

# Intermediate Laboratory I: Chem 341

Fall 2018

Syllabus



## General Information

Professor: Dr. Robert Granger

Meeting times: Tuesday & Thursday 12:30 – 4:50 pm

Corequisite or Prerequisite: Chemistry 331 (or any 300-level course in chemistry with permission)

This course is an integrated, project-oriented laboratory. Lab work in physical chemistry, biochemistry, inorganic, advanced organic chemistry, and instrumental analysis is included.

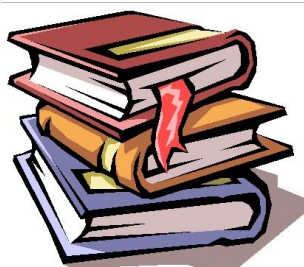
*Chemistry 341 is a writing intensive course.*

In addition to the development of laboratory skills, an objective of this course is to teach students how to keep a professional laboratory notebook, how to write formal lab reports, how to write a proper abstract and how to write-up results in a manner consistent with a professional journal submission. Students will learn to use computer software to aid in the writing of their reports. Additionally, students will be expected to observe industry standards in HAZMAT handling, disposal and labeling. Any violations in safety procedures will result in a reduction in the students grade for that lab.

Students should purchase **two** laboratory (composition-style) notebooks. I prefer graph ruled but it is not a requirement.



Useful references for the course:



1. Carl W. Garland, Joseph W. Nibler, and David P. Shoemaker, *Experiments in Physical Chemistry, Eighth Edition* (McGraw-Hill, Boston, 2008).
2. R. Granger, H Yochum, K. Seinerth & J. Granger, *Instrumental Analysis, 1<sup>st</sup> Ed. (Rev.)* (Oxford, 2016).
3. H. M. Kanare, *Writing the Laboratory Notebook* (American Chemical Society, Washington, D. C., 1985).
4. Karin Knisely, *A Student Handbook for Writing in Biology* (Freeman, 2009).
5. John H. Moore, Christopher C. Davis, Michael A. Coplan, and Sandra C. Greer, *Building Scientific Apparatus: A Practical Guide to Design and Construction, Fourth Edition* (Cambridge University Press, 2009).
6. The ACS Style Guide: Effective Communication of Scientific Information (An American Chemical Society Publication) 3rd Edition by [Anne M. Coghill](#) (Editor), [Lorrin R. Garson](#) (Editor) 2006. A 30% discount is available if you order direct from Oxford. <https://global.oup.com/academic/product/the-acs-style-guide-9780841239999?cc=us&lang=en&promocode=25534>. Use of the 2<sup>nd</sup> edition is acceptable however the 2<sup>nd</sup> ed. does not contain conventions for citing on line resources.

# Experiment List, Lab Report Due Dates, and Grade Weighting

The Grade Weighting for the course (on the schedule) is based on the number of lab periods with each lab period counting roughly as 1/24<sup>th</sup> (4.2%) of the course.

In addition to the student's written work, 5% of the course grade will be subjectively determined by the Instructors as a reflection of observed student behaviors in three major categories: safety, independence, and preparation. Students who need to be reminded about safety issues, students who waste lab time, students whose work is off-task, students who come to lab ill-prepared for class, and so forth will receive low grades in this category.

Unless stated otherwise, lab reports and lab notebooks are **due** at the beginning of lab on the due date.



## Late Policy

If there is sufficient reason, a student may – IN ADVANCE - request an extension of 1 to 5 days with the instructor's permission. For an extension to be granted *without penalty*, a rough draft will be required as evidence that the work is in progress. In no case will an extension of more than 5 days be granted without an applied penalty, unless there is an emergency and in which case the Dean's Office will be involved in making appropriate accommodations.

Unexcused late reports and/or notebooks will be downgraded according to this policy:

Unexcused Delay	Penalty	Example of how this could affect the grade for the assignment
1 day late	5% penalty	A drops to B+ B+ drops to B- C drops to D+
2 days to 5 days late	an additional 3% per day, up to 17% penalty	A drops to B- B+ drops to C C drops to D-
More than 5 days	Assignments will not be accepted	F

## WEEKEND DAYS COUNT!

### Example

Thursday Assignment is due	Friday Assignment is turned in @ 5% penalty	Saturday Assignment is turned in @ 8% penalty (5+3)	Sunday Assignment is turned in @ 11% penalty (5+3+3)	Monday Assignment is turned in @ 14% penalty (5+3+3+3)	Tuesday Assignment is turned in @ 17% penalty (5+3+3+3+3)
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\* Missing a lab will cost you a +/- letter grade for the semester.

