CHEMISTRY 277: FUNDAMENTALS OF ANALYTICAL AND BIOANALYTICAL CHEMISTRY LABORATORY
SPRING, 2020. UNIVERSITY OF MARYLAND, COLLEGE PARK

Assoc. Prof. Jason D. Kahn, Dept. of Chemistry & Biochemistry

Lecture: M 9:00 am – 9:50 am, Atlantic Building, Room 2400

Laboratory sections are all in ESJ 0312; all office hours are in ESJ, in the lab or the common area near the lab.

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8111: LAB MW   12:00-3:20 pm  TA Rachel Ashmore          Office hours MW 3:30-4:30
8121: LAB TuTh 12:30-3:30 pm  TA Courtney Grimes         Office hours TuTh 11:00-12:00
8122: LAB TuTh  3:30-6:20 pm  TA George Caceres          Office hours TuTh 2:30-3:30
8131: LAB WF    3:00-5:50 pm  TA Ian Ferencz             Office hours WF 10:00-11:00
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Dr. Kahn: Office: Chemistry 2500A, in Biochemistry, Wing 5 of the Chemistry complex (Building 091)
Office hours: Mon. 2:00 pm – 3:00 pm, Weds. 3:00 – 4:00 pm, or by appointment, in 2500A
I will often but not always be able to meet after class or extend office hours if necessary.

Contacting me: jdkahn@umd.edu much preferred to 301-405-0058. Please include "CHEM277" in your subject line, quote any previous correspondence in your emails, and do not ask questions that are answered in this document. **Do not email me through ELMS!** Please do not drop in to my office or lab, but I readily make appointments outside of office hours.

TAs: Rachel Ashmore (rjashmor@terpmail.umd.edu) George Caceres (gcaceres@umd.edu)
Courtney Grimes (cgrimes1@umd.edu) Ian Ferencz (iferencz@terpmail.umd.edu)

You can go to any TA's office hours or come to me for help. We all work together.

Please see us as early as possible with questions and concerns: DO NOT wait until a deadline looms!

Web and links: The class web site is provided on ELMS at http://myelms.umd.edu. Grades will be posted. My personal site at http://www.biochem.umd.edu/kahn has a repository of my old exams, useful resources like Matlab and Excel programs, and various exhortations.

Notifications to the class go through ELMS or through a Coursemail list. Please change your ELMS settings to receive announcements as they arrive, rather than as a digest. Your university email address must work.

Course Description

Chemistry 277 is the laboratory accompanying our 4th-semester general chemistry 271 and 276 classes, which cover thermodynamics, chemical equilibrium, acid-base chemistry, redox, and chemical kinetics. In the lab, students will learn analytical laboratory techniques in the context of chemical and biochemical concepts. Students will gain experience in error analysis, absorbance and fluorescence spectroscopy, equilibrium, acids and bases, advanced titrations, oxidation/reduction reactions, chemical kinetics, nanoparticle science, and computer simulation. Students will also gain skills in appropriate documentation of results, data processing and interpretation, the development of scientific hypotheses, the design and execution of experiments, and the written and oral presentation of scientific results. ***Upon successful completion of this course, students should have the necessary preparation to begin work in a research laboratory.***

REQUIRED MATERIALS:

- Safety glasses or goggles: These must be worn AT ALL TIMES in the laboratory.
- Laboratory coat: This should be worn whenever anyone is doing any lab procedures.
- Laboratory notebook. Bound, with numbered pages. I do not care whether there are carbons.
- Lock. Optional, for use to secure student lockers, only during lab periods.
- Breakage cards are not necessary in advance, although you are still expected to pay for any damage

SUPPLEMENTAL TEXT:

- Any current or recent edition of a university-level general chemistry text (many of which are available in the library) should suffice as a reference. Your Chem 271 or 276 text is fine.

BACKGROUND EXPECTATIONS AND MATHEMATICAL TOOLS:

- Familiarity with Chem 131/132, especially stoichiometry, concentration, and dilution calculations.
- You are expected to be able to do algebra. During the semester we will use Microsoft Excel and Matlab, which are both downloadable for free from terpware.umd.edu. Please install both soon.

Lecture Attendance, Notes, and Suggestions for Success

All lecture notes and ancillary files will be posted to ELMS, typically after the lecture. The lecture notes and procedures are sometimes quite detailed, and there may material covered that is not talked about in class. They are also incomplete: I may give more or different examples on the board than in the notes. The PowerPoint is not a substitute for lecture attendance! If I could write a document that encapsulated the lecture and training experience it would be called a textbook…but if textbooks, Wikipedia, online courses, and YouTube could replace professors and laboratories there would be no need for you and I and the TAs to have this quality time together.

I recommend that you take notes in lecture, and then soon after the lecture go over or recopy them, combine the notes with the PowerPoint, and use the textbook/web/procedure docs to help with anything you don't understand. Then ask a friend, the TA, or me about anything that is not clear, ideally before the next lecture or before you need it in lab. There are few things more frustrating than a lecture or a lab that is incomprehensible because you lack the background to understand it: don't do this to yourself. You may record lectures, and I will try to Panopto them, but Panopto often fails.

