Basics of Scientific Writing

A good technical writer is concise yet descriptive and does not confuse the reader by packing too much information into one sentence. Publication in any journal requires the authors to follow strict guidelines. It is unlikely that a paper will be accepted for publication if the provided guidelines are not followed. This document is designed to help students get started with proper technical writing skills. A significant portion of each lab report grade is devoted to proper writing, neatness, and organization (10-20%). Carefully review the guidelines for each section of the lab report.

Part A: Attention to Detail

- Choose one font, one font size, and stick to it (suggested Arial or Times New Roman, font size 10-12), except for changes to font size for headings. Otherwise, there are no specific font or document setting requirements for 108 lab reports.
- Use spell-check then have a human read it for anything spell-check may not catch (especially chemical names).
- Use subscript and superscript where appropriate (H_2O not H2O or worse H20; cm^2 not cm2).
- Give tables proper titles and headings. Tables should not span over two pages (get it on one).
- Avoid casual language. Words like “whatever” and “kinda” do not belong in technical documents!

Small mistakes can have a big impact on the impression of the author. Carefully read each sentence below, indicate each mistake, and re-write the sentence properly.

1) The procedure for this experiment can be find on 40 and 41 of the attached lad notebook pages.

2) The results in this experiment show the different colors that can be obtained bye dying the fabrics.

3) The solution was kind of blue-ish.

4) Sodiun dithionite (Na_2S207) was the oxidizing agent.

Part B: Writing in the passive voice

Science writing, particularly technical writing, is unlike expository writing in that the passive voice is usually preferred in technical science writing. The passive voice enables the writer to maintain an objective stance when describing the purpose, procedure, results, and conclusions in an experiment. Objectivity can also be conveyed by avoiding the use of possessive pronouns like I, we, our, my, etc. **Past tense is used except when stating facts, which are in the present tense.**
For example, *"Limonene eluted first from the column, indicating that it is less polar than carvone."*

Each example below contains far more words or information than necessary, not to mention inclusion of personal pronouns and unprofessional writing style. Carefully read, indicate the errors, and re-write the sentences properly.

1) The whole meaning of this lab is determining the percent yield of the reaction and looking for the synthesis of indigo.

2) To begin the synthesis we had to place o-nitroben aldehyde into a beaker and add water and acetone into it. We used a magnetic stirring bar to stir it while we added NaOH solution. After a certain time we waited for it to cool inside an ice bath them remove it and drop it inside a Buchner funnel.

3) The following are two different incorrect ways of writing the results sentence in a chemical synthesis. Reconstruct these sentences into one using the following format:
"(Chemical name) was isolated as a (description of product) (xx mg, xx % recovery)."

"The actual yield of the blue indigo dye for this experiment was about 0.7 grams or about 70% of what was supposed to be yielded."

"For the percent yield of this reaction we ended up with 70% of indigo synthesized, and the mass was 0.7 g."

5) "Based on how it came out for me, I made plenty of mistakes so it did not come out the way I had hoped."

6) "Me and my lab partner found that the beaker was the least accurate because the % error was the highest out of all of the glasswares at 27%."

Part C: The Abstract

The abstract is an especially concise description of the experiment. It should briefly state the purpose of the experiment, including the experimental purpose to the learning objectives. The abstract should include a brief synopsis of the general experimental procedure (without using specific amounts or sizes of glassware), as well as a statement about the primary results and conclusions. **This can typically be accomplished in *four-six* brief sentences.** Use the following to gather the content of the abstract then construct concise, grammatically correct sentences to convey this information.

Use the Experiment 1 handout, the instructions below, and the sample data on the next page to write a concise, grammatically correct abstract for the first experiment.

Carefully read the full lab handout (including introduction and procedure) before you begin.

Purpose
What was the experimental purpose? This is typically, but not always, found in the experiment title. What were the primary learning objectives? These would be new techniques, principles, or reactions observed. Begin the abstract with the following:

"The purpose of this experiment was to (experimental purpose) so that (learning objectives)."

Procedure
This is the most challenging section to keep short but it is possible to convey the procedural guidelines in **2-3 sentences. Avoid run-on sentences!** Include the chemicals and techniques used. Do not include equipment unless it is significant to the outcome of the experiment (microcolumn, GC, TLC, etc.).

Results
Report the final result or results. Refer to the in-lab questions for guidance and decide on only the most important information to present to the reader (this will not be every result). Use one to two complete sentences to state the result(s) in words and numbers in parentheses with units.

Conclusion
How successful was your experiment? Were the results as expected? Do not assume the reader knows the expected result. This is not the place for emotions – avoid phrases like "I think the results were good"! Keep it factual and use only one sentence. The following are two suggested ways to begin the conclusion sentence.

"The experiment was successful / not successful based on…"
"The results were as expected / not as expected based on…

Work alone **to write the abstract, keeping each section separate (purpose, procedure, results, conclusion) and bring it to the TA. He or she will provide feedback and likely send you back for a re-write. *You cannot leave the lab until your TA approves of your abstract.* It is in your best interest to stay not only because this is page worth 2% of your grade, but also because the abstract is worth 10% of the lab report!**

Isolations and GC Analysis of Citrus Oils - Sample Data

You will use some, but not all, of this data to construct the abstract.