# Professional Laboratory Notebook

DO NOT TAKE NOTES IN LAB USING SCRATCH PAPER! All laboratory work must be documented in real time and directly into your notebook. In a professional chemistry lab, the laboratory notebook becomes part of the evidence submitted during a patent application and the notebook can become evidence during a patent defense. Students are expected to keep a professional laboratory notebook. This is an essential part of this course. Students who do not bring their laboratory notebook to lab will be sent away to fetch it and will be counted as late for class. Students who do not use their laboratory notebook in lab will be downgraded on their student behaviors grade, up to 5% for the course. Additional penalties will be applied on the notebook and/or report grade. NO reminders will be given.

## Setting Up and Using a Lab Notebook

- The first thing you should do when you obtain your bound notebook is to label the spine and front cover.

### Example:

Daisy Fletcher Williams

Chem 341 – Intermediate Laboratory I, Fall 2018

- Number each page starting with page 1.
- Set up the first two pages of the notebook as the table of contents for the notebook (Book ToC). The Book ToC will list each experiment that is in the notebook, and the pages on which each of these experiments can be found, in table format. You can actually set this page up using the lab schedule provided.
- Reserve the left-hand pages of the notebook for scratch work or for the pasting of computer generated figures, spectra, or graphs. These “pastings” should be done with clear tape and all edges should be tapped down.
- The notebook should be kept in ink and be tidy with organized, well-labeled entries. Writing should be clear and concise. *You will be graded in part on writing!*
- Pages should *never* be removed from your lab notebook.

## **Notebook Entries for Each Experiment or Project**

- Table of Contents for the experiment (ToC). Reserve the first few pages for *each experiment* or project for a ToC for that experiment. The experiment ToC will be filled in once the experiment is completed using topic headers and page numbers (vide infra). This will allow you flexibility in your organization and flexibility in how you enter information into your notebook.

## Basic Information on Each Page

Each page in your notebook should include the following (see *Figure 1*):

- Title of the experiment (as left header).
- Page number (as right header).
- *Topic header* for each section recorded on the page. (Examples include prelab notes, data, calculations, results and conclusions, daily summary, introduction, experimental plan, etc.)
- Date the entry was made (at bottom of page).
- Your signature or initials, and the signature of any witnesses (at bottom of page)

New Tech/Old Tech	p. 33
<u>Data:</u> Evolution of CO <sub>2</sub> gas vs. time	
<u>Observations:</u> Blah, blah, ...	
<u>Calculations:</u> $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$	
1/21/2018, (signature of) Many Jones	
Signature of Witness:	
<b>Figure 1.</b> Example of Basic Information	

- Prelab notes (from any prelab lecture) should be entered in your lab notebook. Very often you will find that a detailed set of prelab notes is invaluable in carrying out the experiment and writing up your report.
- Entry of Data and Observations. Above all else, remember that your lab notebook should be an accurate record of what is observed in the lab. Entries should be made as the experiment progresses. All raw data obtained at the bench should be entered *directly* in your lab notebook or in a dated computer spread sheet *simultaneous with observation*. *Never* record data on scraps of paper or as scratch work in your lab notebook or elsewhere! *Never* use “white-out” or erase raw data entries in your lab book. If you make an error in your raw data, cross out the erroneous entry with a thin line, make your correction above the crossed-out entry, and explain briefly in the margin the reason for the change in raw data.
- Daily Summary. At the end of each lab period (the last 10 minutes), you should mark off a section in your notebook and write down a summary of what you accomplished for that lab: what goals you met, and what you will need to accomplish (if anything) during the next lab. This section is a note to yourself. If done correctly, this section will allow you to quickly get up to speed in the next lab session.

Example of a daily summary:

Collected the NMR spectrum of unknown #1.

