

## CHE3027, Physical Chemistry II LAB Syllabus, Fall 2023, Aug. 28 – Dec. 15



This is a lab course that accompanies the second semester of Physical Chemistry. The fundamental goals are to apply concepts you learn in lecture to the analysis of chemical data, to gain experience with specialized equipment and techniques, and to improve in formal scientific communication.

**Dr. Samuel Stoneburner, Assistant Professor**

**Office:** Rohr Science 322 (enter through 330)

**Email:** sstonebu@pointloma.edu

**Phone:** 619-849-7230

**Lab location:** Sator Hall 208

**Section 1:** T: 1:30 pm – 5:00 pm

**Section 2:** R: 1:30 pm – 5:00 pm

**Communication:** I will post information and announcements via Canvas. You should activate notifications. When I am not available in my office, the best way to reach me is by email. I will attempt to respond within one business day.

**Drop-in Hours:** MWF, 10:30am – 11:30am, 1:15pm – 2:00pm  
TR, 8:30am – 10:00am

You do not need an appointment to meet with me during any of the above hours. If you would like to meet at another time, please email me to schedule an appointment with suggested meeting times.

**Corequisite(s):** CHE 3026 (lecture, graded separately)

**Course Description:** A laboratory course featuring spectroscopic and theoretical methods and the analysis of the data generated thereof.

### Required Materials:

- The required texts from CHE 3026. (Lab-specific instructions will be provided on Canvas.)
- Lab coat
- Safety glasses.
- A scientific or graphing calculator
- A computer and Microsoft Excel (*not* Google Sheets or LibreOffice Calc). You should have access to Microsoft Office 365 as a PLNU student.

**About your professor:** I am a computational chemist with a deep appreciation and respect for “wet lab” experimental chemistry. I have spent much more of my teaching career in lab than in lecture, which has given me considerable opportunity to share from my disturbingly library of lab safety horror stories. Feel free to ask about how I was in the building at the University of Minnesota at the time of the infamous lab hood explosion of 2014, my mostly unsupervised summer with cadmium, the relevance of Edmund Burke’s “Reflections on the Revolution in France” to chemical experiments, and possibly second-hand accounts involving elemental sodium, uranium hexafluoride, and/or misused chemical solvents.

**PLNU Mission: To Teach ~ To Shape ~ To Send**

Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

**Course Learning Outcomes:** Upon completion of this course, students will be able to:

- Understand the theories and applications of quantum chemistry as they relate to molecular structure and spectroscopy
- Understand the utility of spectroscopy in revealing the nature and properties of molecular systems
- Use theoretical chemistry software to predict chemical properties
- Analyze and interpret data using appropriate software
- Communicate scientific ideas and results in writing using appropriate software
- Articulate limits and assumptions in experimental methodology and data analysis.

**Safety:** Safety is THE top priority in the lab. Please note the requirement for long pants (a department-wide rule). Other rules will be posted on Canvas. If you fail to comply with these or *any* of the rules in the safety agreement, you may be excluded from the lab and will not have the opportunity to make up missed assignments.

### *Grading and Assessment*

Letter grades will be assigned according to the following scheme:

A-range	B-range	C-range	D-range	F-range
A: Any grade of 93.0% or above.	B+: 87.0-89.9 %	C+: 77.0-79.9 %	D+: 67.0-69.9 %	F: Any grade below 60.0%
	B: 83.0-86.9 %	C: 73.0-76.9 %	D: 63.0-66.9 %	
A-: 90.0-92.9 %	B-: 80.0-82.9 %	C-: 70.0-72.9 %	D-: 60.0-62.9 %	

Percent	Component
10 %	Prelab quizzes (2% each)
30 %	Preliminary results (6% each)
60 %	Lab reports (12% each)*
100 %	Total

Note: “Extra credit”, “curving”, or “rounding up” of the final grade should not be expected or requested. The only way to achieve a given grade is to perform well on the assignments described here. Do not ask for “extra” work to boost your grade.

\*Penalties may be applied to lab report grades if violations of lab rules or course policies occur

**Prelab quizzes:** Each lab will have a quiz at the beginning to ensure you are familiar with the lab, the associated concepts from lecture, and any relevant safety risks. The quizzes will be closed-book, closed-notes, no-internet, but they will not involve complicated math. The quizzes will begin immediately at the section start time, so don't be late.

