonstrate a molecular perspective: making the connections between the **macroscale** (what you see, smell, and measure) to the **microscale** (atoms, molecules, and ions), and the **representational** (symbols, formulas, equations, graphs).
- Ask good questions while carrying out procedures and investigations.
- Observe closely and use scientific insight.
- Practice scientific record keeping skills in a laboratory notebook.
- Display ethical practices in recording evidence.

- Identify the variables in an experiment (independent, dependent, controlled, and uncontrolled variables)
- Identify important factors that affect the execution of an experiment (particularly in experimental design/redesign)
- Identify questionable data (data that does not follow the expected pattern). Repeat/redesign trials that produce questionable data
- Prioritize time and multi-task to meet the needs of the laboratory time constraints.
- Display teamwork in group activities, practice oral communication skills
- Show self-reliance and confidence when working independently.
- Recognize dangers and practice appropriate laboratory safety precautions
- Consult Safety Data Sheets and safely handle and dispose of chemicals

Experience with laboratory software:

- Microsoft Excel - create spreadsheets, tables, graphs, and perform calculations

Experience using laboratory instrumentation:

- analytical balances; visible spectroscopy, powder x-ray diffraction (XRD) spectrometry

Grading Methods and Course Requirements

| Learning Focus | Course Requirement | Percentage of course grade |
|---------------------------------|---|-----------------------------------|
| <i>Preparation and process</i> | Laboratory Notebooks (10%) and Pre-lab Quizzes (5%) | 15% |
| <i>Preparation and process</i> | Laboratory Safety and Professionalism | 10% |
| <i>Process and conceptual</i> | Quality Checks | 25% |
| <i>Conceptual understanding</i> | Post-lab quizzes/assignments | 5% |
| <i>Conceptual understanding</i> | CERs *post-lab writing assignments | 25% |
| <i>Conceptual understanding</i> | Final Exam | 20% |

Your final letter grade will be determined by the usual scale.



There is no automatic rounding or curve to course grades.

| | | | | | | | | | | | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|--|---|--|----|--|----|--|---|--|---|
| | 93 | 90 | 87 | 83 | 80 | 77 | 73 | 70 | 67 | 60 | | | | | | | | | | |
| A | | A- | | B+ | | B | | B- | | C+ | | C | | C- | | D+ | | D | | F |

Laboratory notebooks

The notebook carbon-copy pages you turn in for most experiments will be graded using a mastery system. See the Canvas documents on Notebooks. To encourage learning from feedback, if your lowest notebook grade is one of the first two labs, it will be dropped.

Laboratory Notebook Grading Scheme:

| | | |
|---|---|--------------------------|
|  | Everything looks great! | = full credit |
|  | Everything looks good but you need to correct a few errors | = 85% credit |
|  | Good start but there are many errors that need to be corrected | = 75% credit |
|  | Very poor quality. Significant omissions of necessary elements. | Varies. May = NO CREDIT. |

Pre-lab quizzes

A short quiz, available on Canvas, will be due before each lab period to determine your level of preparation.

Laboratory safety and professionalism

Safety and Stewardship: Because safety in the laboratory is of utmost importance, you must adhere to the safety policies in the lab. *You will never be penalized for an accident*, but you will lose safety points for coming to lab underprepared or disobeying safety rules. The laboratory space is shared by separate sections; to be good stewards of the communal space, we expect you to maintain your lab bench and hood in a safe, clean, and organized manner. The chemistry lab can be a dangerous place, but with the proper training, caution, and care, it can be an exceptionally effective learning environment. Some of the most important safety guidelines are listed here; the complete safety policy will be covered during the second course meeting.

Professionalism: Coming to lab unprepared (i.e. **without:** 1) a means of accessing the handout, 2) your lab notebook, 3) safety glasses, 4) closed-toed shoes, 5) hair that falls below the shoulders tied back, 6) lab appropriate clothing) sends the message that you do not take lab seriously and do not understand the requirements of professional behavior. This is especially true if any of this happens more than once. Students who arrive to lab without the appropriate attire will be sent back to their dorm to change.

Your carbon copy notebook should already be prepared and you should be ready to start work as soon as you get into the laboratory. Additionally, if you frequently take longer than everybody else to finish the experiment and/or writing in your lab notebook, you should examine the way you are preparing for lab and how you are working in lab.

Your approach to safety, stewardship, and professionalism will impact your grade in this course. Egregious or repeated violations of safe practices may result in exclusion from the course, after verbal and written warnings from the instructor.

Quality Checks

Many of the laboratory experiments will be performed in pairs and/or teams. However, to encourage personal responsibility and to ensure that you are gaining fundamental laboratory skills, your individual performance on certain techniques will be evaluated holistically by your ability to complete the process of the laboratory procedure as well as how you demonstrate your conceptual understanding. This includes how you apply the procedure, your decisions during the procedure, how you answer questions, and questions you ask. Other important factors for the evaluation include the amount of time for completion of both the procedure and your notebook (was it beyond average?), your level of independence, and your technique.

Post-lab quizzes

A quiz will be given at the end of most laboratory sessions focusing on the learning goals for the course. These quizzes will cover the course concepts behind the experiments or techniques just completed and may include concepts from previous experiments. Much of the information learned in this lab class is cumulative; therefore, you will be held responsible for these thematic concepts throughout the semester.