Still need to analyze NMR spectrum and obtain the IR and UV-vis

- Calculations and Analysis. Students are expected to begin their calculations and the analysis of their data *while the experiment is underway* and complete the analysis *immediately after* finishing each experiment so that they have time to meet with the appropriate faculty member to go over any questions that may arise. Your data should “make sense.” The calculations and/or analysis should be entered in your lab notebook.
- Annotations. Comments on unexpected results, problems, successes, and so on are characteristic of a good lab notebook.
- Edits. If you need to add a note to a notebook entry from a previous day, use a different color pen and initial and date the entry.

Labeling Chemical Samples. Chemical Samples synthesized during the course of the semester **MUST** be labeled and the label should be correlated to your notebook. A consistent code will be adopted that will allow anyone who finds an orphaned sample to trace its entire history. In addition to this code, any other information you wish to include on the sample label is fine.

Example: If Mary Jones synthesizes a chemical compound on September 10, 2018 and she records the pertinent information on page 33 of notebook #2, then Ms Jones' label for the compound should indicate that it is Ms Jones' compound, the particular notebook in which the sample is described, the number of the page on which the description can be found, and the date. An acceptable label would be...

M. Jones B2, P33, 9/10/18

Additional Information is acceptable and often preferable but not legally required. For example, in addition to the above label, Mary might add a chemical formula, name or state of purity. This additional information is not required but can be very useful.

M. Jones B2, P33, 9/10/18

$[\text{Fe}(\text{Cp})_2]\text{Cl}_2$  recrystallized from ether

### Filling in the Experimental Table of Contents (ToC)

NOTE: The ToC is filled in **after** the experiment is complete.

Your final task for each experiment is to fill in your ToC on the first few pages of your entries for the experiment (see *Figure 2*).

New Tech/Old Tech	p. 28
<u>Table of Contents</u>	Page #
1. Prelab Notes	29, 32
2. Introduction/Objective	29-31
3. Observations	31,32,35
4. Data	31, 33, 35
5. Calculations	31, 32, 33, 36
6. Daily Summary	33, 35
7. Results and Conclusions	34, 36

1/21/2018, (signature of) Many Jones  
Witnessed by: (signature of) Susie Sweet Briar

**Figure 2.** Table of Contents for Experiment

### REMINDERS.

A notebook that is a continuum of scribbles and scrawls from cover to cover will waste your time and confuse you when you try to locate information for your write-ups and oral reports.

No single system for setting up your notebook will work in all situations so **adopt a flexible attitude.** Get comfortable using topic headers to add information into your notebook. You can organize your notebook later when you construct the ToC. This will allow you to add information directly into your notebook in real time.

Your notebook is a record of your scientific work. If it is unintelligible to a reviewer (your lab instructor) then it is as if you never did the work in the first place.

Get started on your laboratory report **WHILE YOU ARE IN LAB.** Do not wait until the experiment is

complete to get started on your report. By drafting the report simultaneously with carrying out the experiment, you will save time and confusion. Drafts of your report can be done in pieces and are essentially a compilation of your *Results and Conclusion* topic headers.

## Laboratory Reports

A *formal* report will be turned in for each lab. Mark the due dates into whatever personal organizer tool you use. I keep my google calendar synched to my phone and you are encouraged to use whatever tool works best for you.



In this course one of our teaching objectives is to train you to write in the style of a chemical journal submission. We will follow the guidelines for the *Journal of the American Chemical Society*. A word template for a JACS paper is available on line ([http://pubs.acs.org/page/jacsat/submission/jacsat\\_templates.html](http://pubs.acs.org/page/jacsat/submission/jacsat_templates.html)) and is recreated on the following pages for your convenience. You have free access to all ACS journals however the password is tied to the I.P. addresses of the 2<sup>nd</sup> floor Guion computers. You must come to Guion or go through the Library website to access these journals. Additionally, several copies of ACS journals have been included with this syllabus as examples. You should study these articles for style and construction conventions.

