

**Chemistry 303: Physical Chemistry Laboratory**  
Department of Chemistry & Biochemistry, Loyola University Chicago  
Spring 2023

Instructor: Dr. Dan Killelea  
Office: Cuneo Hall 404  
Email: dkillelea@luc.edu Please use **CHEM 303** as subject  
You **must** use your .luc address for such communication.  
Office Hours: *by appointment*  
Discussion (required): 11:30 am – 12:20 pm FH-007  
Lab: Sc 001: Mo, 8:20 am – noon:20 FH-315  
Sc 002: We, 8:20 am – noon:20 FH-315  
TAs (Office Hours): Maxwell Gillum (We, 2 – 3 pm, FH-017)  
Faith Lewis (Mo, 3 – 4 pm, FH-017)

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!

### **Lab Safety**

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To enter the lab, protective glasses, long pants/skirts, 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 your 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 and provided*. ALL data, calculations, graphs, and work must be written in the notebook.

**You must have safety glasses for the first lab.**

### **Course Overview**

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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) Computer programming, electronic circuits, and device development
- 2) The basics of information and mathematical transformations
- 3) We will further explore the interaction of light and matter over three lab sessions.
- 4) A bit of spectroscopy
- 5) Principles of vacuum and Thermal Desorption from surfaces
- 6) Electronic Structure Calculations

## Schedule

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This is our tentative schedule for the term. The topics and order may change. All labs will be in-person, and groups will be assigned in week 1.

<i>Week</i>	<i>Date</i>	<i>Topics</i>
1	16 Jan	Introduction; Information (no lab meetings)
2	23 Jan	Arduino and Electronics day and Principles of Fourier Transformations
3	30 Jan	Round A: (Diffraction, PIB, or Planck)
4	6 Feb	Round A: (Diffraction, PIB, or Planck)
5	13 Feb	Round A: (Diffraction, PIB, or Planck)
6	20 Feb	FTIR Spectroscopy of HCl/DCI
7	27 Feb	Theoretical Calculations of HCl/DCI ; Notebook turn in
8	6 March	Spring Break
9	13 March	Vacuum
10	20 March	Round B: (TPD, FTIR, or SEM)
11	27 March	Round B: (TPD, FTIR, or SEM)
12	3 April	Round B: (TPD, FTIR, or SEM)
13	10 April	Easter Monday
14	17 April	Conversations and Notebook turn in
15	24 April	Make up Day

## Grading:

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Grades will be determined out of 700 total points:

Attendance: 100 (10 points per lab)

Lab Reports: 500 (10 reports)

Conversation: 100

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

The following scale will be used:

>92%: A	88-92%: A-	84-88%: B+	80-84%: B
76-80%: B-	72-76%: C+	68-72%: C	60-68%: C-
50-60%: D	< 50%: F		

Points and grades 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. Feel free to work with your fellow students, I strongly encourage collaboration amongst you all.

## Course Structure:

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- The course consists of a weekly 50-minute discussion (Fr., 11:30a, FH-007) and a 4-hour lab. The discussion period will be for wrapping up the previous lab and getting set for the next.
- Attendance is ***mandatory*** for the lab portion of this course. If you miss or will be absent, contact DRK as soon as possible. You will receive 10 points for attending each lab.
- ***In case of illness: STAY HOME! Contact DRK promptly, and arrangements will be made.***
- Chem 303 will consist of experiments and lessons in data acquisition, analysis, and reporting.
- On the discussion before a lab, you **must have thoroughly read the provided material and complete the first four sections of the report in your notebook** (as described later in this syllabus). You may not begin the experiment until these portions are complete.

**Consultation / Safety:** Each student will have an informal ‘consultation’ with the instructor(s) at the start 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.

**Lab Reports:** Reports for each lab must be completed **before** starting the next experiment (unless otherwise stated). No reports will be accepted after Friday, 5 May 2023. The reports will be evaluated for *thorough notes* about each experiment and the *completeness* of the work. Late reports will be docked 10 points day<sup>-1</sup>.

**Exams:** There will be a final vocal conversation worth 100 points. The instructors will conduct this with each of you as scheduled.

## 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. Some experimental procedures have questions to answer or other stated objectives that must be included in the results/discussion. Please keep things concise, yet thorough. Having your report started will allow you to keep notes in your report, and then you just turn in the whole thing.

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?

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### Important Information

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#### **Pass/Fail Conversion Deadlines and Audit Policy**

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A student may request to convert a course into or out of the "Pass/No-Pass" or "Audit" status only within the first two weeks of the semester. For the Spring 2023 semester, students can convert a class to "Pass/No-Pass" or "Audit" through Monday, January 30th. Students must submit a request for Pass/No-Pass or Audit to their Academic Advisor.

#### **Health, Safety, and Well-Being On-Campus**

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Please be familiar with and adhere to all guidelines posted on the *Health, Safety, and Well-Being Update* site: (<https://www.luc.edu/healthsafetyandwellbeing/>.) This site relays important updates and protocols related to COVID-19 and other matters.

