

Syllabus

Chem 123: Introductory chemistry laboratory I

Introductory Chemistry Laboratory is a two-semester sequence of courses in modern experimental chemistry. Students in these courses practice standard laboratory techniques for running reactions, preparing samples, and measuring their properties. They analyze data and assess experimental methods. They document experimental work so that others can understand and replicate their findings. Finally, they interpret their results in terms of chemical theory, in order to draw conclusions about the behavior of materials. Students who master these laboratory skills will be prepared to carry out molecular research in several fields, including chemistry, materials, neuroscience, and biology.

Objectives

Students learn basic principles of measurement and data analysis. In addition, they develop and master a variety of skills: performing laboratory techniques, documenting experimental work, interpreting results quantitatively, communicating ideas effectively, and evaluating the reliability of analytical methods.

Learning in this course is fundamentally experiential. Class activities model standard research practices and modes of investigation. Although experiments are *about* chemical phenomena and principles, they are *not* designed to *demonstrate* chemistry. Instead, they provide an opportunity to understand how scientific questions are posed and answered, and to describe precisely the limitations of empirical knowledge.

Students should be ready to collaborate with fellow students in class, since experimental work is typically organized around team projects. The laboratory is a social environment, and progress on experiments requires a readiness to engage in small-group discussion.

Class meetings

Each section meets once per week, 1:10p – 4:00p, in Tomsich 103 and 105. Attendance for the full period is required for full credit.

Required materials

Purchase the Chem 123 Laboratory Manual from the College Bookstore. The purchase also includes the cost of a laboratory notebook and a pair of safety goggles, provided during check-in for your section.

Your laboratory notebook serves as a written record of your work in the laboratory. You must use the type provided by the Laboratory Coordinator at check-in, which is *numbered, duplicating, and top-perforated* (*i.e.*, the white, top page is perforated for removal, leaving behind yellow carbon copies). The most economical and convenient product that meets these requirements is the Hayden-McNeil *Student Lab Notebook* with spiral binding (ISBN 978-1-930882-09-6). If you run out of pages, you can purchase a new notebook from the Laboratory Coordinator, who offers a discounted price. You can use the same notebook in other laboratory courses, including Introductory Chemistry Lab II, Organic Chemistry Lab I, Organic Chemistry Lab II, and Biochemistry Lab.)

Safety goggles are required for participation in the course. You must use the type provided by the Laboratory Coordinator at check-in, which is impact- and splash-resistant.

Course activities

Pre-laboratory quizzes

You will have a short, online quiz each week before the laboratory period. Each quiz helps you: (a) practice basic laboratory calculations and concepts; (b) prepare for each experiment, so that we as a class can use precious laboratory time efficiently; (c) ensure you are aware of safe laboratory practices. For all these reasons, the quizzes are a required component of the course. You must finish the quiz before you start the experiment. Quizzes are repeatable; you may attempt each quiz as many times as you want, to get full credit. You should be able to finish each quiz within 10 minutes. (If you have an accommodation that grants extra time on exams, please ask the LBIS Help Desk to adjust your Moodle account accordingly.)

Class meetings

Each class meeting will generally start with a quick check of your notebook, assignment into teams, instructions for using time effectively, and a brief demonstration of special techniques, if necessary. Most of your time will be spent carrying out your procedure and recording data and observations. Most students finish about an hour before class ends. At this point, you will have your notebook checked again, and begin working on the Results section. As time permits, we will compare results as a class and discuss our interpretation of them.

Laboratory notebook

You must maintain a laboratory notebook as a written record of lab work. It documents your preparation before each experiment, your observations and measurements during it, and your analysis afterward. Label your notebook with your name. Follow the format described in the *Laboratory Notebook Guide*.