# Template for Submission of Manuscripts to American Chemical Society Journals

## Word 2010, Column Wide Abstract Version

This template is a guide to be used to prepare manuscripts for submission. Please consult the Instructions to Authors or a recent issue of the journal for detailed guidelines and procedures for submission. This template is intended to benefit to the author in that the entire manuscript (text, tables, and graphics) may be submitted in one file. Inserting graphics and tables close to the point at which they are discussed in the text of the manuscript can also be a benefit for the reviewer.

When you submit a manuscript using this template, you will not actually see the page formatting that appears in the printed journal. This will occur as part of the editorial production process. Abbreviated instructions for using the template follow. Consult the documentation for your specific application and version for more information. Additional instructions can be found in the readme file at the web page where you downloaded this template.

### Using the template

In ACS publications there are many different components of a manuscript (i.e., title, abstract, main text, figure captions, etc.) that are represented in the template. See the Guide, Notes, Notice, or Instructions for Authors on the journal's homepage to determine which parts should be included for the manuscript that you are preparing

1. If typing your manuscript directly into the template, select (highlight) the text of the template that you want to replace and begin typing your manuscript (i.e., select the Title section for typing in your title).
2. If you have already prepared your document in a Word file, you will need to attach the template to your working document in order to apply the Word Style tags. Further instructions can be found in the readme file at the web page where you downloaded this template.
  - a. Go to the Word Style list on the formatting toolbar and you will see all the Word Styles from the template that has now been imported into the current document. A Styles toolbar has been generated that will display the different Styles for you to choose from. If this is not present, select **View, Toolbars**, and then select **Styles** and it should appear. You can close this at any time and then reopen it when needed.
  - b. Click in the sentence or paragraph and then go to the Word Style menu on the toolbar and select the relevant Word Style. This will apply the Word Style to the entire text (sentence or paragraph). Do this for all sections of the manuscript.
3. To insert graphics within the text or as a figure, chart, scheme, or table, create a new line and insert the graphic where desired. If your graphic is not visible, ensure that the Word Style is "Normal" with an automatic height adjustment. If the size of the artwork needs to be adjusted, re-size the artwork in your graphics program and re-paste the artwork into the template (maximum width for single-column artwork, 3.3 in. (8.5 cm); maximum width for double-column artwork, 7 in. (17.8 cm)). **NOTE:** If you are submitting a Table of Contents graphic, please insert the graphic at the end of the file.
4. Ensure that page numbers are present on all pages before submitting your manuscript.
5. Delete these instructions and any sections that are not needed.
6. Save the file with the graphics in place: select **Save As (File menu)** and save it as a document file (not a .dot template file).
7. Proof the manuscript to ensure that all parts of the manuscript are present and clearly legible.

**TITLE (Word Style "BA\_Title").** The title should accurately, clearly, and concisely reflect the emphasis and content of the paper. The title must be brief and grammatically correct. The space above the title is provided for the Journal logo. Do NOT delete this space.

**AUTHOR NAMES (Word Style "BB\_Author\_Name").** Include in the byline all those who have made substantial contributions to the work, even if the paper was actually written by only one person. Use first names, initials, and surnames (e.g., John R. Smith) or first initials, second names, and surnames (e.g., J. Robert Smith). Do not use only initials with surnames (e.g., J. R. Smith) because this causes indexing and retrieval difficulties and interferes with unique identification of an author. Do not include professional or official titles or academic degrees. At least one author must be designated with an asterisk as the author to whom correspondence should be addressed.

**AUTHOR ADDRESS (Word Style "BC\_Author\_Address").** The affiliation should be the institution where the work was conducted. If the present address of an author differs from that at which the work was done, indicate with a symbol and give the Present Address under Author Information. If more than one address, use symbols to match author names to address(es).

### *Supporting Information Placeholder*

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**ABSTRACT:** (Word Style "BD\_Abstract"). All manuscripts must be accompanied by an abstract. The abstract should briefly state the problem or purpose of the research, indicate the theoretical or experimental plan used, summarize the principal findings, and point out the major conclusions. Abstract length is one paragraph.

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**TEXT (Word Style "TA\_Main\_Text").** For full instructions, please see the journal's Instructions for Authors. Do not modify the font in this or any other section, as doing so will not give an accurate estimate of the formatting for publication and final length of the paper.

