

Your Laboratory Notebook

Maintaining a well-kept and accurate lab notebook is the most important component of good laboratory performance. The effort invested now in developing good habits of notebook use will be repaid many times over for students pursuing a career in the sciences (and other disciplines!). Furthermore, some universities require submission of your AP Chemistry notebook before they will grant AP credit in chemistry even if you score a "5" on the A.P. chemistry exam. A notebook with duplicate pages is required for this course.

Lab Notebook Basics

A lab notebook must be permanently bound. Ringed binders or spiral bound books are not suitable. (At a professional level, lab notebooks may become a legal document for many reasons. In that case a spiral notebook in which pages could be torn out without notice would not hold up in court.) All writing must be entered legibly in **permanent ink**. If an error is made, it should be marked through with a **single line** so as not to obscure the original entry. Your name and contact information should be written on the front cover. Reserve the first page of the notebook for a table of contents. Number all pages in advance at the bottom right corner (unless pre-numbered) and never remove pages. All graphs must be properly labeled, computer generated, and permanently glued into your notebook or they will not be graded. Percent errors greater than 10% may result in a point deduction on lab reports.

The Format of Your Lab Report

For each lab we do in AP Chemistry, you will write up a formal lab report in your lab book. The lab report is a formal document, so use proper grammar and punctuation. For the purposes of this class, your target audience is other AP Chemistry students who have NOT done the lab you are writing up. Therefore, write on a level such that students with similar background knowledge to yours could use your lab report to repeat your procedure and verify your data and conclusions without having access to the lab manual or handout you used. You should use the **objective voice (3rd person)** for all your writing. You will tear out and turn in the carbon copy pages leaving the originals in your notebook. Every lab report should include the following sections with headings:

1. Abstract

The abstract is a one paragraph, *concise* (about 100 words) yet detailed summary of the report. It should contain these four elements:

- What the objectives of the study were (the central question);
- Brief statement of what was done (Methods);
- Brief statement of what was found (Results);
- Brief statement of what was concluded (Discussion).

Often, the abstract is the last piece of the report written.

2. Introduction

This section tells the reader why you did the experiment. Include background information that suggest why the topic is of interest and related findings. It should contain the following:

- Descriptions of the nature of the problem and summaries of relevant research to provide context and key terms so your reader can understand the experiment.
- A statement of the purpose, scope, and general method of investigation in your study. Express the central question you are asking.
- Descriptions of your experiment, hypothesis, research questions.

3. Experimental (Materials and Methods)

This section should describe all experimental procedures in enough detail that someone else with your level of experience could repeat the experiment. Some guidelines to follow:

- Explain the general type of scientific procedure you used to study the problem.
- Describe what materials, subjects, and equipment you used (**Materials**).
- Explain the steps you took in your experiment and how did you proceed (**Methods**).
- Mathematical equations and statistical tests should be described.

4. Prelab Questions

If the lab includes prelab questions or calculations, answer these using the information in the lab or your previous knowledge in complete sentences.

5. Results

This is where you record all the measurements and observations you made during the lab and attach any graphs and charts generated during or after the lab to display your data. All data should be organized into numbered and labeled data tables with correct significant figures and labeled units (e.g., Data Table 1: Absorbance of 550 nm light by Blue #1 Solutions). Graphs must be computer-generated and include title and graph number, axes labels and units where applicable. All results should be presented, including those that do not support the hypothesis. Statements made in the text must be supported by the results contained in figures and tables.

6. Calculations

You must show at least one sample calculation for each piece of data in your table that was not simply a measured value. For example, if you record the number of moles of NaCl, but you obtained that from measuring the mass of NaCl, you must show in the calculations section how you got the number of moles from the mass. If you did this step in multiple trials, only one calculation is necessary. Equations must be shown and then the values substituted and the answer given.

7. Discussion

The discussion section should explain to the reader the significance of the results and give a detailed account of what happened in the experiment. Evaluate what happened, based on the hypothesis and purpose of the experiment. If the results contained errors, analyze the reasons for the errors. The discussion should contain:

- Summarize the important findings of your observations.
- For each result, describe the patterns, principles, relationships your results show. Explain how your results relate to expectations (this might include a percent error) and to references cited. Explain any agreements, contradictions, or exceptions. Describe what additional research might resolve contradictions or explain exceptions.
- Describe possible sources of error and how they affected your data. Instrumental and human error exist in all experiments and should not be mentioned as a source of error. If "human error" ruined your data, then the experiment should be repeated before it is written up.
- Suggest the theoretical implications of your results. Extend your findings to other situations or other species. Give the big picture: do your findings help us understand a broader topic?

8. Conclusion

This is a brief paragraph where you:

- Restate your hypothesis/objective.
- Quote data that either shows that you met or did not meet the objective.
- Describe possible sources of error and how they affected your data. Instrumental and human error exist in all experiments and should not be mentioned as a source of error. If "human error" ruined your data, then the experiment should be repeated before it is written up.
- Suggest how to improve your results if you were to repeat the experiment. For example, "The data demonstrates that solutes lower freezing points of pure substances because when NaCl was added, the freezing point dropped by 5 °C."

9. Post Lab Questions

Answer any questions given at the end of the lab assignment. Use complete sentences for any question requiring an explanation and show all your work for any question requiring a calculation.

Additional Tips for Lab Reports

Discussion Section

DO	DON'T
present the data you collected	give opinion that your data was good or bad
discuss how you obtained your data and explain complex calculations	describe details of the procedure again or explain every addition or subtraction step in words
refer to data tables, charts, and graphs by their number (e.g., Table 1-2)	use the phrase, "our graph shows..." or start sentences with numbers
analyze how your data supports or rejects your hypothesis or objective	assume the reader will understand your data without an explanation
only use analysis that you can support with your data and/or observations	describe what you think or what you think should have happened
compare your results to known or expected values by calculating percent error, difference, standard deviation, etc.	expect the reader to trust your results without proof

Conclusion Section

DO	DON'T
briefly restate the objective ("In this lab...")	list procedural steps
state whether or not you met the objective and provide simple data to support this statement	write, "We met the objective." and fail to support this statement with proof
list/explain any significant errors and how they influenced the data	write "human error messed up the lab" or unjustly blame the equipment
make suggestions for improving the procedure, process and/or outcome of this experiment if you were to repeat it	criticize the procedure or equipment without offering an idea for fixing the problem