Please be on time for lecture and especially lab. **PLEASE MAKE SURE THAT YOUR MOBILE PHONE DOES NOT RING DURING LECTURE OR LAB. PLEASE DO NOT USE A LAPTOP DURING LECTURE**: I have found in the past that they are too much of a distraction for you and your neighbors. Finally, I can't realistically stop you from texting, but

YOU CAN'T REALISTICALLY LEARN AND TEXT AT THE SAME TIME: PICK ONE.

Relationship to Other Courses

Prerequisites for this course include Chemistry 146/177 or 131/132, 237 or 231/232, and 247 or 241/242, all of which I hope you remember well. In particular, you should be familiar with chemical bonding and hybridization, bond energies, stoichiometry, functional groups, nucleophiles and electrophiles, and acids and bases. We will use some calculus as well, although you will not need to use it for assignments or exams. You are expected to be able to do algebra easily and quickly. During the class we will use LoggerPro, Microsoft Excel, and Matlab.

Many of you are taking a Gen Chem II lecture, Chem 271 or Chem 276. We have attempted to coordinate coverage between lab and lecture, but we may not always succeed. Chemistry 277 is a stand-alone course, and the grading policies and the curves or lack of same for the all the classes are completely independent. Neither I nor the TAs will have specific knowledge about any lecture class. Chemistry 272 does similar labs but at a less advanced level. Detailed instructions from 272 may lead you astray, and all policies are completely independent (although frequently similar).

Our overall 1-2-1 general-organic-general chemistry course sequence is somewhat unusual, and we seek continuous improvement. Please help us by sending feedback: the best way to do this is by doing the muddy/clear surveys described below, providing me or the TAs with constructive suggestions during or after the semester, and participating in the CourseEvalUM program as described by the Provost:

> Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process.

This course is a prerequisite for BCHMs 461, 462, 463, 464, and 465 as well as CHEM 425. Understanding free energy, redox potentials, and acid-base titrations is essential in those classes. Please let me know if you think there is excessive overlap or disagreement among classes.

To succeed in this course, you must keep up.
Attend every class and lab even if you think you have seen some of the material before.
Create a framework of knowledge into which to fit facts, don't try to just memorize.
And…Allow yourself to enjoy the experience!

This document is much too long in the hopes that it will answer most of your questions, forestall problems, and remove ambiguity. If you have a question regarding policies, dates, or other course issues, please consult the syllabus and ELMS before contacting me. I am happy to clarify anything in the syllabus or answer any questions that it does not cover, but if you ask a question that is directly answered here my answer will be "Syllabus."

Requirements, Grading, and Academic Honesty Policies

GRADING BREAKDOWN

Lab Reports and Worksheets 1-9	260 points
Project lab 10 (Report & Presentation)	50
Pre-labs	75
Lab Notebook/Journal	30
Surveys	35
Exams	150
Total	**600 points**

Laboratory Reports (260 pts for reports 1-9)

There will be 8 laboratories this semester, some of which will be comprise multiple experiments. All students are required to turn in a lab report for each of the scheduled laboratories. If there are multiple experiments in a laboratory, there will be a single report for the entire laboratory. Each lab report will be prepared electronically (Microsoft Word or equivalent), turned in on paper, and also uploaded to ELMS. Paper lab reports will be turned in at the beginning of the lab period when they are due (typically one week after completion of the laboratory). The electronic version must be uploaded by 11:59 p.m. on the Friday of that week. Only the paper copy will be graded, except if the paper is illegible for some reason. If a lab cannot meet for any reason beyond the student's control [for example, the University closes for an ice storm], the upload deadline stays the same and lab reports due that day must be submitted at the next lab session for your section.

We will develop your lab writing skills progressively through the semester, building from worksheets up to reports that have the structure of a scientific paper, with an Abstract, Introduction, Materials and Methods, Results, and Discussion. The early labs will have fairly detailed rubrics but later in the semester you will be more independent.

Project Lab 10 (50 pts)

Students will work in small groups to propose, design, and execute a bespoke nanoparticle project or an adaptation of one of the other labs done in class. The project will conclude with an in-lab PowerPoint presentation to your lab mates.

Pre-labs (75 pts)

Reading the lab procedure carefully in advance and making your own notes about it is the best way to ensure good results in the laboratory. Anyone who has made a complicated dish in a kitchen knows that flailing around reading the recipe while trying to cook in real time does not lead to success. One or two pre-lab questions may be posted to guide your learning. You will write down a guide to the experiment in your notebook before the lab. For multi-part experiments you must write a separate pre-lab for each part of the experiment. The pre-lab should include the purpose of the lab, the experiment(s) to be done, an outline of the procedure including the function of each reagent, any safety concerns or warnings, an outline of the analysis to be done afterward, and answers to any prelab questions. You are encouraged to discuss the pre-labs with your peers, but everything you write in the notebook must be your own words and understanding. Do not just copy the procedure – explain it to yourself! With all that said, we will be rather informal with prelab grading. Your TA will circulate around the lab during the first few minutes and assign you a grade of 0-5 points based on a quick look at your prelab. There will be no regrades. Doing a good prelab really is its own reward – it will make everything you do go much more smoothly.