**Preliminary results:** Physical chemistry experiments often require less time in the lab itself than other chemistry courses, but much more time *after* the lab period for calculations and analysis. The schedule intentionally has “off” weeks to give you time to analyze data and work through calculations. To help you make sure you get through some of that work before too much time has passed, you will submit your results and calculations several days before the full lab report is due.

Submit an Excel spreadsheet with all work and results clearly labeled. You will make individual submissions, but working together with your group (or others) is allowed and encouraged. Your submissions will go through Turnitin. It is expected that there will be similarities between different students’ spreadsheet files, but that *they will not be identical*.

Grades will be based on completion, accuracy, and clarity of presentation:

- **Completion (30 pts):** The spreadsheet must include the following:
  - (10 pts) All raw data used in the experiment (whether collected by you or someone else)
  - (10 pts) All calculations needed to find any final results required by the report.
  - (10 pts) All final results required by the report.
- **Clarity (50 pts):** The spreadsheet must be organized and all parts must be clearly labeled.
  - (10 pts) Cells containing raw experimental data should be labeled with any applicable units and variable names. It is okay to use column or row labels if there is a table of data.
  - (10 pts) Cells containing constants (e.g., conversion factors or reference values for comparison) must be labeled with a name or commonly used variable (e.g., “c” for the speed of light) and units.
  - (5 pts) Reference values should have the source listed as well.
    - It does not need to be a formal ACS citation. If it is from the textbook, say “Engel” and the page number.
    - If it is from the internet, give a link to the specific web page.
    - Beware of taking the first value that shows up in Google without going to the source page – those values are often from internet forums or homework “help” sites, and the data are frequently incorrect. Also, just saying “Google” won’t get you any credit.
  - (10 pts) Calculated values should be labeled with the intended calculation.
    - If it is an equation provided in the lab handout, with no rearrangement, you can just cite the equation number.
    - You should not need to be typing large equations into Excel using Equation Editor. I can read Excel formulas, so it is sufficient to type a verbal description (e.g., “rearranged Equation 8 to solve for wavelength”).
  - (10 pts) The spreadsheet must be organized so that I can readily follow your thinking.
    - You have a lot of flexibility here, but you should be keeping related calculations together, and ideas should flow left-to-right or top-to-bottom (or both). Feel free to use multiple sheets, cell borders, or color coding to separate/differentiate sections.

- (5 pts) The file should be prepared in Microsoft Excel, not Google Sheets or other “free” alternatives. You have access to Microsoft Office as a PLNU student, and other software alternatives are deficient in multiple ways. Using something like Google Sheets and then switching the file to Excel often leads to obscure and arcane errors.
- NOTE: If the labeling and organizing feels like it is taking up a lot of your time, talk to me about it. While it is possible that you just haven’t had to make a spreadsheet for someone else to read before, there is a good chance that you are doing more than I intended in some way.
- **Accuracy and precision (20 pts):**
  - (10 pts) Final results must be within an acceptable range of reference values.
    - “Acceptable range” is a highly context-dependent concept and will include possible equipment failure or similar in-the-moment issues that do not reflect on your technique.
  - (10 pts) All raw data and final results should have correct sig figs.

**Lab reports:** While you will work in groups, you will submit individual lab reports. You are permitted to discuss your reports with each other, but your work should be your own. Your submissions will go through Turnitin and will be reviewed for possible plagiarism.

Each lab report will have the same structure and rubric:

- **Titles and authorship (5 pts):** Your name, the names of other group members, the title of the experiment, and the date(s) the in-lab work was performed.
- **Methods (30 pts):** A description of the experimental procedure.
  - (20 pts) There should be enough detail provided for someone to be able to reproduce the experiment without referencing the provided lab handout.
  - (5 pts) Any relevant hazards, first aid, and/or disposal concerns should be addressed.
    - ***Do not*** include the standard warnings or first-aid procedures that are in every SDS. The point here is to show that you can distinguish between noteworthy specific points of concern vs. the baseline procedure for every activity involving any chemicals. If there is nothing noteworthy, explicitly say so.
  - (5 pts) Everything should be in paragraph form, not bullet points or tables.
  - Everything should be in your own words, not quoted from the lab instructions and/or SDSs. ***Verbatim copying will be treated as plagiarism even if sources are cited.***
- **Calculations (0 pts, only if necessary):** You do not need to resubmit your spreadsheet unless correcting errors from your preliminary results submission is necessary for your report to be understood. Any such corrections will not change the grade of the preliminary results assignment.
  - Do not include calculations in your lab report, and ***especially*** do not copy/paste tables or screenshots from the spreadsheet into your report.
- **Results and Discussion (50 pts):** A section that combines a presentation of the most important or relevant results with a meaningful discussion that explains what the results mean and addresses any required follow-up questions.

