The Laboratory Notebook

Mr. Bigler

Revised: October 29, 2010

You will record your data and observations in a laboratory notebook. We will use the same 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.

Your lab notebook must be a separate notebook. (*I.e.,* you may not use one section of a multi-subject notebook.) It should have the pages bound into it in a way that they cannot be easily removed (such as a composition notebook). Composition notebooks are ideal; loose-leaf notebooks are not acceptable.

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 compromise format that will satisfy *almost* everyone. As you are getting used to using a laboratory notebook, keeping the *goals* in mind instead of the specifics of the particular format will make it a lot easier to adapt to someone else's style in the future.

In this class, the sections of your lab notebook write-up will exactly follow the steps of designing an experiment, because the most important elements you will want to recall about an experiment are usually the ones that went into designing it:

- What were the objectives of the experiment?
- What was the overall plan?
- What, exactly, did I do? (*I.e.,* what were the specific details?)
- What actually happened? What did I observe? What did I measure?
- What could I conclude from the data? What are the results of any calculations based on the data?
- How well did the experiment meet the objective? What went wrong? What should I do differently next time?

Sections

To make it easy to find information, you will want each experiment to be recorded in an organized fashion. For this class, we will use the following system:

Title

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 the independent and dependent variables. (For example, "The Effects of _____ on _____".)

Objective

This is a short description of what you are trying to do. Your description can be words, chemical reactions, diagrams, or a combination of all of these. If you are testing a hypothesis, you would state the hypothesis in this section. The only requirement is that anyone knowledgeable about chemistry must be able to tell from looking at this section what your intent was. This section can also include your motivations (why you are doing the experiment), if they are relevant.

Overview/Plan

This is a short description of how you intend to accomplish your objective. It should *not* be a *detailed* step-by-step procedure, though it should give a basic overview of the procedure you intend to use. This section can include an outline, flow chart, and/or labeled diagram(s).

Relevant Information

This optional section is a place to list any information you might want to have readily at hand during your experiment, such as physical constants or other data about the compounds and materials that you are working with. For example, if you were doing a calorimetry experiment to determine the specific heat of an unknown metal, you would include the specific heat of water, so you would have it handy for your calculations.

Procedure

You will write this section *as you perform the experiment*. It needs to include:

- the names of your lab partners
- the names, concentrations, and quantities of each substance that you used. (In industry, you would also include the manufacturer and grade of each chemical.)
- the name & description of any major equipment used, where "major" means anything larger than an electronic balance. (In industry, you would also include the manufacturer and model number for major equipment.)
- a detailed description of each step *exactly as it is performed*.

Because this is the only time you will actually write the detailed description of your procedure, you need to allow yourself enough time to write down each step before going on to the next one. Do not leave anything for later, because you are likely to forget important details.

Data & Observations

You will also write this section as you perform the experiment. It needs to include everything you think might be relevant to your experiment.

In general, it is easiest to create a table for recording data. Most data tables should be set up so that the columns represent each of your independent and dependent variables, and the rows represent each data point.

Record all analog measurements to one more (estimated) decimal place than the finest marking. For example, if you have a graduated cylinder that is marked to the nearest 1 mℓ, you would estimate and record the volume to the nearest 0.1 mℓ. (If the last digit is zero, be sure to record it, as it is significant.)

You can record observations either in the data table, or in a separate section. If observations in a separate section refer to entries in a data table, be sure to include some sort of cross-reference.

Note that you do not have to use complete sentences or worry about spelling or grammatical errors in this section, though it does need to be legible and comprehensible. The goal is for anyone reading this section to be able to verify *exactly* what you did, and *exactly* what happened, with a minimum of assistance or explanation from you.

Analysis

You will write this section after completing the experiment. As described above, this section includes everything you need to answer your objective, using your data. If the experiment involved measurements, this section will include calculations from the experiment (show all work) and your experimental yield (if relevant).

You should always round 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 published data are available, you should always reference the published data and calculate your percent error.

Your analysis should also consider any possible sources of error (especially any errors that you believe actually occurred), considerations to keep in mind the next time you perform a similar experiment, and suggestions for future related experiments.

If your objective included a hypothesis or goal, you should finish with a quick mention of whether or not your hypothesis was correct, or whether or not you accomplished your goal.

Rules

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

- All entries in a lab notebook must be hand-written, in ink.
- All pages *must* be numbered consecutively, to show that no pages have been removed. If your notebook did not come with pre-numbered pages, you need to number *all of them* by hand *before* using the notebook.
- Start each experiment on a new page.
- At the end of each experiment, sign and date the bottom of the last page. (In industry, every single page would have its own box for your signature and the date.)
- When crossing out an incorrect entry in a lab notebook, *never* obliterate it. Always cross it out with a single line through it, so that it is still possible to read the original mistake. (This is to prove that it was a mistake, and you didn't change your data or observations. We all make silly mistakes, so you don't need to feel embarrassed about the original text still being legible.) If you accidentally scribble something out, write your initials next to the change.
- *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 brief explanation of why you crossed out the page, and sign and date the cross-out.
- *Never, ever* change data after the experiment is completed. Really. I mean it. Your data, right or wrong, is what you actually observed. Changing your data constitutes fraud, which is a form of cheating that is every bit as bad as plagiarism. You can still get an A on an experiment that didn't work; changing or faking your data will get you the full penalty for cheating, including a zero for the experiment.

  This also means that you should never change anything on a page you have already signed and dated. If you realize that an experiment was flawed, leave the bad data where it is. Just add a note that says "See page ___." with your initials and date next to the addendum. On a new page, refer back to the page number of the bad data and describe briefly what was wrong with it. Then, give the correct information and sign and date it as you would an experiment.

In Conclusion

Remember that your laboratory notebook is your only record of what you actually did. 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 more information you record in your notebook, the more useful it will be. If you need a more immediate incentive, the more information you have in your notebook when you are writing that 3–5 page lab report at 3:00 a.m. the night before it's due, the less work you'll have to do to find everything, and the more sleep you'll get.

Works 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.