Problem sets

Although this is a laboratory-based course, there is specific and important content you are expected to master. You may be given in-lab and out-of-lab problem sets throughout the semester which will require you to practice course concepts. Giving quality effort to these assignments will help you to prepare for the post-lab quizzes, CERs, and the final exam.

CERs (Post-lab writing assignments)

Writing is crucial to the progression of science and scientific writing is helpful to your development as a scientist. For the first three laboratory courses in chemistry (Chem 150, 202, and 203) you will not be required to write a complete laboratory report. We want you to focus on learning how to report evidence in a formal style and on writing a valid, well supported scientific explanation/conclusion. Think carefully about your experiment, evaluate the evidence you collected, and present only the most important information in a coherent fashion. An additional document, available on Canvas, provides more detail about the expectations and requirements.

Final Exam

Many of the concepts, thinking skills, and techniques you will learn in this course are interconnected and build on previously learned techniques, skills, and concepts. Consequently, you will be tested on your understanding and

application of the student learning goals for the course in a written final exam which will be held near the end of the semester during your regular lab period.

Attendance

The only acceptable reasons for missing a lab session are serious illness/emergency, a religious holiday, or a college-related activity (such as a field trip or a trip where you are representing the school). If you miss a lab for any other reason, you will receive a zero. If you do not follow the procedure below for obtaining permission for the absence, you will receive a zero regardless of the reason:

In the case of a serious illness or emergency, you must let your instructor know the reason BEFORE the day and starting time of the lab. If the reason is acceptable, you may be allowed to make up the lab another day that week or if that is not possible, the instructor will make other arrangements.

If you know you are going to need to miss lab for a religious holiday or a college-related activity, you must talk to your instructor at least a week before the lab. You may be allowed to make up the lab another day that week or if that is not possible, your instructor will make other arrangements.

Only one lab may be missed (including any pre-approved reason) without a course grade penalty.

Honor Code Policy

Lab sessions are a perfect place to promote and utilize collaborative learning. You are encouraged to discuss the experiments with others before lab and while in lab. However, your CER post-lab write-ups are to be **your work alone**. You should not work with another student after the lab is over. Collaboration on any CER is a violation of the Oxford College Honor Code and will be treated as such. This rule applies to any portion of reports from previous semesters as well as papers available over the internet. Your name on your CER is your pledge that the work is yours and that you did not give or receive unauthorized assistance. The usual penalty for students who are found to have violated the honor code is an F in the course.

Accommodations

If you have a documented disability and have anticipated barriers related to the format or requirements of this course, or presume having a disability (e.g. mental health, attention, learning, vision, hearing, physical or systemic), and are in need of accommodations for this semester, we encourage you schedule a meeting to discuss this with your instructor. You will also need to contact the Office of Accessibility Services (OAS) to learn more about the registration process and steps for requesting accommodations.

If you are a student that is currently registered with OAS and have not received a copy of your accommodation notification letter within the first week of class, please notify OAS immediately by emailing Megan Bohinc at

oas_oxford@emory.edu. Students who have accommodations in place are encouraged to coordinate a face to face meeting with me during the first week of the semester, to communicate your specific needs for the course as it relates to your approved accommodations. All discussions with OAS and faculty concerning the nature of your disability remain confidential.

For additional information regarding OAS, please visit the website:
<https://inside.oxford.emory.edu/life-at-oxford/accessibility-services/>

CHEMISTRY 150 LAB SCHEDULE Fall 2018

Scharf Lab Sections

| Date | Lab Session | Topic | Pre-lab assignment | Notes |
|---------|-------------|---|---|---|
| Sept 4 | 1 | Introduction <i>*survey and concept inventory</i> | | |
| Sept 11 | 2 | Safety, notebooks, CER activities | Watch safety video, take safety quiz | <i>Also complete:</i> Excel assignment 1 Excel assignment 2 |
| Sept 18 | 3 | Density and measurement | <i>Pre-lab Quiz</i> | *Quality check 1 CER 1 |
| Sept 25 | 4 | Making Solutions | <i>Pre-lab Quiz</i> | |
| Oct 2 | 5 | Dilutions | <i>Pre-lab Quiz</i> | *Quality Check 2 |
| Oct 9 | -- | NO LAB <i>Fall Break</i> | | |
| Oct 16 | 6 | Calibration curves | <i>Pre-lab Quiz</i> | CER 2 |
| Oct 23 | 7 | $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ dehydration Week 1 | <i>Pre-lab Quiz</i> | |
| Oct 30 | 8 | $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ dehydration Week 2 | <i>Pre-lab Quiz</i> | CER 3 |
| Nov 6 | 9 | Titration | <i>Pre-lab Quiz</i> Excel assignment 3 | *Quality check 3 |
| Nov 13 | 10 | Chemical Reaction Projects | <i>Pre-lab Quiz</i> | CER 4 (optional) |
| Nov 20 | -- | NO LAB <i>Thanksgiving</i> | | |
| Nov 27 | 11 | Final Exam | | |

* Quality checks are performed **on** these days

-- CERs are listed on the dates they are *assigned*, not due dates. See Canvas for specifics of due dates for each CER.