Lab Notebook/Electronic Data (30 pts)

Your lab notebook is a record of what actually happened in lab, not what should have happened. The lab notebook is a contemporaneous record, not subject to revision: You can change your interpretation of what happened in the lab, but not the facts. If it isn't in the notebook, you can't prove it happened, so every claim in your lab report should be supported by the notebook. I believe in physical notebooks for all of these reasons. We do, however, often collect data electronically, and recopying electronic records by hand is pointless. The primary data recorded by each lab group in LoggerPro should be used for each student's individual reports. It is up to you to make sure that all primary data (usually CSV or Excel files) is distributed to all members of the group, through e-mail, copying to flash drives, sharing to a google drive, or whatever works for your group. The combination of lab notebook and electronic data is the raw material for your lab reports.

We will have periodic grading of lab notebooks. At one or more times in the semester, you may be asked to scan and upload one or more labs from your lab notebook, with dates and labs to be announced with very little notice. It is therefore

absolutely critical that you keep your journal up to date. Lab notebooks will be graded based on completeness, intelligibility, and the appropriateness of their relationship to your lab reports.

Other assignments (40 pts)

There will be additional activities for which you can earn points, such as completing Muddy/Clear surveys: after each class or lab, you will be expected to complete a very short survey on ELMS covering some aspect of the class or lab. I use this in lieu of clickers to stay calibrated on the pacing of the class or to identify ideas that need to be retaught. Answers are anonymous, but if I am sufficiently upset by a response, I can find out who posted it. These are basically free points.

Exams (150 pts)

The first and only hour exam will be on March 9. The second (final) exam will be during the Chemistry Common Lab Final Time, May 14. The exams will focus on material that you should have learned in writing up pre-labs and lab reports.

Exams may require calculators (of any sort that handles logs), and no other aids will be permitted. Formulas and equations will be provided. Sample exams will be provided. If you have a disability issue handled through ADS, please let me know as soon as possible so that accommodations can be made.

Regrades and Absence Policies

Regrades: If there is clerical error or a mismarked multiple choice question, just let me or your TA know, and we will fix it. If you believe there is a substantive grading error, you may submit the exam or lab to me for regrading, along with a note on a separate sheet describing the issue. Do not alter the exam or lab itself in any way. I reserve the right to regrade the entire exam or lab, so it is only worth your while to ask for a regrade if you feel truly underappreciated. I also reserve the right to refuse to regrade anything submitted in pencil or multiple colors. Exams and labs are still graded by humans, so there are always a few points that could be argued about, which is a waste of time and effort. Therefore, **regrade changes will actually be applied only if they total 5 or more points, except for clerical errors.** Regrade requests will be accepted up to one week following the return of the exam or lab.

Missed Labs or Exams: If you absolutely must miss a lab or exam, you must email or call me or your TA in advance or within 24 hours after the event, and you must also present a valid University excuse (please secure a note from the Health Services if possible). For an exam you will then be permitted to take a make-up, or, preferably, be assigned a grade based on the remaining course work. For a lab you can get shared data as described below. All labs and exams are Major Graded Events. It is Department policy that missing more than THREE labs (with each section of a multipart lab counting as one absence for this purpose) results in an automatic failing grade.

Academic Integrity

Cheating will not be tolerated. The University's Honor Council sets high standards for academic integrity, and I support its efforts. Please note in this regard the University Honor Pledge. The Student Honor Council proposed, and the University Senate approved this Pledge: "I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination." You will be asked to write out and sign the pledge statement on all examinations (http://www.shc.umd.edu/SHC/HonorPledgeUse.aspx). Furthermore, I expect and enforce adherence to the University's Code of Academic Integrity (see http://www.ugst.umd.edu/courserelatedpolicies.html). You are also hereby directed to read my personal statement on plagiarism at http://www.biochem.umd.edu/kahn/plagiarism.html, as a condition of taking this course. Mobile phones must be turned off and stored out of reach and sight during exams, and headphones may not be used.

Students must also include and sign the Honor Pledge at the end of each lab report. Any evidence of academic dishonesty found by a TA and reported to the instructor will be pursued by the Department: examples include, but are not limited to (a) fabrication of data (defined by the *Code of Academic Integrity* as "intentional and unauthorized falsification or invention of any information…in an academic exercise"); (b) use of data other than that found in your notebook or electronic data shared among your group; (c) unauthorized collusion with others, including but not limited to, communal calculation of experimental results and copying of qualitative answers from another student.

The instructional design of this course encourages student collaboration and cooperation while in the lab. However, these policies specifically dictate that *all lab reports are to be completed by each individual student on his or her own*.

Even More on Academic Integrity

I strongly encourage you to discuss concepts and techniques with your classmates, as this is an important learning exercise. However, *whatever you turn in as a lab report must be analyzed and composed solely by you*. To further expand on what constitutes violations of academic integrity, here is a specific list of things that are permissible and not permissible.