#### **Final Exam**

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This class does not have a final exam.

#### **Course Repeat Rule**

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Effective with the Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C- or better grade. The three attempts include withdrawals (W). The Department advises that it is preferable to complete a course with a grade of C or C-, and to demonstrate growth in future coursework, than to withdraw from a course.

After the second attempt, the student must secure approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department of Chemistry & Biochemistry website: <https://www.luc.edu/chemistry/forms/> and personally meet and obtain a signature from either the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. A copy of this form is then taken to your Academic Advisor in Sullivan to secure final permission for the attempt.

#### **Student Accommodations**

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Loyola University provides reasonable accommodations for students with disabilities. Any student requesting accommodations related to a disability or other condition is required to register with Student Accessibility Center (SAC), located in Sullivan Center, Suite 117. Professors receive the accommodation notification from SAC via Accommodate. Students are encouraged to meet with their professor individually in order to discuss their accommodations. All information will remain confidential. Please note that in this class, software may be used to record class lectures in order to provide equal access to students with disabilities. Students approved for this accommodation use recordings for their personal study only and recordings may not be shared with other people or used in any way against the faculty member, other lecturers, or students whose classroom comments are recorded as part of the class.

activity. Recordings are deleted at the end of the semester. For more information about registering with SAC or questions about accommodations, please contact SAC at 773-508-3700 or [SAC@luc.edu](mailto:SAC@luc.edu).

### **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 College of Arts & Sciences, which can be viewed at:

<https://www.luc.edu/cas/advising/academicintegritystatement/>

A basic mission of a university is to search for and to communicate the truth as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a fundamental tenet of the intellectual life of the community. Students of Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty.

Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, submitting false documents, and deliberately disrupting the performance of other class members.

Any instance of dishonesty (including those detailed on the website provided above or in this syllabus) will **immediately result in a grade of F for the entire course** and will also be reported to The Chair of The Department of Chemistry & Biochemistry who will decide what additional steps may be taken.

### **Loyola University Absence Policy for Students in Co-Curricular Activities (including ROTC):**

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Students missing classes while representing Loyola University Chicago in an official capacity (e.g., intercollegiate athletics, debate team, model government organization) shall be allowed by the faculty member of record to make up any assignments and to receive notes or other written information distributed in the missed classes.

Students should discuss with faculty the potential consequences of missing lectures and the ways in which they can be remedied. Students must provide their instructors with proper documentation i.e., "[Athletic Competition & Travel Letter](#)" describing the reason for and date of the absence.

This documentation must be signed by an appropriate faculty or staff member and it must be provided to the professor in the first week of a semester. It is the responsibility of the student to make up any assignments. If the student misses an examination, the instructor is required to allow the student to take the examination at another time.

<https://www.luc.edu/athleteadvising/attendance.shtml>

Students who will miss class for an academic competition or conference must provide proper documentation to their instructor as early in the semester as possible.

**Scientific Conferences and post-graduate visits:** If you are presenting your work at a conference or visiting another school for post-graduate study, or have a job interview, please discuss with Dr. Killelea ASAP, and **before** the absence. These are not valid excuses for an absence, but we can make arrangements if you let me know ahead of time.

### **Accommodations for Religious Reasons**

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If you have observances of religious holidays that will cause you to miss class or otherwise effect your performance in the class you must alert the instructor **within 10 calendar days of the first class meeting of the semester** to request special accommodations, which will be handled on a case by case basis.

### **Universal Absence Accommodation Policy**

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The purpose of a universal absence accommodation policy is to account for emergency circumstances (e.g., serious illness, caring for a family member, car accident) that require you to be absent from class, while maintaining fairness in grading for students who attend and complete all in-class graded assignments. We believe that class attendance and participation are essential for your success in this class, and that your health is important to us and our shared community. Please use good judgement

and stay home if necessary/prudent for your circumstances.

This is the universal accommodation policy for in-class graded assignments:

- On a case-by-case basis, as this is a lab course and attendance and participation are mandatory. You should be prepared provide documentation for an absence. These accommodations are automatically available to all students.

### **Privacy Statement**

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Assuring privacy among faculty and students engaged in online and face-to-face instructional activities helps promote open and robust conversations and mitigates concerns that comments made within the context of the class will be shared beyond the classroom. As such, recordings of instructional activities occurring in online or face-to-face classes may be used solely for internal class purposes by the faculty member and students registered for the course, and only during the period in which the course is offered. Students will be informed of such recordings by a statement in the syllabus for the course in which they will be recorded. Instructors who wish to make subsequent use of recordings that include student activity may do so only with informed written consent of the students involved or if all student activity is removed from the recording. Recordings including student activity that have been initiated by the instructor may be retained by the instructor only for individual use.

### **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. I am always willing to discuss how I can adapt the class and its materials so that you are successful. Especially nowadays. The past two years have been very stressful to many of us, and I hope that we can work together to be better.