- (10 pts) Data (results) are integrated in with discussion, including in-text cross-references.
  - This means that tables and figures are embedded in the text as near as possible to where their contents are discussed. Cross-references will read something like “(Table 1)” at the end of the sentence that first mentions the contents of Table 1.
  - The integration of results and discussion into one section imitates many chemistry journal formats. ***This section is not like biology lab reports where there are two distinct sections for Results and Discussion.***
- (10 pts) Tables, figures, and equations are properly formatted and labeled:
  - Tables:
    - Tables must be numbered sequentially within the lab report.
    - Tables should have captions *above* the table with the table number and a brief description of the contents.
    - Headings of columns should have units where applicable.
  - Figures:
    - Figures must be numbered sequentially within the lab report.
    - Figures should have captions *below* the figure with the table number and a brief description of the contents.
    - If the figure is a graph, axes should be labeled (including units, if any).
    - If the figure is a graph, the axis values should be selected so that the data takes up most of the space of the graph. There should not be large empty spaces simply because of the axis value ranges.
  - Equations should be made in Equation Editor and should be numbered sequentially within the lab report. The first equation in your report should be “Equation 1”, even if it was Equation 5 in the instructions.
- (5 pts) The data is limited to final results or, if applicable, raw experimental data that is explicitly discussed (e.g., during error analysis).
  - The point here is to demonstrate that you understand what is most relevant or interesting to your discussion and that you can filter out all the data that is only supporting in nature. In chemistry journal articles, intermediate calculations and/or raw experimental data will usually be presented in a “Supporting Information” document rather than cluttering up the article itself.
- (5 pts) Discussion questions must be fully answered and in paragraph form.
  - There should not be a numbered list of isolated sentences or sentence fragments answering the questions. The answers should be a part of the overall discussion.
  - It is acceptable to answer more than one question in a single paragraph if the answers are short and sufficiently related.
- (10 pts) Discussion question answers should be correct. To the extent they depend on your data, they should correctly follow from your data, even if that gives an answer you know from other sources to be inaccurate.
  - If your data lead to inaccurate conclusions, you should address the issue(s) in your error analysis (see the “error analysis” point, below).

- Disregarding parts your data to make the answer come out “correct” is a common part of academic misconduct among professional researchers. Don’t do it.
- (10 pts) Error analysis should be included whether or not it is explicitly requested in the lab handout.
  - If there are any discrepancies between your results and known reference values or other expected results, you should address these discrepancies and speculate as to possible causes.
  - If any specific possible sources of error are mentioned in the discussion questions, be especially sure to address those.
  - Even if there is no discernible error in your results and the discussion questions to not bring up any possible errors, you should still think through the procedure and talk about where error could have been introduced.
  - In ALL cases where error is discussed, you should talk through how the results would be affected if a given error source were present.
    - Which value would be affected? Would it make it artificially high or low?
- **References (5 pts):** Any outside sources should be cited in [ACS reference style](#).
  - The references should be sequentially numbered in the order that they are cited in the text.
  - Within the main text, use superscript numbers at the end of the sentence or group of sentences using the cited content.
    - This is similar to the Wikipedia format, except they have brackets around the superscript numbers, but you should not have the brackets.
  - As is always the case, be wary of possible plagiarism, including (but *not* limited to):
    - Failing to cite an outside source (and therefore presenting an idea as your own).
    - Failing to cite the lab handout (it is not your writing and is therefore an outside source).
    - Failing to paraphrase material from an outside source.
      - If you directly quote an outside source, but do not use quotation marks, it is still plagiarism even if you cite the source.
      - If you directly quote an outside source, and you do use quotation marks, and you do cite the source, it is not plagiarism, but in most scientific contexts it is considered poor writing.
- **Personal reflection (10 pts):** A paragraph describing your subjective experience with the lab. You are encouraged to include specific techniques or concepts that you appreciated learning, or that you wish had been included. You can also describe other aspects of the experiment that you thought were enjoyable, or tedious, or evoked some other sort of emotional reaction. In other words, tell me what specifically you liked or disliked about the lab, for whatever reasons. This feedback is helpful for me in deciding what to change the next time I teach the course.
  - This section should NOT be a summary of the experiment echoing the Methods and/or Results and Discussion sections. It is not a Conclusion or Abstract or anything resembling a part of formal scientific communication.

