

**Chemistry 303: Physical Chemistry Laboratory**  
Department of Chemistry and Biochemistry, Loyola University Chicago  
Spring 2016

Instructor: Dr. Dan Killelea  
Office: Flanner Hall 103  
Phone: (773) 708-3136  
Email: dkillelea@luc.edu  
Office Hours: M 2 – 3 pm and W 9 – 10 am, or by appointment (FH 103)  
Lab: M, 8:30 am – 12:20 pm or T, 1:00 pm – 4:50 pm; Flanner 315  
Teaching Assistant: Greg Deye  
MW 2 – 3pm, FH-123

Course Prerequisites: A grade of C- or better in Chemistry 302 or co-enrollment in Chem 302. If you have not completed the course prerequisite, you may be administratively dropped from the class. Please discuss this with the instructor immediately!

Please see the Sakai site for up-to-date information and posts.

A bound lab notebook is *required*. ALL data, calculations, graphs, and work must be written in the notebook. **You must have such a notebook and safety glasses for the first lab.**

---

### Course Overview

This course will introduce laboratory techniques and analysis central to physical chemistry. We will pursue the following activities (note these topics are subject to change):

- 1) The quantification of information in experimental data. Mass spectra, IR spectra, and proteins will be the objects of interest.
- 2) The statistical analysis of experimental data: strategies for dealing with uncertainty. Measurements will focus on solution densities, crystallization velocities, electrochemical potentials, and evaporation rates.
- 3) The application of mathematical models to experimental data. Measurements will re-visit crystallization velocity. Temperature and time measurements will also be featured.
- 4) Experimental measurements of  $\pi$ . Let us measure  $\pi$  four different ways and celebrate  $\pi$ -Day along the way.
- 5) Techniques and applications of Fourier spectral analysis. We will investigate spectral analysis, infrared and laser light diffraction experiments.
- 6) We will further explore the interaction of light and matter over three lab sessions.
- 7) Experimental study of periodic precipitation in electrolyte solutions.

## Schedule

This is our tentative schedule for the semester. The topics and order may change.

<i>Week</i>	<i>Date</i>	<i>Topics</i>	<i>Quiz?</i>	<i>Other</i>
	17 Jan	Overview, ground rules, syllabus		
1	24 Jan	The quantification of information in experimental data	Y	
2	31 Jan	Statistical analysis of experimental data		
3	7 Feb	Application of mathematical models to experimental data		
4	14 Feb	Techniques and applications of Fourier analysis		
5	21 Feb	Let us dutifully celebrate $\pi$ -Day!	Y	
6	28 Feb	Mid-term oral exam		
	6 Mar	<i>No class: Spring Break</i>		
7	13 Mar	Light/Matter Lab #1	Y	
8	20 Mar	Light/Matter Lab #2	Y	
	27 Mar	<i>No class: Easter Break</i>		
9	3 Apr	Light/Matter Lab #3		
10	10 Apr	Experimental study of periodic precipitation	Y	
11	17 Apr	Final Oral Exams		
12	24 Apr	Research Presentations		

## Grading:

Grades will be determined out of 500 total points:

Pre-Lab Quizzes:	50
Lab Consultation Points/ Safety:	100
Notebook:	100
Mid-term Oral exam:	75
Final Oral Exam	100
Research presentation:	75

The following scale will be used:

>90%: A	88-90%: A-	86-88%: B+	76-86%: B
74-76%: B-	72-74%: C+	62-72%: C	60-62%: C-
50-60%: D	< 50%: F		

Teamwork is integral to lab meetings. Points and grades, however, will be grounded upon individual effort and achievement. P-Chem is neither easy nor quick to learn, but the process is rewarding if good-faith effort is made. Students are urged to consult with the instructors to discuss problems before they become serious.

## Course Structure:

---

- This is a lab course, thus, attendance is **mandatory** for all meetings. Labs may not be ‘made-up’ or otherwise rescheduled. If you miss or will be absent, contact DRK as soon as possible.
- Chem 303 will consist of experiments and lessons in data analysis, presentation, and reporting.
- You will have a permanent lab partner, and together may work in small groups to conduct the experiments. It is important that each member is an active participant in the lab; contact DRK if there is a problem with this, promptly.
- Before each lab, you **must thoroughly read the provide material and complete the first four sections of the report in your notebook** (as described later in this syllabus). You (and you group) may not begin the experiment until these portions are complete.
- Peer learning. For a few of the labs, groups will cycle, rather than each group doing the same lab in a given week. For these experiments, the group that did the lab the previous week will inform the next group how to properly do the lab. This will be part of the consultation / safety assessment.

**Quizzes:** You *may* also be given a short pre-lab quiz on the objective and methods for the scheduled experiment. There will be 5 quizzes worth 10 points each. The quiz will cover some combination of the lab to be done that day and the ones done up to that point in the semester.

**Consultation / Safety:** Each student will have an informal ‘consultation’ with DK and/or GD at the end of each lab meeting. We will discuss the day’s experiment, the data, and the work-up. We will evaluate each student’s knowledge of the fundamental chemical principles the lab covered, their experimental technique, the quality of their observations, and their insight into the significance of their observations. Also, effective communication with other groups in helping them get going on their experiment will be evaluated. The safe conduct of the experiment will also be reviewed; lack of safety equipment (*e.g.* proper attire, eyewear, not following instructions) will result in significant deduction of points.

**Notebook:** During consultation, your notebook entries for both the current experiment and the *previous* weeks lab will be examined. Your notebook may be collected near the midterm and in the final week for evaluation as well. The notebooks will be evaluated for *thorough notes* about each experiment and the *completeness* of the work.

