

**Chemistry 303: Physical Chemistry Laboratory**  
Department of Chemistry and Biochemistry, Loyola University Chicago  
Spring 2018

Instructor: Dr. Dan Killelea  
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Office Hours: M, 1:30 – 2:30 pm; or by appointment (FH 103)  
Lab: M, 8:30 am – 12:20 pm; Flanner 315  
Teaching Assistant: Marie Turano  
Tu., 10am – 11 am. FH-019.

Course Prerequisites: A grade of C- or better in Chemistry 301 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!

**Lab Safety:** To enter the lab, protective glasses, long pants/skirt, closed-toe shoes, and tied back hair are required. Loose fitting clothing (that hangs and can get in the way) is strongly discouraged. Please use chairs for you winter attire and do not put clothing on the floor or lab benches. Eating and drinking are strictly forbidden in the lab. Pay attention to what you and others are doing. Improper lab conduct will result in significant penalties.

A bound lab notebook is *required*. Please obtain a “National Brand Computation Notebook, 4x4 Quad, Brown, Green Paper, 75 sheets”. This is < \$10 from amazon. 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.**

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### 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) We will further explore the interaction of light and matter over three lab sessions.
- 2) Study the diffusion of small molecules through a semipermeable membrane
- 3) Computer programming, electronic circuits, and device development
- 4) Principles of vacuum
- 5) Thermal desorption from surfaces
- 6) Electron microscopy and electrochemistry

## Schedule

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

<i>Week</i>	<i>Date</i>	<i>Topics</i>
1	22 Jan	Introduction and Safety Presentation
2	29 Jan	Light/Matter Lab #1
3	5 Feb	Light/Matter Lab #2
4	12 Feb	Light/Matter Lab #3
5	19 Feb	Light/Matter Labs – Evaluate and optimize
6	26 Feb	Diffusion and Dialysis
	5 Mar	<i>No class: Spring Break</i>
7	12 Mar	Build your own spectrometer I
8	19 Mar	Build your own spectrometer II
9	26 Mar	SEM / electrochemistry
	2 Apr	<i>No class: Easter Break</i>
10	9 Apr	Principles of Vacuum Science
11	10 Apr	Temperature programmed desorption
12	16 Apr	Gadget labs?
	23 Apr	Final Oral Exams

## Grading:

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Grades will be determined out of 500 total points:

Notebook:	500
Final Oral Exam	95
Evaluation	5

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:

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- 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 acquisition, analysis, 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 provided material and complete the first four sections of the report in your notebook** (as described later in this syllabus). You (and your 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.

**Consultation / Safety:** Each student will have an informal ‘consultation’ with the instructors 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. Finally, you must thoroughly clean up and put away equipment after completion of the lab.

**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 10 experiments, all will be used for your grade. Each experiment is worth 50 points.

**Exams:** There will be a final oral exam worth 95 points. The instructors will conduct these with each lab pair. We will discuss these in greater detail near the middle of the semester.

**Course Evaluation:** Successful completion of the course evaluation will merit 5 points. Please email DRK informing me that you have completed the evaluation by 5pm on April 28<sup>th</sup> to receive credit.

## Notebook/report format

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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

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

[https://www.luc.edu/academics/catalog/undergrad/reg\\_academicintegrity.shtml](https://www.luc.edu/academics/catalog/undergrad/reg_academicintegrity.shtml)

The basic commitment of a university is to search for and to communicate the truth as it is honestly perceived. The university could not accomplish its purpose in the absence of this demanding standard. To the extent that this standard is respected, a genuine learning community can exist. Students of this university are called upon to know, to respect, and to practice this standard of personal honesty.

Plagiarism is a serious form of violation of this standard. Plagiarism is the appropriation for gain of ideas, language, or work of another without sufficient public acknowledgement and appropriate citation that the material is not one's own. It is true that every thought probably has been influenced to some degree by the thoughts and actions of others. Such influences can be thought of as affecting the ways we see things and express all thoughts. Plagiarism, however, involves the deliberate taking and use of specific words and ideas of others without proper acknowledgement of the sources.

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**

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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/>.

### **Your well-being**

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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.

### **Chem 302 Co-requisite**

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SPRING 2018

Students wanting to drop lecture after midterm may stay in the co-req lab only if lecture midterm grade, posted in LOUCS, is a D or better. Students should continue to attend the lecture until the week of the drop date to gain as much background knowledge as possible. For Spring 2018 students wishing to drop lecture, and have a mid-term grade of D or better (in lecture), can seek assistance from the Department of Chemistry & Biochemistry office beginning Tuesday March 20 at 9:00am through Monday March 26<sup>th</sup> at 4:00pm. Students with a midterm grade of F must drop the co-req lab along with the lecture. No exceptions.