***NO lab reports this semester include any requirement for an Abstract, Introduction, or Conclusion.***

**Schedule and time requirements:** The PLNU Credit Hour Policy states that 2 hours of preparation per 3 hours of lab time is “normal”, meaning almost **2.5 hours per week** (besides lab itself) would be reasonable for the CHE3026 lab course. Realistically, it will take much more than that for all of the data processing and write-up, which is why you will usually have lab on *alternating* weeks. **The “off” week effectively provides an extra 5-plus hours intended for analysis and writing.** I have also done my best to schedule lab deadlines to overlap as little as possible with exams and other major deadlines for the lecture course.

We also have lab capacity limitations for some equipment, so within each section you will be split into two groups (“A” and “B”). **Both “A” and “B” groups will meet on the same week**, but scheduling within the lab period will vary. Some experiments will have one group beginning at the start of the lab period, and the other group starting about halfway through. Other experiments will have everyone there from the beginning, but rotating through different activities. Specifications will be given in the lab handouts. Group assignments will be on Canvas.

### *Additional Notes and Policies*

**Incompletes, late assignments and extensions:** All assignments are to be submitted/turned in by the due date/time, including assignments posted in Canvas. You are responsible for making sure that your submission is complete and legible *in Canvas* (i.e., “corrupted” files will not be accepted). Assignments will automatically close at the exact time at which they are due. Late work will not receive credit.

Incompletes will only be assigned in extreme circumstances such as an ongoing medical situation. PLNU policy requires that “Incomplete” grades be resolved by the end of the following semester.

I realize that there may be illness, family emergencies, or other life concerns that prevent you from being able to complete occasional assignments. I am willing to consider requests for extensions to deadlines, but requests must be made in advance, and they will be considered on a case-by-case basis. If you need an extension on an assignment, please email me and suggest a specific new (extended) deadline that you believe would meet your needs.

**Attendance:** Regular and punctual attendance at all classes is essential for learning, and lab classes are participation-based. Being late will cause you to miss the pre-lab quiz (and associated points). Being significantly late (i.e., after I have delivered critical safety and/or procedural information) will be considered an absence, resulting in a 0 for the entire experiment and all associated assignments. Leaving before completing your work (including any necessary cleanup and disposal) will also be considered an absence.

Per [PLNU attendance policy](#), if a student is absent for 1 lab period (which is more than 10 percent of class sessions), I will issue a written warning of de-enrollment. If the absences exceed 20 percent (2 lab periods), the student may be de-enrolled without notice until the course withdrawal date (Nov. 3) or, after that date, receive an “F” grade.

If you are truly unable to attend on a given day, please let me know as soon as you become aware of the problem. I have no desire to give anyone a “0” for attendance, but we also face serious logistical constraints that prevent “make-up” labs from being an automatic possibility.

**Technology:** The use of portable electronic devices (phones, laptops, iPads, etc.) not related to the course is not permitted during the lab discussion and procedures. Other uses of technology are permitted if you are waiting for your turn for the use of equipment if (and only if) there is nothing else you could be doing related to the lab AND your use of technology does not present a distraction to others present.

PLNU’s course-information website, Canvas (<http://canvas.pointloma.edu>), is used as a repository for course material such as grades and miscellaneous items. Announcements will be sent out via Canvas. It is your responsibility to check Canvas regularly and to confirm that your correct email address is in the system.