There are 9 experiments; the low experiment will be dropped and 8 used for your grade. For each experiment, Consultation/Safety and Notebook count equally towards the maximum 50 points.

**Exams:** An oral mid-term exam (75 points) will occupy one of the lab meetings. There will also be a final oral exam worth 100 points. DR and GD will conduct these with each lab pair. We will discuss these in greater detail near the middle of the semester.

**Research Paper/Presentation:** The last several meetings will concentrate on energy levels, spectroscopy, magnetic resonance, and periodic precipitation experiments. Each student will write a research-style paper on the experiment of his or her choice. We will discuss the research paper in greater detail after the first few meetings. Students will pair up to give a brief ( $\approx 10$  min) oral presentation about the topic they chose in the final week of class.

## Notebook/report format

---

Each experiment should be organized as shown below. You **must** have the first four sections completed in order to begin the experiment.

1: **Title:** Provide a descriptive title for the experiment.

*Example:* Effect of Halide Electronegativity on the Band-gap of Makebelieveium Nanoparticles

2: **Objective:** Briefly state the objective of the experiment. What is the hypothesis and what data are you trying to obtain to verify the hypothesis, and how will you know if it is verified or not?

*Example:* The objective of this experiment is to determine if the electronegativity of the halide in Mb-halide nanoparticles shifts the band gap. We will measure the absorption of 10 nm nanoparticles of makebelieveium (Mb) halides using UV/Vis spectroscopy. The energy of the absorption peak corresponds to the band-gap, thus by obtaining spectra of nanoparticles for three different halides will allow us to determine if the different halides alter the spacing between the valence and conduction bands in the nanoparticles. If only a small shift is observed, then the electronegativity of the halide is not an important aspect in the energy of the particles, but the observation of a shift among the three halides suggests the band-gap is not simply the result of electron confinement.

3: **Method:** State how you intend to obtain the desired data. For example, how will the materials be prepared, what instruments will be used, in what order must the steps be taken, etc.

4: **Expected Results:** Briefly state what results you expect to observe and why.

*Example:* The average diameter of the nanoparticles is 10 nm; using the particle-in-a-box approximation, I expect the band gaps to be on the order of 1 eV ( $100 \text{ kJ mol}^{-1}$ ) with only small differences for the three halides, for the confinement of the electron in the particle is much more significant than the bonding among the atoms for electrons in the conduction band.

5: **Data/Calculations/Analysis:** All data must be recorded here, as well as observations and the procedure you followed. All calculations and analysis must also be included. For computational work, provide adequate detail so the computation could be repeated if the file were lost.

6: **Results and Conclusions:** Describe the findings of this study. Were the results what you expected? Why not? What changes did you have to make to the procedure or equipment in order to obtain the data? How should the procedure be improved?

## Academic Integrity

---

All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts & Sciences, that can be viewed at:

[http://www.luc.edu/cas/pdfs/CAS\\_Academic\\_Integrity\\_Statement\\_December\\_07.pdf](http://www.luc.edu/cas/pdfs/CAS_Academic_Integrity_Statement_December_07.pdf)

Anything you submit that is incorporated as part of your grade in this course (e.g. quiz, examination, homework, lab report) must represent your own work. Any students caught cheating will, at the very minimum, receive a grade of "zero" for the item that was submitted and this grade cannot be dropped. If the cheating occurred during a course exam, the incident will be reported to the Chemistry Department Chair and the Office of the CAS Dean. Depending on the seriousness of the incident, additional sanctions may be imposed.

I have no tolerance whatsoever for cheating or plagiarism. **Any instance of dishonesty (including those detailed on the website provided above or in this syllabus) during a quiz, test, or exam will result in a failing grade for the course.** The Dean of Arts & Sciences and The Chair of The Department of Chemistry & Biochemistry will also be notified. I truly hope to never have to invoke these processes. Please be honest with your work.

**Teamwork:** I strongly encourage you (the class) to work together to solve assigned and unassigned problems. In order to learn and excel in Physical Chemistry, you should work through problems. The assigned problems are a minimum. Work together with your classmates, if you do not understand

something, someone else may. You will also find that explaining a solution to your classmate will cement the information in your mind, and make you a better student.

When working as a group, if each member contributes to the discussion, and you each hand in very similar work, that is perfectly acceptable given the nature of the assignments. On the other hand, if someone simply copies an assignment from someone else, that is plagiarism, and will be treated as such.

### **Students with Disabilities**

---

If you have any special needs, please let me know in the first week of classes. The university provides services for students with disabilities. Any student who would like to use any of these university services should contact the Services for Students with Disabilities (SSWD), Sullivan Center, (773) 508-3700. Further information is available at <http://www.luc.edu/sswd/>.

### **Tutoring**

---

The Loyola Undergraduate ACS has open tutoring every week on W and R evenings in Flanner 129. In addition, Loyola maintains a Center for Academic Excellence & Tutoring (<http://www.luc.edu/tutoring/>). Again, this is a service included in your tuition, so I encourage you to utilize their assistance.

### **Your well-being**

---

If there are events occurring in your life that cause school to diminish in its priority, please discuss this with me or contact the Wellness Center (<http://www.luc.edu/wellness/index.shtml>) or the dean of students ([http://www.luc.edu/studentlife/dean\\_of\\_students\\_office.shtml](http://www.luc.edu/studentlife/dean_of_students_office.shtml)) for assistance. These are services that **your** tuition pays for and can be invaluable for your personal health and maintaining progress towards your degree.