

Laboratory Notebook Guidelines

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You will record your data and observations in a laboratory notebook. We will use a simplified version of the same principles and guidelines for laboratory notebooks that are used in colleges and in industry. The purpose of a laboratory notebook is to show *exactly* what you did and when you did it, in case you need proof to back up a claim of a new discovery or to patent an invention.

The Physical Notebook

Your lab notebook must be a separate notebook (*i.e.*, you may not use one section of a multi-subject notebook), and it must have the pages bound into it in a way that they cannot be easily removed. Composition notebooks are ideal; spiral notebooks are acceptable, but only if they do not have perforations for tearing pages out neatly. Notebooks with easily removable pages, such as 3-ring binders, are not acceptable.

Your lab notebook is *only* for recording and writing up physics experiments. You should not combine it with your other physics notes. The practical reason for this is that when you hand in your notebook, you will not have access to it until I grade it and return it to you, which can sometimes take a few weeks.

Goals

Your laboratory notebook is a diary of your experiment. The goal of a laboratory notebook is to be able to go back to it later to answer *any* question you might have about the experiment.

Every teacher, professor, manager, boss, or company has specific laboratory notebook formats and guidelines. Not only isn't there any one right way to keep a lab notebook, there isn't even a single compromise format that will satisfy most people. This means you can't just do exactly what you learned in a previous science class, and you also can't just do what you learn from this class when you get to college. However, the goal for this notebook format is for it to be reasonably close to what you're likely to need to do in the future.

In this class, the sections of your lab notebook write-up will exactly follow the steps of designing, conducting, and analyzing the experiment:

- **Objective:** What was I trying to do?
- **Plan:** How did I try to do it? (What did I decide to do/measure, and how was I going to use those measurements to meet the objective?)
- **Notes:** What did I actually write down during the experiment? (This is *very* important)
- **Procedure:** What did I do? (in detail)
- **Data & Observations:** What actually happened? What did I observe? What did I measure?
- **Analysis:** What did I calculate based on my data? How good are the results? What went wrong? What should I have done differently?
- **Conclusion:** Did the experiment meet the objective? How well? What was the main result?

Each of these sections is described in more detail in the next section.

Sections of the Writeup

Title & Date

The title of the experiment and the date should appear at the top of the page where the experiment starts. A good title should describe the relationship between what you did (the independent variable) and what you were measuring (the dependent variables). (For example, “The Effects of _____ on _____”.) A good title should not have the word “lab” or “experiment” in it.

You should list the names of your lab partners under the title and date.

Objective

This is a short description of what you are trying to do. For most high school experiments, the objective is usually stated in one or two sentences, though it can be longer. If you are testing a hypothesis, you would state the hypothesis in this section. This section can also include your motivations (why you are doing the experiment), if they are relevant.

Overview/Plan

This section is written *before* you perform the experiment. It is a short description of how you intend to accomplish the objective. Its purpose is to answer the question, “What do I need to know so I can start the experiment?” It should *not* be a *detailed* step-by-step procedure (you will write that after you perform the experiment). However, it needs to include exactly which measurements you need to take, and what you will do with those measurements once you have them. Your plan does not need to be in sentence form—if it is more convenient, your plan can be a list, outline, flow chart, and/or labeled diagram(s).

Notes

While you are performing the experiment, you may not have time to write your procedure and data tables neatly in their final form. However, you *must* write down notes about your procedure and results that are detailed and complete enough to be able to write a better version afterwards without leaving anything out.

These notes *must*:

- be written *directly* into your notebook*
- be written in permanent ink (not pencil and not erasable ink)
- be recognizable as your original procedure and data (*i.e.*, be legible, even if they’re not neat)
- not have any parts that are erased, covered up (*e.g.*, with “white-out”), or scribbled out so that it is impossible to see what was originally there

Record all analog measurements to one more (estimated) decimal place than the finest marking. For example, if you have a ruler that is marked to the nearest mm, you would estimate and record the volume to the nearest 0.1 mm. (If the last digit is zero, be sure to record it, as it is significant.)

For digital measurements (such as stopwatch times or balance readings), record all of the digits displayed, including all zeroes. If the display is fluctuating up and down, record the highest and lowest readings.

It’s expected that this section may be messy and hard to follow. You will write a cleaned-up version of your procedure, data and analysis on the pages that follow. The purpose of this section is to make sure that anything you wrote down during the experiment ends up in your notebook.

**E.g.*, if you fail to do this and write your original notes on a paper towel, you will need to tape the paper towel into your notebook and sign your full legal signature across each piece of tape, as described in the “Rules” section at the end of this document. If you write your data on your hand, you will need to tape in a photocopy your hand *and* include a signed and dated statement attesting that the photocopy is of your original data.