**FIGURES (Word Style "VA\_Figure\_Caption").** Each figure must have a caption that includes the figure number and a brief description, preferably one or two sentences. The caption should follow the format "Figure 1. Figure caption." All figures must be mentioned in the text consecutively and numbered with Arabic numerals. The caption should be understandable without reference to the text. Whenever possible, place the key to symbols in the artwork, not in the caption. To insert the figure into the template, be sure it is already sized appropriately and paste before the figure caption. For formatting double-column figures, see the instructions at the end of the template. Do NOT modify the amount of space before and after the caption as this allows for the rules, space above and below the rules, and space above and below the figure to be inserted upon editing.

**SCHEMES (Word Style "VC\_Scheme\_Title").** Groups of reactions that show action are called schemes. Schemes may have brief titles describing their contents. The title should follow the format "Scheme

**1. Scheme Title".** Schemes may also have footnotes (use Word Style "FD\_Scheme\_Footnote"). To insert the scheme into the template, be sure it is already sized appropriately and paste after the scheme title. For formatting double-column schemes, see the instructions at the end of the template. Do NOT modify the amount of space before and after the title as this allows for the rules, space above and below the rules, and space above and below the scheme to be inserted upon editing.

**CHARTS (Word Style "VB\_Chart\_Title").** Groups of structures that do not show action are called charts. Charts may have brief titles describing their contents. The title should follow the format "Chart 1. Chart Title". Charts may also have footnotes (use Word Style "FC\_Chart\_Footnote"). To insert the chart into the template, be sure it is already sized appropriately and paste after the chart title. For formatting double-column charts, see the instructions at the end of the template. Do NOT modify the amount of space before and after the title as this allows for the rules, space above and below the rules, and space above and below the chart to be inserted upon editing.

**TABLES.** Each table must have a brief (one phrase or sentence) title that describes its contents. The title should follow the format "Table 1. Table Title" (Word Style "VD\_Table\_Title"). The title should be understandable without reference to the text. Put details in footnotes, not in the title (use Word Style "FE\_Table\_Footnote"). Do NOT modify the amount of space before and after the title as this allows for the



**space above and below the table to be inserted upon editing.**

Use tables (Word Style "TC\_Table\_Body") when the data cannot be presented clearly as narrative, when many precise numbers must be presented, or when more meaningful interrelationships can be conveyed by the tabular format. **Do not use Word Style "TC\_Table\_Body" for tables containing artwork.** Tables should supplement, not duplicate, text and figures. Tables should be simple and concise. It is preferable to use the Table Tool in your word-processing package, placing one entry per cell, to generate tables.

**Displayed equations** can be inserted where desired making sure they are assigned Word Style "Normal". Displayed equations can only be one column wide. If the artwork needs to be two columns wide, it must be relabeled as a figure, chart, or scheme and mentioned as such in the text.

## **ASSOCIATED CONTENT**

### **Supporting Information**

(Word Style "Section\_Content"). A brief statement in nonsentence format listing the contents of material supplied as Supporting Information should be included, ending with "This material is available free of charge via the Internet at <http://pubs.acs.org>." For instructions on what should be included in the Supporting Information as well as how to prepare this material for publication, refer to the journal's Instructions for Authors.

## **AUTHOR INFORMATION**

### **Corresponding Author**

(Word Style "Section\_Content"). Give contact information for the author(s) to whom correspondence should be addressed.

### **Present Addresses**

(Word Style "Section\_Content"). †If an author's address is different than the one given in the affiliation line, this information may be included here.

### **Author Contributions**

(Word Style "Section\_Content"). ‡These authors contributed equally. (match statement to author names with a symbol, if applicable)

### **Notes**

(Word Style "Section\_Content"). The authors declare no competing financial interests. Any additional relevant notes should be placed here.

## **ACKNOWLEDGMENT**

(Word Style "Section\_Content"). Generally the last paragraph of the paper is the place to acknowledge people (dedications), places, and financing (you may state grant numbers and sponsors here). Follow the journal's guidelines on what to include in the Acknowledgement section.

## **REFERENCES**

(Word Style "TF\_References\_Section"). References are placed at the end of the manuscript. Authors are responsible for the accuracy and completeness of all references. Examples of the recommended formats for the various reference types can be found at <http://pubs.acs.org/page/4authors/index.html>. Detailed information on reference style can be found in The ACS Style Guide, available from Oxford Press.