What is permissible:

- E-mailing of data sheets to group members – You will perform experiments in groups, and one (or more) member(s) may enter data during the collection of the data to evaluate the experiment as it is proceeding. Because you will all be using the same data for your analyses, it is fine and in fact necessary to share the electronic data file that contains *only the collected data*, usually an Excel document.
- Discussing how you will do calculations via in-person conversations and via e-mail, but not working together (see below), and not comparing numbers to make sure you have the same answer.
- Helping someone use Excel or other software to learn how to process or analyze experimental data, so long as you are using made-up data.
- Working together on pre-lab activities. Any material that you write down should be your own, but you are encouraged to discuss concepts, techniques, and safety issues with your peers when preparing pre-lab material.

What is ***NOT*** permissible:

- Processing of experimental data together. This includes, but is not limited to, setting up Excel columns to do numerical manipulations of collected data (either while working with each other or by e-mailing a precalculated data sheet to each other), making plots, taking a plot made by someone else and changing the chart title/axes titles/data points, printing someone else's graph because you were their partner so you should have the same results, and getting help processing your own data.
- Doing calculations on real data together.
- Composing pre-lab material together or showing or e-mailing someone else your pre-lab with the intention of letting them copy. (This latter action is "facilitation" and is a violation of Section 1(c) of the Code of Academic Integrity.)

The following will be considered violations of the Code of Academic Integrity, and will usually result in referral of all students involved to the Office of Student Conduct:

- Having identical or highly similar spreadsheets in a lab report. Note: if you shared Excel sheets, then the raw data will be the same, but the spreadsheet layout and plots should not be identical.
- Lab reports in which the same exact plots are submitted by members of the same group. As listed above, you should perform your own spreadsheet calculations, which will result in graphs with different shapes/sizes and formats/symbols/titles/axes/legends, etc.
- Having the same exact organization of thoughts in a discussion question or more than one discussion question. This rarely occurs by chance and is usually an indication that students either worked together and/or sent a document back and forth and changed some of the wording. TAs have a keen eye for the wording in verbal explanations.

Finally, as mentioned above, the campus Senate has approved a variety of detailed policies and procedures covering your rights and responsibilities. These can be found at http://www.ugst.umd.edu/courserelatedpolicies.html. Please let me know if you think anything in this document substantively conflicts with University policy.

Final Grades

Your final grade will be based on your performance relative to the class and to my expectations (*i.e.* it may be curved, but I draw the lines between grades depending on how the class as a whole performed). Letter grades will not be assigned on the midterm exams, labs, or other assignments, but I will give qualitative feedback. While a 90% guarantees an A, you do not need to score 90 % to get an A—when in real life do we ever really expect to approach perfection? I anticipate roughly 40:40:15:5 A:B:C:D, with D's and F's given only as needed but without hesitation. Plus/minus grades will be given. *Exam and lab grades and your totals will be available on ELMS, and it is up to you to make sure that our records agree.*

Finally, if we are to take the trouble to grade your work, you should take the trouble to see how you can improve. **All exams and labs must be picked up before the end of the semester. I reserve the right to deduct 4 points for every exam or lab that is still in my possession at the time of the final exam.**

LABORATORY POLICIES AND PROCEDURES

All students have the responsibility for being familiar with and adhering to University policies relating to courses. These policies can be found at http://www.ugst.umd.edu/courserelatedpolicies.html

Students are required to have the following items to be admitted to the lab:

- Acceptable safety goggles or glasses
- A lab coat
- Students must wear long pants that cover the entire leg. Garments such as shorts, Capri pants, skirts, and dresses are not acceptable.
- Students must wear appropriate shoes in the laboratory. Shoes must cover the tops of your feet. Sandals, flip flops, open-toed shoes and ballet flats are unacceptable, and high heels are strongly discouraged.
- You do not need to buy Chemistry Department breakage cards at the beginning of the semester, but if you break something you will have to pay for it. This can be done at the stockroom.
- A lab notebook and a pen

Laboratory Preparation

- To prepare adequately for each lab, you should read the background material, go over the relevant lecture and, most importantly, prepare a pre-lab as described above.
- Listen to the TA's brief pre-lab lecture at the beginning of each lab period.
- If you have any safety concerns or questions, bring them up immediately, at any time.

Attendance

- Your TA must be present before you can enter the lab.
- You are required to attend and be punctual for all scheduled laboratory sessions. All lab activities begin at the scheduled start time. Students who arrive more than 20 minutes after the scheduled start time will not be allowed into the lab.
- You are allowed to be absent from and/or leave uncompleted no more than **three** of the scheduled labs and still remain in CHEM 277 during this semester. Regardless of the reasons, if you are absent from and/or leave uncompleted **more than three** of the scheduled experiments, you will **fail** CHEM 277.
- If, after you arrive at the laboratory, a teaching assistant, faculty member, or laboratory coordinator dismisses or excuses you because of a safety violation and you arrive back at the lab more than 20 minutes after the scheduled start time for your section, you will not be allowed to do that day's lab.
- To "Complete an exercise" means that you (a) attend your scheduled laboratory section; (b) perform the assigned laboratory work; and (c) turn in your lab report.
- You are guaranteed access only to the laboratory section for which you are registered. If you are absent from one of the scheduled experiments, we attempt to allow you to do the lab with another section, but there is no guarantee that this will be possible. Please contact me and your TA as soon as you know of any possibility of missing a lab.