Laboratory reports

Laboratory reports serve as evidence of your activities in class. Prepare reports in your notebook and turn in *original* pages for credit. To get credit for your work, you must complete the following sections by the time indicated:

- **Introduction and Procedure:** 1:10p, at the beginning of class
- **Procedure** (with data filled in): 4:00p, at the end of class
- **Results:** 4:00p, 1 day after class

Please submit clean, original copies (top white pages), with dark and legible writing. Carbon copies, torn pages, and pages not from your notebook are unacceptable and will be discarded. Your instructor may ask you to submit each section as you complete it; or may initial each one and ask you to turn in all sections when the Results are done.

Quizzes

For each experiment, a quiz and solutions will be posted online. The quiz will not be marked or graded; it simply allows you to check your own progress and assess your readiness for the final exam. Set aside time in your schedule to take the quiz, in a quiet place, under exam conditions: with a calculator and 3" × 5" card of notes, and without the Laboratory Manual or music. As you have limited time for exams, you should practice answering questions smoothly and rapidly. (If you are not familiar with the types of questions possible, you will waste time during the exam trying to remember how to do them.)

Grading

The total grade is based on participation (50%) and the final exam (50%).

Participation

You will get full credit each week by completing quizzes, completing laboratory work safely, attending the full lab period, and preparing each section of your lab notebook *completely* and *on time*.

Quizzes. Each quiz is available at the beginning of the semester. It is your responsibility to attempt each quiz, multiple times if necessary, well before class starts — and before potential server outages. You must score at least 80% on a quiz by the deadline for your section. You will lose credit for failing to complete a quiz on time.

Laboratory work. To get credit for safe completion of an experiment, you must: (a) demonstrate valid experimental technique, (b) use time efficiently, (c) work safely, and (d) be a good citizen in the laboratory. You will lose credit for being inconsiderate of fellow students, leaving a mess for someone else to clean up, abusing equipment, endangering classmates, or disposing of materials irresponsibly. In extreme or repeated cases you will be dismissed from the course permanently.

Attendance. You are required to attend your *assigned* laboratory section every week. Absence from a laboratory period will incur a penalty of 10% from the total participation grade. Students who repeatedly miss classes will be dismissed from the course permanently.

First-time waivers: Because students have various reasonable excuses to miss class, such as athletic competitions, religious obligations, and illness, we will waive the penalty for the first two absence, *with no questions asked*. Additional absences will not be waived, even if excused.

Extended or serious illness: If you have an extended or serious illness that confines you to your bed (the “Dorm List”), please consult with your instructor and with the Dean of Academic Advising to make special arrangements for completing your work.

Lab notebook. Each section of your lab notebook must be complete at the specified times. Incomplete sections will incur a penalty of 5% from the total participation grade.

Exams

The Schedule of Experiments (end of this document) gives the date of the final exam. The exam will be no longer than 2 hours. You will receive a page of reference data, which will be posted ahead of time. In addition, you may bring a 3" × 5" card of notes for reference, and write anything you want on both sides of it.

Optional exam: For your convenience, we will administer an optional midterm examination on Oct. 28. If your score on this exam is higher than on the final exam, then it will replace half of the final exam grade.

Exams are intended entirely to evaluate your mastery of the subject, and will not be returned for study purposes. Posted quizzes are representative of exam questions, so use them to prepare for exams. Exams test you on basic conceptual questions, writing in the lab notebook (*e.g.*, parts of an Introduction, Procedure, or Results section), and interpretation of results (Discussion topics).

Policies

Safety

The experiential nature of this course requires special vigilance and standards of behavior in class. To put it bluntly, failure to observe standard practices and precautions can leave you dead, disfigured, maimed, or sterile. You are expected to conduct yourself in a safe manner at all times in the laboratory. Exams will include questions on laboratory safety.

Rough play, unauthorized experimentation, or other activities deemed unsafe by the instructor will result in dismissal from the class and 0 credit for participation for the day. Attending class while impaired from sleep deprivation, drug abuse, or other activities will also result in dismissal. Severe or repeated incidents will result in permanent dismissal from the course.

