Keeping Your Laboratory Notebook

Your laboratory notebook must be the *original* record of your own work, written *as* you do it: *Never erase*. *Never remove pages*. Never use white out. Just cross out neatly anything you think is incorrect; you may have been right the first time and later need to recover what you wrote originally. If you have produced a graph or chart of your data on an instrument or computer, *fold it in half*, label it and fasten it into your notebook *with the fold toward the center so it opens like the other pages*. Do not record observations or data on scratch paper since you may lose it, forget to transfer the information to your notebook, or make mistakes in copying it. In this course you will hand in your laboratory notebook as a complete record of what you did and thought, mistakes and all. Occasionally your peers will read and offer comments on your notebook. **The notebook should be written so that someone with a background comparable to yours could repeat an experiment based solely on what you have recorded**. For the integrative projects, you will also hand in a formal report based on the records kept in your notebook.

*IMPORTANT: Save a few pages at the beginning of your notebook for a **table of contents***. Number the pages so that you can find things. Never worry about setting aside enough pages for an experiment since a simple "continued on page *xx*" and "continued from page *yy*" will let you follow where you are going and have been. Keep your Table of Contents up-to-date by regularly writing in the title and starting page number of each lab.

Notebook checklist

____ Table of Contents
____ Sewn/bound lab notebook
____ Partners acknowledged
____ No erasures/written in non-erasable ink
____ Pages numbered
____ No pages removed
____ Date recorded when work done
____ Reasonably legible
____ No loose pages (Graphs folded in half and fastened in notebook with the fold toward the center)
____ Original record (Data and observations recorded during lab, not recopied)

As in any writing, you should strive for content, organization, and clarity. You should know ahead of time what each step of a procedure is trying to accomplish. As a scientist, you will either be trying something new and making up your procedure yourself, or you will be trying to repeat something from the literature, perhaps in a better way or for a different purpose. Either way, you must have some idea what a particular step or procedure is for *before* you do it. If you can't figure something out, *ask*! That's why the instructor and an experienced student assistant are in lab with you.

The following organization for your lab notebook, even for small laboratory exercises, will help you focus on what is important and find things when you need them later. Grading will be based on your use of this style. **You get points for each section so it's better to have clearly labeled sections**! The same style is also used in future Beloit chemistry courses.

Purpose

Method

Actions with observations

Data

Calculations and graphs

Discussion

PURPOSE. State the object of your experiment in *one sentence.* Be specific so that you will know when you have accomplished your objective. For example, "Determine the molarity of a NaOH solution" is more useful than "Learn more about acids and bases." Write down the purpose in your notebook *before* you start any lab work.

METHOD. *How* will you go about achieving that stated purpose? Briefly outline the principles involved in the experimental procedure you plan to use, even if you provide a reference for the exact procedure. You should try to summarize as briefly as possible the *logic* of what you plan to do. Method is *not* a list of the steps in the procedure. The method for a synthesis might be the chemical equation for the reaction you plan to carry out, or for an analysis the method might be "I will determine the moles of acid by titrating with standard base using phenolphthalein as the indicator." The latter example illustrates that purpose and method can often form a single logical sentence: "I want to accomplish [PURPOSE] by using [METHOD]." Write down the method in your notebook *before* you start any lab work.

ACTIONS WITH OBSERVATIONS. Record what you *do* and what you *see* in your own words as you do it. Most procedural errors involve misunderstanding, and we can often figure out what went wrong if your notebook contains what you actually did and saw**.** *Copy down information from the labels of the reagent bottles you use.* (Is the bottle labeled 1.78 g $AgNO_3$/liter really the 0.1 mole/liter solution you were supposed to use?) Include how you measured all amounts. You need to be able to tell from your notebook the date on which you actually did the work and with whom you worked. A sketch can often be an effective, efficient form of showing an experimental set up. Simple phrases, sequences of notes, outlines and sketches, or a table are easier to follow than a dense paragraph of continuous prose with complete sentences. Write this section *during* the experiment, *as you record each step of your actions and observing what happened*. Someone with a background comparable to yours should be able to repeat the experiment based solely on what you have recorded.

DATA. *Record all data directly in your lab notebook and label all entries* – what you have measured and in what units. *Use tabular form* for data as much as possible, with plenty of space and room to cross out entries or add others. Don't be afraid to spread a table out onto two facing pages. For analytical balance or buret readings, record initial and final readings, not just the subtracted result. *Do not write data on anything else for later recopying*. This data section must be written *during* the experiment and not copied from a lab partner.

CALCULATIONS AND GRAPHS. Provide an example or explain *how the data you obtained in lab are used to obtain the final result you report*. Calculations randomly scattered on the page without labels and units are not sufficient even if they come out correctly. (Remember, you may need to be able to reconstruct what you did months later.) If the report requires repetitive calculations for more than one set of data, show the calculations for one set and make a table for the rest. *Show <u>units</u> on all numbers*. Make sure that units cancel properly in calculations. *Graphs should have a title, have labeled axes, be folded in half with the fold toward the center and be fastened in your notebook.*

DISCUSSION. *Answer the question posed by the PURPOSE; discuss and summarize any numerical results*. Your discussion should be written in paragraph form with complete sentences and tie together what you are learning in the classroom and lab. It is OK to type and spell check your discussion, and add a printed copy to your notebook. Always include some estimate of the uncertainty in any numerical result. In general chemistry this often means reporting your results to the proper number of significant digits and *identifying which measurement limited the number of significant figures.* If you can identify any specific sources of bias in your measurements or assumptions in your method that would affect your result, indicate whether each will tend to make your results high or whether they will tend to make your results low. A general reference to "human error" is not useful. *Questions posed in laboratory directions* are meant to aid your thinking about possible conclusions. Understanding, explaining, and knowing the limitations of what you have done are as important as getting the "correct" answer (assuming a "correct" answer or result exists).