Mass of orange peels: 150.00 g

Distillation temperature

Temperature at first drop: 95 °C

Temperature at last drop: 100 °C

Approximate volume of citrus oil – 3.2 mL

Mass of citrus oil – 2.88 g

There should be copies of GC chromatograms available for students to practice measuring retention times and integration. Report your findings in the tables below. This data is for practice and the writing exercise only. Use your own data from the GC chromatograms you obtain in your report.

Table 1. Standard GC Retention times

Sample	**Corrected t_R (s)**
α-pinene standard	
β-pinene stnd.	
Limonene stnd.	
γ-terpinene stnd.	

Table 2. GC Analysis of Citrus Oil

Peak #	**Peak ID**	**Corrected t_R (s)**	**Integration (cm^2)**	**% Composition***
1	α-pinene			
2	β-pinene			
3	Limonene			
4	γ-terpinene			

Part D: Experimental Methods and Compound Characterization

Experimental methods and compound characterization are found at the end of scientific journal articles, dissertations, and other technical documents to give the reader instructions on how to recreate the experiment and confirm the structure of the newly synthesized compounds. The format and general content differs depending on the field. Students will include this section at the end of several lab reports using the generally accepted guidelines followed by synthetic organic chemists: one General Methods paragraph followed by one additional paragraph per compound synthesized. A sample Experimental Methods section is provided on eCommons and contains much more information than 108 students are expected to include. *Use passive voice and past tense.*

General Methods

Reagents and by-products do not get full descriptions but are mentioned in the "General Methods" section with the following statement: "All reagents were commercially available, unless otherwise stated." Typically researchers would then describe how reagents and solvents were purified, but this does not apply to 108L/M students. Next, define the abbreviations and list the specifications for NMR (MHz of instrument) and IR (medium for analysis, such as salt plates or Teflon) if used in the experiment.

Experimental Methods

Following general methods, each organic compound or reaction gets its own paragraph (one paragraph per reaction/compound). Depending on the forms of analysis available to students (based on experimental techniques as well as spectra provided), some or all of the following should be included in the experimental methods and compound characterization section.

- Reaction scheme - including reactants, reagents, products, solvent(s), and % yield
  (structures and reaction schemes can be hand-written
- **Full chemical name of product in bold** (common and/or IUPAC)
- Brief description of reaction set up and workup including…
  - Names and amounts of each reactant and reagent (mmol and mL or mg)
  - Name and amount of solvent (mL)
  - Order of addition, if pertinent, and reaction conditions (time, temperature)
  - Description, name, and amount of product obtained and % yield:
    - Ex. "Benzhydrol was obtained as a clear liquid (1.00 g, 87% yield)."

Characterization follows in the same paragraph (after reporting the yield) and includes some or all of the following.

- Melting point or boiling point
- Optical rotation
- Distinctive IR stretch(es) – one or two distinguishing peaks, such as carbonyl or O-H stretches
- GC Results – oven temperature, retention time, and percent composition in parentheses

Part E. Format for Literature References

There is a standard A.C.S. (American Chemical Society) format for listing references in the chemical literature that you are required to follow (http://pubs.acs.org/books/references.shtml). This format, illustrated below, must be used in the reference section of your report, if appropriate. Be sure to document all assertions and past work described in your reports with a footnote. Footnotes can be referred to more than once. Use superscripts with corresponding numbered references at the bottom of the page or at the end of the report.

BOOKS
Author's last name, first initial, *Title of Book,* Publisher: City of publication, **Year of pub**.; pages used.

Examples
Crews, P.; Rodríguez, J.; Jaspars, M. *Organic Structure Analysis, 2nd Ed.;* Oxford: New York, **2010**; pp. 67-70.

Palleros, D.R., *Experimental Organic Chemistry;* Wiley: New York, **2000**; pp. 61-70.

JOURNALS

Author's last name, initials.; 2nd author's last name, initials.; (continue for each author). *Journal abbrev.* **Year**, *Vol.,* first to last page of article.
Proper journal abbreviation used in italics*, **year in bold, *volume in italics*, no issue number

Examples
Tansakul, C.; Lilie, E.; Walter, E. D.; Rivera III, F.; Wolcott, A.; Zhang, J. Z.; Millhauser, G. L.; R. Braslau, R. *J. Phys. Chem. C,* **2010**, *114,* 7793-7805.

Sanchez, L. M.; Lopez, D.; Vesely, B. A.; Della Togna, G.; Gerwick, W. H.; Kyle, D. E.; Linington, R. G. *J. Med. Chem.*, **2010**, *53*, 4187-97.

Woehrmann, M. H., Gassner, N. C., Bray, W. M.; Stuart, J. M.; Lokey, S. *J. Biomol. Screen.* **2010**, *15,* 196-205.

WEB SITES
Use full websites addresses so a reader could locate your referenced material on the web. **Be wary of the content. The info on the web is usually not peer reviewed, and can be erroneous!** If you do cite a website, include the date the website was accessed.

Example
http://organicchemistry.wordpress.com/2007/08/18/tips-for-writing-organic-chemistry-lab-reports/
accessed 7-23-09.