SYNOPSIS TOC (Word Style "SN\_Synopsis\_TOC"). If you are submitting your paper to a journal that requires a synopsis graphic and/or synopsis paragraph, see the Instructions for Authors on the journal's homepage for a description of what needs to be provided and for the size requirements of the artwork.

To format double-column figures, schemes, charts, and tables, use the following instructions:

Place the insertion point where you want to change the number of columns

From the **Insert** menu, choose **Break**

Under **Sections**, choose **Continuous**

Make sure the insertion point is in the new section. From the **Format** menu, choose **Columns**

In the **Number of Columns** box, type **1**

Choose the **OK** button

Now your page is set up so that figures, schemes, charts, and tables can span two columns. These must appear at the top of the page. Be sure to add another section break after the table and change it back to two columns with a spacing of 0.33 in.

**Table 1. Example of a Double-Column Table**

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8

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Authors are required to submit a graphic entry for the Table of Contents (TOC) that, in conjunction with the manuscript title, should give the reader a representative idea of one of the following: A key structure, reaction, equation, concept, or theorem, etc., that is discussed in the manuscript. Consult the journal's Instructions for Authors for TOC graphic specifications.

Insert Table of Contents artwork here

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## Writing

- Make good writing a habit! From the course Canvas site, download the handout entitled “Guidelines for Assessing Writing Skills” for some characteristics of good writing. You will be graded in part on your writing.
- Be extremely careful in ***your choice*** of words. Incorrect use of vocabulary words will cause you to lose points on your reports. Check to be sure you are really communicating what you intend! The language of science is quite specific, terse and dense. Proof read your work multiple times and ask yourself the following question... “could another chemist who was not familiar with this lab, recreate this work?” A major cause of bad writing is incomplete understanding of the concepts and how language is used to describe them. Good writing should be clear, logical, and concise. If your instructor gives you feedback such as “rephrase,” you need to work much harder on your writing. You may want to go to the ARC to get assistance.
- Use the past tense when describing your lab work and the results you obtained (i.e., “Analysis of the kinetic data indicated that the reaction was first-order.”). Scientific laws and theories may be described using the present tense (i.e., “Beers Law states ...”). The pronouns “I” “we” or “us” should never appear in a scientific journal. If you feel you must use a personal pronoun the only acceptable choice is “one” however it is best to rephrase the sentence to avoid the use of personal pronouns.
- Proofread your work. Rewrite sections to eliminate repetitively redundant and superfluous<sup>1</sup> phrasing, awkward transitions, sentence fragments, run-on sentences, and non-parallel construction. Use spell-checking software to catch spelling errors.

## Laboratory Schedule

A detailed *Laboratory Schedule* for the semester is given in a separate document (available on line). Students will be working individually.

## Individual Projects

During the designated weeks in the second half of the semester, each student will complete an individual project. Faculty advisors for the projects will be assigned, as much as possible, to accommodate student interests. Our goal is to give students the maximum possible breadth of experience in chemistry. Each student will submit her top choices for projects. These should include at least one project under each of the faculty members in the department.

Students will turn in a well-referenced *formal report* on their project, and will also give an *oral report*.

## Oral Reports

While oral reports are not a major focus of Chemistry 341 (as they are in Chemistry 342), students will give a formal oral report on their individual project with appropriate audiovisual aids. An *Abstract* of the talk is required (see below). Consult the faculty concerning choice of material for presentation and for advice on the

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<sup>1</sup> For example, this sentence ☺

use of *PowerPoint*.

## Abstracts

A power point presentation on how to write a good abstract is available on the Canvas site. A written *Abstract* is required for each formal report and for the oral presentations. The *Abstract* should be handed out to all students and faculty in the course **at the time the oral report is given**. The *Abstract* should include the following:

- *Title, date, and your name.*
- *A summary of the work accomplished with references.* This should be one-half page in length (two-thirds page single-spaced is the absolute maximum!). Here we assume you will use similar spacing and fonts to those we use in this handout (*Times* or *Times New Roman* 12-point font with single line spacing)!
- *Reference list* (numbered in order of citation).