**PLNU academic accommodations policy:** PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities. Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center ([EAC@pointloma.edu](mailto:EAC@pointloma.edu) or 619-849-2486). Once a student’s eligibility for an accommodation has been determined, the EAC will issue an academic accommodation plan (“AP”) to all faculty who teach courses in which the student is enrolled each semester.

PLNU highly recommends that students speak with their professors during the first two weeks of each semester/term about the implementation of their AP in that particular course and/or if they do not wish to utilize some or all of the elements of their AP in that course. Students should have this discussion with the instructor even if they were using the same accommodations in the previous semester. Students should be aware that not all accommodations can be applied to the chemistry lab in the same way as in many lecture courses. The “hands-on” nature of the lab class limits how accommodations can be applied without fundamentally altering the academic standards of the course.

Students who need accommodations for a disability should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. It is the student’s responsibility to make the first contact with the EAC.

**PLNU academic behavior policy:** Both faculty and students at Point Loma Nazarene University have the right to expect a safe and ordered environment for learning. Any student behavior that is disruptive or threatening is a serious affront to Point Loma Nazarene University as a learning community. Students who fail to adhere to appropriate academic behavioral standards may be subject to discipline. *In the context of chemistry lab courses, failure to comply with **any one** of the safety rules and policies may qualify as disruptive behavior.* See [Academic Policies](#) for additional definitions of different kinds of disruptive behavior and for further policy information.

**PLNU academic honesty policy:** Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See [Academic Policies](#) for definitions of kinds of academic dishonesty and for further policy information.

In the context of a lab course, academic honesty does not mean that you have to cite your lab partner on every line on a data table. If you were assigned to work together, and you put your partner's name on the lab report, it is already assumed that you both worked together to gather the data. However, if you were to use data from a different group, you would need to give them credit. Academic honesty *does* mean that you are not thoughtlessly copying your partner's answers for your own lab report. It also means that you should not copy from a lab report that someone turned in for some previous semester, *even if that someone was you*. Academic dishonesty also includes lying in order to gain an advantage, and the various examples of plagiarism noted in the Lab Report rubric above (under "References").

**Artificial Intelligence (AI) Policy:** You are allowed to use Artificial Intelligence (AI) tools (e.g., ChatGPT, iA Writer, Marmot, Botowski, etc.) in this course. Any work that utilizes AI-based tools must be clearly identified as such, including the specific tool(s) used. For example, if you use ChatGPT, you must cite ChatGPT including the version number, year, month and day of the query and the statement "Generated using OpenAI. <https://chat.openai.com/>".

You are responsible for the accuracy of any information you submit. AI is known to "hallucinate", so use it at your own risk.

**PLNU copyright policy:** Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

**Sexual misconduct and discrimination:** Point Loma Nazarene University faculty are committed to helping create a safe learning environment for all students. If you (or someone you know) have experienced any form of sexual discrimination or misconduct, including sexual assault, dating or domestic violence, or stalking, know that help and support are available through the Title IX Office at [pointloma.edu/Title-IX](http://pointloma.edu/Title-IX). Please be aware that under Title IX of the Education Amendments of 1972, **it is required to disclose information about such misconduct** to the Title IX Office.

If you wish to speak to a confidential employee **who does not have this reporting responsibility**, you can contact Counseling Services at [counselingservices@pointloma.edu](mailto:counselingservices@pointloma.edu) or find a list of campus pastors at [pointloma.edu/title-ix](http://pointloma.edu/title-ix)