- Shared data: Provided that you show documentation for a University-approved reason for missing a lab, you will be permitted to contact one of your group members and get data that you can use to complete the post-lab questions and data analysis. The lab report is due on the same day that the missed lab is due. ***It is your responsibility to notify your TA and the instructor of your absence and your intent to use shared data.*** Events that justify an excused absence include religious observances; mandatory military obligation; serious illness of the student or of an immediate family member; participation in University activities at the request of University authorities; and compelling circumstances beyond the student's control (e.g., death in the family, required court appearance). Absences stemming from traffic/transit problems or from work duties other than military obligation (e.g., unexpected changes in shift assignments) do not typically qualify for excused absence.
- If the University closes for inclement weather, or the Department cancels a lab, failure to perform that lab **will not** count against a student's absence limit and the student **will not** be required to take a make-up exam to earn credit for it; rather, sample data will be provided so the report can be completed as usual. Students will be responsible for the material of the missed exercise on any and all exams.
- If you physically perform a lab, you are **not** eligible to apply for make-up data, nor are you permitted to ask your TA for another group's data, nor is your TA permitted to give you any data other than the data that you collected. Whatever you turn in must be based on data you collect in lab, even if the experiment didn't "work" or the data are "bad." Your time in lab is your opportunity to make sure that you collect and record the data that you need to complete the lab report. So-called failure of an experiment may be a learning opportunity in disguise.

Late Lab Reports

- Generally, late work will NOT be accepted without substantial cause.
- Under extreme circumstances late work MAY be accepted, if cleared with the instructor. TAs are not authorized to accept late lab reports without the approval of the instructor.
- Approval for late work must be requested no later than 24 hours prior to the work due date. *Please note that simply needing more time or having a busy work schedule do not qualify as extreme circumstances.* There is enough time between the last experiment in a laboratory and the due date of the report that it should not be difficult to complete the report *so long as you plan for it*. As Dr. Stone says, **DUE DATE ≠ DO DATE**. If you do receive approval after this time, 10% of the grade will be deducted per day or fraction thereof that the lab report is late. Approval will never be granted after the lab report is due except under truly extreme circumstances.

LABORATORY SAFETY

An important part of any laboratory course is learning and practicing good safety behavior. Unsafe practices can put you and those around you in danger. Although we have tried to reduce the dangers of the labs that you will undertake, there are still risks. You should make yourself aware of, and prepare for, all potential hazards before performing any procedure in the laboratory. Getting into good safety habits now will help to prepare you to work in a research laboratory, where the potential hazards may be considerably more serious and unpredictable.

- During the check-in process, students are expected to sign and submit the Safety Contract (to be provided), affirming that they have read, understood, and agreed to follow the safety rules.
- All students **must** wear safety glasses or goggles when **anyone** in the lab is doing **anything** like working on an experiment or cleaning up. Cleaning up is often a dangerous time in the lab: you are more likely to run across uncharacterized material.
- Wearing safety goggles/glasses means that they are worn over the eyes or over other glasses. Wearing goggles does not mean "on the forehead" or "on top of the head" or "dangling from the neck."
- Students must wear a lab coat while in the laboratory. The lab coat should be buttoned up or zipped up before **anyone** in the lab begins working. Long hair should be pulled back out of the way.
- Students must wear long pants and appropriate shoes as described above.

"Three Strikes" Policy (Departmental policy)

Any member of the Department of Chemistry and Biochemistry (the lab coordinator, any TA, any faculty member, and stockroom personnel) is permitted to record violations of rules relating to safety attire (goggles/safety glasses, lab coats, pants, closed-toed shoes), which will count as "strikes." Safety rules must be followed from the moment that your TA tells you that the lab activity is underway until you ***exit the lab*** (not until you finish your experiment).

The consequences for lab safety violations will be as follows:

- Strike Number One – A verbal warning will be given by your TA and will be recorded on a sheet dedicated to recording lab safety violations. If the violation is corrected and sufficient time remains to complete the experiment, you will be allowed to do so without further penalty.
- Strike Number Two – A safety violation will again be recorded. Again, if the violation is corrected and sufficient time remains to complete the experiment, you will be allowed to do so without further penalty. If you are unable to correct the violation in time to complete the experiment, you will be dismissed from lab for the day. You will be allowed to take a make-up exam or receive sample data, depending on the policies of the course you are in. The dismissal will count as an excused absence (one of the total of three that you are permitted).
- Strike Number Three – You will be dismissed from lab for the day and a safety violation will be recorded. The dismissal will count as an unexcused absence, meaning you will not be eligible to take the make-up exam or receive sample data (depending on the course you are in) and you will receive a zero for the lab that will count towards your course grade.
- Additional safety violations will duplicate the consequences of the third safety violation.