Procedure

This is the neaten-up version of your procedure notes from above. Your procedure can be a sequential list or a narrative paragraph. It needs to include:

- The names of your lab partners.
- Descriptions of the specific materials and equipment that you used. This can be a separate list, or you can just mention all of the materials as you write about what you did.
- A *detailed* description of each step *exactly as it was performed*. Each step must mention any materials or equipment you used in that step.
- A *labeled* sketch of any apparatus you have set up, if applicable.

You should write this section as soon after you perform the experiment as possible, before you forget what you meant when you wrote down your notes.

Data & Observations

This section needs to include everything you observed, measured, or recorded during the experiment. In general, it is easiest to set up a data table with columns for your independent and dependent variables (the different things you're measuring), and rows for each data point.

You can record qualitative observations either within the data table or separately, depending on the amount of information you need to record. However, if you record observations and quantitative data separately, be sure it's obvious which observations go with which data points.

As with the procedure, you should write this section as soon after you perform the experiment as possible, before you forget what you meant when you wrote down your notes.

Analysis

Your analysis section needs to include everything you did with the data you took. If you took measurements, this section will include calculations from the experiment (including an example of each type of calculation).

You should always round the final results of your calculations off to the appropriate number of significant figures. (Keep a minimum of one extra digit during your calculations to minimize accumulated round-off errors.)

If you are comparing your results to known results, you need to mention the published values and perform some sort of error analysis. (Usually in a high school experiment, this will be percent error.)

Your analysis should also consider any possible sources of error, including:

- Possible errors or variations that are inherent to the way the experiment was performed or the way the data were collected.
- Any specific problems that actually occurred during the experiment that you were not able to correct or repeat.

Note that your sources of error should not include assumed human errors in the procedure (*E.g.*, “We might have measured the distance incorrectly.”) After all, if you knew about the mistake during the experiment, you would have corrected it and re-taken the data. Similarly, errors in your analysis (such as calculation mistakes) are *never* acceptable as sources of error—you should just take care that they don’t happen!

Conclusion

Your write-up should finish with a brief conclusion that relates your analysis to your objective. This section should include the calculated values of any quantities mentioned in your objective, and should include a sentence describing how well the experiment did or did not accomplish the objective.

Rules

The general rules and guidelines for writing in lab notebooks are:

- All information in your lab notebook should be hand-written directly into the notebook in ink. The only exceptions are calculations or graphs done on a computer as part of the Analysis section. Each experiment should start on a new page, with the title of the experiment and the date at the top.
- Anything inserted into a lab notebook (such as a printout from a lab instrument, or a graph or spreadsheet generated by a computer program) must be taped directly into the notebook. You must sign your full signature across each piece of tape, ensuring that your signature extends across the tape, onto the printout, and onto the notebook page.
Printouts of spreadsheets must include formulas as well as values. (In Microsoft Excel, you can print one normal copy and one copy with Formula Auditing Mode turned on.)
- *Never* remove pages from a lab notebook for any reason. If you need to cross out an entire page, you may do so with a single large “X”. If you do this, write a sentence explaining why you crossed out the page, and sign and date the explanation. You will lose points if there is any evidence that pages have been removed.
- *Never, ever* change your original data after the experiment is completed. Your data, right or wrong, are what you *actually* observed. Changing your data after the fact is fraud, which is a form of cheating that is every bit as bad as plagiarism. (Scientists have ruined their entire careers by faking data.) You will lose points if there is any evidence that you changed any of your original data.

In Conclusion

The purpose of keeping a lab notebook in a high school physics class is both to practice communicating what you did to other people and to learn how to keep a research lab notebook, in case you need to do so in college or later in your career.

In a research lab or industry, there are some additional rules for lab notebooks that we do not follow in a high school class. Generally, in a research notebook, the rules for the “notes” section would apply to the entire notebook. All mistakes must be crossed out with a single line, and every cross-out must be initialled and dated. Every page must be signed, dated, and witnessed, and nothing may be added to or changed on a page once you have signed it. The rules for taping data into a notebook came directly from a pharmaceutical company that I worked for before becoming a teacher (except that the photocopy of the student’s hand would need to be notarized).

Ultimately, your laboratory notebook is your record of what you actually did. The reason for following the rules is because if you worked for a company that was applying for a patent, your notebook might be the only proof that someone from your company had actually invented the substance or process. The better your notebook can hold up in court as an untainted record of exactly what you did and when you did it, the more useful it will be.

Also, the better the write-up in your notebook is, the easier it will be to use the information to write that 3–5 page formal lab report at 3:00 a.m. the night before it’s due.

Work Cited

Pavia, Donald L., Gary M. Lampman, George S. Kriz, and Randall G. Engel. *Introduction to Organic Laboratory Techniques, A Microscale Approach*. (Philadelphia: Saunders College Publishing, 1990). Pp. 16–22.