Safety rules are detailed in the orange document you signed, *Safety in Chemistry Department Laboratories*, but some basic rules include:

- Wear shoes that cover your toes.
- Do not eat or drink in the laboratory, and do not bring food or drink into the laboratory.
- Wear protective eye ware while you are in the laboratory.

Expectations outside of class

For a 0.25-unit class, you can expect to spend 4–5 hours each week preparing for lab and working on assignments. You should attend office hours to clarify background knowledge and the analysis of results. When you meet with your instructor, please bring notes and questions, so we can use time efficiently.

You may also consult with tutors in the Math and Science Skills Center; however, please do not ask them for detailed instructions on preparing assignments, as this is outside the scope of their duties.

Attendance

You are required to attend your assigned laboratory section every week. Absence from a laboratory period will incur a penalty of 10% from the total participation grade. Students who repeatedly miss classes will be dismissed from the course permanently.

Because students have various reasonable excuses to miss class, such as athletic competitions, religious obligations, and illness, we will *wave* the penalty for the first two absences, with no questions asked.

Additional absences will not be waived except in special circumstances, such as an extended illness. In these cases, the absences may be waived if they are excused explicitly by either the Dean of Students or the Dean of Academic Advising.

Academic Honesty

Because collaborative work is an integral activity in the sciences, we wish to emphasize the difference between appropriate and inappropriate cooperation. You can learn from the exchange of ideas, and we encourage discussion both in laboratory and outside the laboratory. All materials submitted for a grade, however, must be prepared by you alone. This means that *discussing* an assignment must happen separately from actually *doing* the assignment. If you are not sure whether an activity constitutes appropriate cooperation, please consult your instructor for guidance.

A special exception is the Procedure section of your lab notebook. Because you will often work with a partner on an experiment, you may need to copy observations or measurements from your partner's notebook while in the laboratory.

Students with Disabilities

If you have a disability and need some type of accommodation in order to participate in this class, please discuss your concerns with the Coordinator of Disability Services. Your instructor and the Coordinator will discuss appropriate accommodations. All discussions regarding disabilities are confidential. Only the Coordinator can approve an accommodation.

If your accommodation grants additional time on an exam, meet with your instructor, at least 1 week before the exam, to schedule the additional time.

If you require a separate exam setting, you must discuss a possible venue and time with the Coordinator of Disability Services and with your instructor. If you require special services, such as a scribe or interpreter, you must schedule the provision of those services. Any arrangements you make must be approved by the instructor at least 1 week before the exam.

The Coordinator of Disability Services is Erin Salva (PBX 5453 or salvae@kenyon.edu).

Schedule of Experiments

Week	Date	Experiment
1	Sep 02	Introduction: check-in, safety, brief experiment on measurement
2	Sep 09	1: Identifying a metal carbonate through CO ₂ composition
3	Sep 16	2: Spectrophotometric analysis: preparing standards
4	Sep 23	2: Spectrophotometric analysis: measuring light absorption
5	Sep 30	3: Determining molecular weight by acid-base titration
6	Oct 07	— <i>Reading Days (no lab this week)</i> —
7	Oct 14	4: Synthesis of a coordination compound
8	Oct 21	4: Synthesis of a coordination compound
9	Oct 28	Optional Exam (1 hour) 5: Determining energy density by calorimetry: synthesis of biodiesel
10	Nov 04	5: Determining energy density by calorimetry: combustion of biodiesel
11	Nov 11	6: Determining charge by ion-exchange chromatography
	Nov 18	7: Ligand substitution in coordination complexes: synthesis
12	Nov 25	<i>Thanksgiving (no lab this week)</i>
13	Dec 02	7: Ligand substitution in coordination complexes: stability testing
14	Dec 09	8: Predicting molecular properties with electronic structure methods
Finals	Dec 19	Final Exam at 8:30a