Please note that in all lab courses offered by the department, more than three absences, for any reason (including dismissal from lab), results in a grade of F for the course.

More on Lab Safety

- The 277 lab will involve chemical reactions that, for the most part, are not exothermic, and should not pose significant danger if a minor accident occurs. That being said, any lab is potentially a dangerous place if the equipment and chemicals are not treated with respect.
- With this in mind, make sure that you familiarize yourself with the location of all safety resources on your first day in the laboratory, and remind yourself briefly each time you enter the lab. If you see that any safety resource is missing or potentially has some problem, inform your TA or the instructor immediately.
- If any chemical contacts your skin, you should immediately wash the affected area with soap and water. If a significant quantity of any chemical contacts your skin, or if you feel any type of burning, the affected area should be flushed for at least 15 minutes under running water. For contact with the face, the eyewash should be used for facial flushing. In the unlikely event that a chemical splashes behind your goggles, you should keep your eye(s) open and attempt to look in different directions while the eyewash flushes your eye(s) to make sure that running water contacts as much of your eye surface as possible.
- For all injuries, no matter how innocuous or minor, if you or the TA or the instructor has any concern at all, you should go to the University Health Center, in Building 140 on Campus Drive, directly across from the Stamp Student Union, to follow up on your injury and to get it examined by a medical professional. Accidents occurring in lab are covered by University insurance policies, so do not avoid following up your injury for the sake of saving money.
- If the injury is serious enough to decrease your ability to focus on the lab and remain safe for the remainder of the lab period, you will be excused from the lab without penalty to go to the Health Center. The TA may ask another student to escort you to the Health Center, again without penalty to the accompanying student. In this case, you will need to ask the Health Center personnel to confirm to the instructor that you were seen during the lab period.
- In any circumstance where you have concerns about safety it is okay to contact campus police, who can then contact the proper authorities. Campus police can be contacted by dialing 911.
- Although the Department of Chemistry and Biochemistry does not have a policy requiring the wearing of gloves in

our undergraduate labs, I strongly encourage you wear gloves in lab. Gloves can be purchased fairly cheaply at the University bookstore. They are a small investment that can pay off in a major way should something unfortunate happen. We will attempt to provide gloves in the lab as well, but you may need to purchase them if you have unusual allergies or very large or small hands.

- Food and drinks are absolutely forbidden in the laboratory. If a food or beverage container is found on your lab bench, the person responsible for putting it there will be dismissed from the lab. In the event that no one from a table of four claims responsibility for said item, everyone in the group will be dismissed from the lab. Dismissal from the lab, in accordance with the syllabus, means you will receive a grade of zero for the lab and you will not be eligible for sample data.

Lab Cleanliness

A clean lab is essential for safety, saves everyone time in your class and in others that use the room, and helps to protect the equipment and extend its longevity. With this in mind, leaving a clean lab at the end of each period is a high priority and is the responsibility of the entire class. Your TA may deduct three (3) points from the report of **each person** in the lab if any of the following conditions exists at the end of the lab period:

- A pH probe is found in any condition other than upright, in a bottle with electrolyte, attached to a ring stand.
- A spectrometer unit is found in any condition other than safely put away in the box ready for the next lab section. Remember, power down the spec and ALLOW THE FAN TO STOP ON ITS OWN before unplugging it and putting it away.
- Glassware is not washed, clean, and put away.
- Any reagents are left around the balance with their lids off.
- Any solid reagents are spilled on the bench top or around the balances.
- The doors on any balance are not closed.
- Any caps are off of any reagent bottles.
- The lab is unreasonably messy (many bits of paper, parafilm, tape, etc. on floor).

Persistent cleanliness violations may result in the deduction of more than 3 points.

Note: These rules regarding cleanliness apply to everyone, whether you are responsible for violation of one of the rules above or not. The goal of this policy is to encourage you to be mindful of not only your working area and conditions, but also of those around you, as these rules are constructed in a way in which many of you stand to be penalized for the careless actions of one or a few.

Accessibility and Disability Service (ADS, the office formerly known as DSS)

If any student needs ADS accommodation, please bring your written documentation to the instructor as early as possible in the semester.

Accessibility and Disability Service
0126 Shoemaker Hall
College Park, Maryland 20742
Hours: Monday through Friday, 8:30am - 4:30pm
Phone: (301) 314-7682
https://www.counseling.umd.edu/ads/