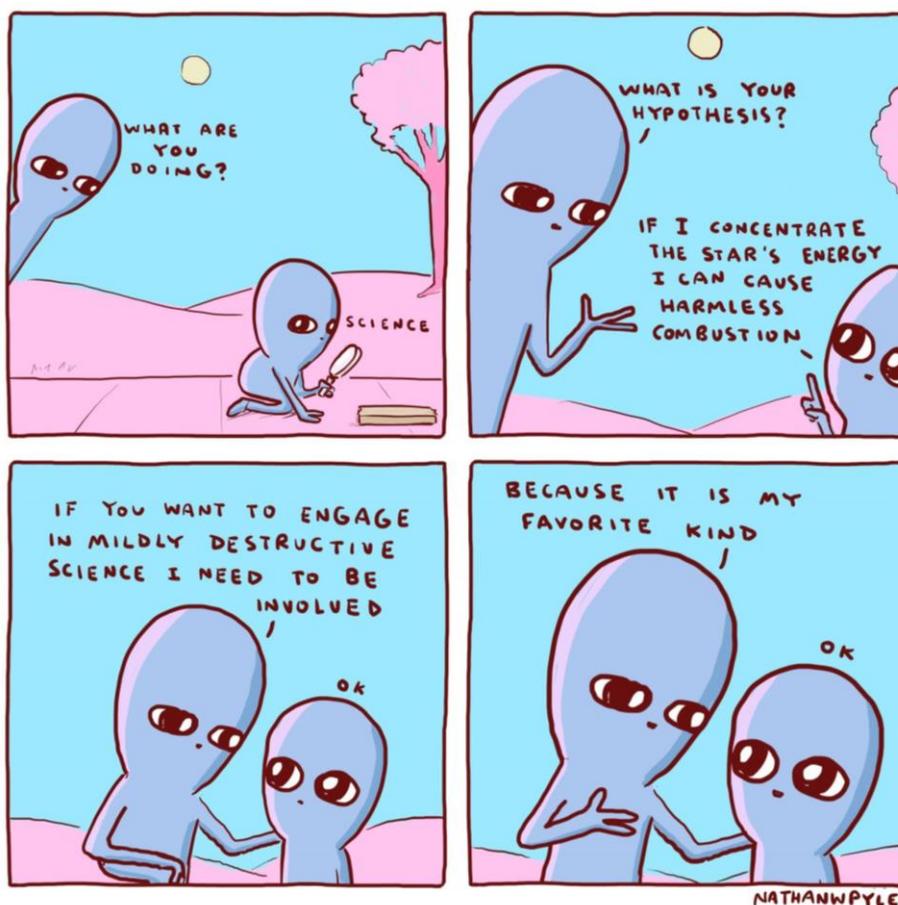
**Spiritual care:** PLNU strives to be a place where students grow as whole persons. To this end, we provide resources for our students to encounter God and grow in their Christian faith.

If you have questions, a desire to meet with the chaplain, or if you have prayer requests, you can contact the [Office of Student Life and Formation](#).

**State authorization:** State authorization is a formal determination by a state that Point Loma Nazarene University is approved to conduct activities regulated by that state. In certain states outside California, Point Loma Nazarene University is not authorized to enroll online (distance education) students. If a student moves to another state after admission to the program and/or enrollment in an online course, continuation within the program and/or course will depend on whether Point Loma Nazarene University is authorized to offer distance education courses in that state. It is the student's responsibility to notify the institution of any change in his or her physical location. Refer to the map on [State Authorization](#) to view which states allow online (distance education) outside of California.

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**CHE 3027: Physical Chemistry II LAB: Tentative schedule**

The schedule may change during the semester. Watch Canvas for updates.

Dates (T/R)	Lab	Due dates (11:59pm)
Aug. 29/31	0: Math Workshop	
Sep. 5/7	1: Photoelectric Effect	
Sep. 12/14	No experiment: Analysis and writing	Sep. 15: Exp. 1 Preliminary Results
Sep. 19/21	2: Conjugated Dyes	Sep. 22: Exp. 1 Lab Report
Sep. 26/28	No experiment: Analysis and writing	
Oct. 3/5	No experiment: Analysis and writing	Oct. 6: Exp. 2 Preliminary Results
Oct. 10/12	3: Roto-vibrational Spectra	Oct. 13: Exp. 2 Lab Report
Oct. 17/19	No experiment: Analysis and writing	
Oct. 24/26	No experiment: Analysis and writing	Oct. 23: Exp. 3 Preliminary Results Oct. 27: Exp. 3 Lab Report
Oct. 31/Nov. 2	4a: Computational Chemistry, Part 1	
Nov. 7/9	No experiment: Analysis and writing	Nov. 10: Exp. 4 Preliminary Results <i>Lab Report due after Part 2</i>
Nov. 14/16	5: Fluorescence	
Nov. 21/23	No experiment: Analysis and writing	
Nov. 28/30	4b: Computational Chemistry, Part 2	Nov. 27: Exp. 5 Preliminary Results Dec. 1: Exp. 5 Lab Report
Dec. 5/7	No experiment: Analysis and writing	Dec. 8: Exp. 4 Lab Report