## Computer Software

*Microsoft Word* is the recommended program for word processing, and *Microsoft Excel* for mathematical processing of data, preparing graphs, and doing least squares fits. Learn to use these programs! They will really save you time! Both programs are available on most of the computers in Guion (both on the Macs and the PCs).

Be sure to learn how to construct tables and use the equation editor in *Microsoft Word*. Consult the faculty if you are new to this. See the link to “Microsoft Word ‘Extras’ for Chemists” which you can download off the Course’s Canvas Site.

*Excel* has a helpful tutorial entitled *Learning Microsoft Excel*, which is highly recommended for inexperienced users. A handout, which is useful for doing least squares fits, is available from the link “How to do Least Squares Fits with Microsoft Excel” on the Course Canvas Site.

Other useful programs are *PowerPoint* (for giving presentations), *ChemDraw* (for drawing chemical structures) and *Mathematica* (for all types of mathematics). Consult the faculty to find out which computers have this software. *ChemDraw* has an excellent tutorial.

## Accommodations for Learning Differences

If you have a documented LD, contact your Professors at the beginning of the semester. You will also need to provide documentation to the Dean’s Office to obtain appropriate accommodation.

## Grades

Letter grades (A, A-, B+, B, B-, etc.) will be given on each lab report and for the final oral report. They will be averaged on a 4.0 scale (like your college GPA) and weighted as specified in the schedule.

## Grading Criteria

### Characteristics of Grade “A” Work

- Student arrived on time for lab and was prepared to begin lab work without delay.
- Experimental expertise was evident: careful technique was used, and initiative, creativity, and tenacity were apparent when problems arose. Student was enterprising about finding background references, resolving experimental problems, asking questions, and scheduling her lab work.
- Efficient use was made of lab time, and good lab “housekeeping” was followed. If group work was involved, the team worked well together with everyone contributing.
- Data was entered in the laboratory notebook (see above) simultaneous with observation. Data was entered in tabular form whenever possible. Explanations were given when data was crossed out. Items were well-labeled and appropriate units were affixed.
- Student gave thought to results, *as they were being obtained*, and worked to find problems as they were occurring.
- Calculations were clearly presented and easy to follow.
- The lab report guidelines were carefully followed.
- Yes, we mean it! The lab report guidelines were carefully followed!
- Report was well written, and appropriate material was included in all sections. Writing was clear and concise, and arguments were carefully phrased and presented in a logical order. Attention was given to both accuracy and style.
- If unexpected results were obtained, the student made an obvious effort to find out why. Was some of the raw data incorrect due to student error or instrument malfunction, was the experimental design faulty, or were the original expectations incorrect?

### Characteristics of Grade “B” Work

Work was completed, for the most part, as required for a grade of *A*. However, *one* of the following applied:

- Work was unsatisfactory in one area above.
- Work was mediocre in several areas above.
- There were lots of small problems throughout the report and/or in the way the lab was carried out.
- Report was poorly written, but was excellent in all other respects.

### Characteristics of Grade “C” Work

Work was completed, for the most part, in a satisfactory manner. However, there were a number of omissions, the report was generally sloppy and showed insufficient thought.

### Characteristics of Grade “D” Work

Work was completed, but was unsatisfactory in a number of respects.

## Oral Reports

### Characteristics of Grade “A” Presentation

- The presentation was well-organized with a good introduction, middle, and conclusion. The presentation told a complete story, and the beginning and end (but not necessarily the middle) of the talk would be comprehensible to the educated non-scientist.

- The use of visual aids was excellent and appropriate to the topic. The student did not simply “read” material from audiovisual aids. She used *PowerPoint* and/or transparencies to show chemical structures, to give equations for chemical reactions, to present data, and to highlight points to be discussed.
- The student appeared to be in command of the material, and was able to answer reasonable questions from the audience.
- The speaker’s voice was audible. She established eye contact with everyone in the audience, and got them interested in her subject. The presentation was well-rehearsed, and the speaker did not simply “read” the talk from prepared text.
- She showed up for class on time, and was prepared and ready to start her talk when the audience was seated.

Lower Grades

See general rationale given above.