SPRING 2020 LECTURE, LABORATORY, ASSIGNMENTS, and EXAM SCHEDULE

Lecture and Lab Dates				Activity	Assignments Due
8111 MW	**8121 TuTh**	**8122 TuTh**	**8131 WF**		
Week 1: 1/27/2020				Lecture 1 – Course policies, getting started; Error Analysis	
1/27	1/28	1/28	1/29	**No lab.** Make sure you have a lock, breakage cards, safety glasses, flash drive, lab notebook, lab coat, and pen.	
1/29	1/30	1/30	1/31	No lab.	
Week 2: 2/3				Lecture 2 – Error Analysis; Absorption and Fluorescence Spectroscopy	
2/3	2/4	2/4	2/5	Laboratory 0: Check-in, intro. Safety Contract. LoggerPro intro. Laboratory 1: Uncertainty and Error	
2/5	2/6	2/6	2/7	Laboratory 2A: The Bradford Assay	2/8 Lab 0 file upload
Week 3: 2/10				Lecture 3 – Fluorescence Spectroscopy; Equilibrium	
2/10	2/11	2/11	2/12	Laboratory 2B: Iron in Eggs	Lab 1; Struct. Sci. Paper Worksheets
2/12	2/13	2/13	2/14	Catch up with Lab 2, and open office hrs for L2 report prep and how to write an abstract	
Week 4: 2/17; JDK out of town				Lecture 4 – Grad Student Research Talks	
2/17	2/18	2/18	2/19	Laboratory 3: Fluorometric Analysis of Quinine	
2/19	2/20	2/20	2/21	Finish lab 3, L3 open office hours (OH)	Lab 2 incl. Abstract
Week 5: 2/24				Lecture 5 – Nanoparticles	
2/24	2/25	2/25	2/26	Laboratory 4A: Rhodamine Equilibrium	
2/26	2/27	2/27	2/28	Laboratory 4B: Alcohol Dehydrogenase	Lab 3 report includes Abstract + Intro
Week 6: 3/2				Lecture 6 – Kinetics	
3/2	3/3	3/3	3/4	Laboratory 5: Silver Nanoparticles (AgNPs)	
3/4	3/5	3/5	3/6	Test review, lab also available for additional AgNP work if needed by your group	Lab 4: Abstract + Methods + Results
Week 7: 3/9				**EXAM 1, covering labs 1-4**	
3/9	3/10	3/10	3/11	Laboratory 6A: Iodine Clock part 1	
3/11	3/12	3/12	3/13	Laboratory 6A: Iodine Clock part 2	
3/15-3/22				**Spring Break**	
Week 8: 3/23				Lecture 7 – Titration I	
3/23	3/24	3/24	3/25	Laboratory 6B: Iodination of Acetone	Lab 5 full report
3/25	3/26	3/26	3/27	Wrap up lab 6, open OH, Student-Developed Lab (SDL) planning	
Week 9: 3/30				Lecture 8 – Titration II; Experimental design and proposals	
3/30	3/31	3/31	4/1	Laboratory 7A: Soda Ash Titration	SDL Proposal Draft
4/1	4/2	4/2	4/3	Open office hours for SDL proposal review with TA	Lab 6 full report
Week 10: 4/6				Lecture 9 – Entropy, computer simulation of microstates	
4/6	4/7	4/7	4/8	Laboratory 7B: Cold-Eeze	Materials for SDL
4/8	4/9	4/9	4/10	Laboratory 7C: Vitamin C Titration	Drop w/ W day, 4/10
Week 11: 4/13				Lecture 10 – Advanced data analysis methods	
4/13	4/14	4/14	4/15	Laboratory 8: Computer Simulation of Einstein Solid Model	Lab 8 worksheet to be uploaded 4/19
4/15	4/16	4/16	4/17	Laboratory 9: Analysis of a Mixture of Chromophores	Final SDL Proposal
Week 12: 4/20				Lecture 11 – Presenting scientific data	
4/20	4/21	4/21	4/22	Open office hours for Lab 7 report, planning for Lab 9	
4/22	4/23	4/23	4/24	Laboratory 10: Student-Developed Lab	Lab 7 full report
Week 13: 4/27				Lecture 12 – Giving scientific presentations	
4/27	4/28	4/28	4/29	Laboratory 10: Student-Developed Lab	Lab 9 worksheet
4/29	4/30	4/30	5/1	Laboratory 10: Student-Developed Lab	
Week 14: 5/4				Lecture 13 – Review	
5/4	5/5	5/5	5/6	Student Developed Lab PowerPoint presentations: 15 minute presentations + 5 min for questions	PowerPoint upload 24 hours in advance
5/6	5/7	5/7	5/8	Lab cleanup if not completed in the prior period; exam prep	
Final Exam: Thurs., 5/14/19				**Labs 5-8; Chemistry Common Lab Final Time: 1 hr within 6:30-8:30 p.m., Place TBA**	

Comments on the Schedule

We will do our best to stick to the schedule above. There are days, for example 4/20-4/22, when at the moment attendance looks optional. While that may turn out to be the case, it may not, depending on how the labs go. *You should not make firm plans to leave town during any of the assigned times*. If we schedule something at the last minute during an assigned time, you should be there. We are, however, mostly human, and we will give as much advanced notice as possible.

Learning Outcomes

What do we want you to get out of this class?

In any Chemistry course, you will learn many details that will need to be memorized, and therefore are likely to be rapidly forgotten. The pKa or formic acid or the Arrhenius equation will always be a click away on Wikipedia—why memorize them? If that is all there is to chemistry, then why is it that someone, typically besides yourself, has decided that you must take this course? There must be some skill you should retain after taking this course that cannot simply be mimicked by Googling. The answer is that the details and the approaches of chemistry are needed to assemble a way of thinking, and we want that way of thinking to stay with you after the details have faded into nostalgia.

What are the tenets of the chemistry way of thinking? Here are some: The universe operates subject to fundamental physical and chemical principles. To understand how the material world behaves, we must understand molecular-level properties and how they translate to bulk properties. Chemistry is the central science, and the principles of chemical bonding and reactivity, redox, kinetics, and thermodynamics are essential to understanding physics, biology, environmental science, materials science, and engineering.

All of the above applies to a lecture course as well as to a lab. What is it about lab courses in particular that has caused so many faculty committees and medical schools to think they are worthwhile, even though they are expensive, time-consuming, labor-intensive, and possibly unsafe? Lab courses emphasize that knowledge is gathered through human effort. Making a curve fit match the data should help you recognize that we believe scientific ideas because we have seen them explain behavior that we have observed but have not readily understood. Also, lab should give you some appreciation of the difficulty and the contingent nature of research.

Science is fundamentally an experimental endeavor. Here's the process followed by researchers:

(1) We identify something about the universe that the community doesn't understand, or we come up with an idea for a device that hasn't been created yet.

(2) We imagine/sketch/calculate/simulate possible explanations/solutions.

(3) We devise experiments to test the possibilities.

(4) We carry out the experiments, which can take from 5 minutes to 50+ years.

(5) We interpret the data, draw any possible conclusions, and go back to steps 1-4 as necessary.

(6) When we are reasonably certain that we have learned something that the community didn't know before, we communicate our results as widely as possible, typically in a peer-reviewed publication in a scientific journal.

In this class, we focus on steps 3-6, which boil down to the following process:

(a) You will read and understand the experiment that we have designed for you. Advance preparation for lab is essential: if you do not know where you are going, you will end up someplace else (Yogi Berra). The minimum required knowledge for each lab includes what the experiment is and why you're doing it, the materials necessary and their properties, any safety concerns, the procedure, and the data that you intend to collect. Note that this is the minimum required: you will complete the labs faster and your results will be better and therefore easier to write up if you understand the labs ahead of time in more depth. The Introduction to a lab report lays out what the experiment is and why you are doing it. By the end of the class we would like you to progress to being able to design experiments for yourself – this skill is essential in any research-oriented environment.

(b) You will carry out the experiment with focus and dedication. There is just no substitute for paying attention. If you do not do the experiment as planned and/or document carefully what was done differently, then it cannot be repeated. If it cannot be repeated, then it didn't happen. The data you collect are immutable. That is why we keep careful lab notebooks,

so that there is no doubt about what happened. Interpretations vary afterwards, but not facts. The lab notebook's contemporaneous description is the key source for the Materials and Methods section of the lab report.

(c) You will interpret the data according to the models used in designing the experiments, and you will extract qualitative and quantitative results. This is known as writing the Results section of a lab report.

(d) You will evaluate the (mis)match between your expectations and your results. If necessary, you will try to come up with explanations for why an experiment failed. Whether it worked or not, you will think about what could be done to make it work better or what the next thing to study would be. This is reported in the Discussion section, often lumped in with Results. Great scientists shine at step (d).

(e) All of this will be communicated in an accurate and clear format and explained so that someone else (i.e. especially me or your TA) can understand what you did and what you think about it. This means that your lab report needs to be well-written or your PowerPoint carefully crafted.

If you achieve (a) – (e) you will be qualified to start a research career. Steps (1) and (2) above come with experience.

Finally, a few words on the principles of ethics in science that motivate the rules that you must follow: Integrity in reporting results is the cornerstone of the scientific enterprise, because people who build on your results are expending their time and money based on your assurance that the experiment was done as described. In an industrial or medical setting, people may be trusting their lives to your results. Plagiarism is utterly unacceptable because it is theft, of a particularly vicious type. When I die, I will leave behind a record of scientific ideas and results that I claim come from my work, my creativity, my eloquence. Plagiarism is the process of taking credit for someone else's record, and therefore stealing the essence of what makes the other person a creator. We hope that this class will help you absorb these principles.

We university instructors have additional ethical requirements. The act of giving you a passing grade in this class signifies to the world that in our judgment you have some significant level of competence in the material. Everyone out there is trusting us, and the value of a University of Maryland degree stems in large part from the demonstrated abilities of all the students whom previous instructors sent out into the world with degrees. That is why, though I view a willing student's failure to learn mainly as my failure to teach, I still give failing grades without hesitation.

The meta-question is why society believes that the biological and chemical sciences are worth supporting even in the face of many other competing priorities. Besides just curiosity, the obvious answer is that all of us want to live longer, healthier, more productive, more sustainable lives. We want to use chemical and life science knowledge to improve our food, technology, environmental stewardship, and society. To be an informed citizen in the 21st century you need to know some chemistry, so we want you to retain enough of what we learn here to make well-reasoned decisions about the technical, ethical, and moral opportunities and hazards of new advances.

When you fill out your CourseEvalUM evaluations, please reflect on how well the material you actually learned is aligned with these ambitious goals.

Intellectual Property

Syllabus Date and version: January 22, 2020

v. 1.01 corrected typos and office hours

v. 1.00 initial version