How to Keep a Laboratory Notebook

One of the most useful skills you will acquire in the laboratory is the proper use of a laboratory notebook. Notebooks, or other formally kept records, are an essential tool in many careers, ranging from that of the research scientist to that of the practicing physician. The effort invested in developing good habits of notebook use will be amply repaid for students who pursue a future in the basic or applied sciences. Experience has indicated that skillful notebook use is developed by most students only through continued special effort – it does not come naturally. Some of the main principles of sound notebook use are outlined below.

The laboratory notebook is a permanent, documented, and primary record of laboratory observations. Therefore, your notebook will be a **bound journal** with pages that should **be numbered in advance and never torn out**. Write your name, the name of your TA, and your lab section on the cover of your notebook. All notebook entries must be in **ink** and **clearly dated**. No entry is ever erased or obliterated by pen or "white out". Changes are made by drawing a single line through an entry in such a way that it can still be read and placing the new entry nearby. If it is a primary datum that is changed, a brief explanation of the change should be entered (e.g. "balance drifted" or "reading error"). No explanation is necessary if a calculation or discussion is changed; the section to be deleted is simply removed by drawing a neat "x" through it.

All of the *required* entries in your notebook (see below) must be written on the *right-hand* pages. (Concession to southpaws: if you are left-handed and you find it more convenient to write on the left-hand page, that's fine. However, once you choose the left, stick to the left. Don't flip-flop.) You can write whatever you want on the empty pages, but don't treat these entries as your official record because your instructors won't. If you want to write plans and outlines, record data (temporarily), do calculations, then do so. The left-hand pages belong to you.

In view of the fact that a notebook is a primary record, data are not copied into it from other sources (such as this manual or a lab partner's notebook, in a joint experiment) without clear acknowledgment of the source. Observations are **never** collected on note pads, filter paper, paper towels, Post It notes, or other temporary paper for later transfer into a notebook. If you are caught using the "scrap of paper" technique, your improperly recorded data may be confiscated by your TA or instructor at any time. It is important to develop a standard approach to using a notebook routinely as the primary receptacle of observations.

Aside from the prelab requirements, note that the majority of the calculations and notebook write up can and should be accomplished in "real time" – while you are in the lab, recording data and observations, and making calculations. **Always bring a calculator to lab.**

Your notebook should professional, concise, accurate, **neatly (legibly)** written, and logically organized. It must be complete enough that another researcher could, without ever speaking to you, use your notes to exactly replicate your experiment. This in fact is frequently the case in laboratories where a researcher takes over a project from someone who has moved on. Everything you do in the laboratory should be included in your notebook, from procedure to calculations. When notebooks are examined, we will look for the following points in almost all cases:

Title: Exactly as stated in the lab manual

Objective: Don't just re-state the lab title, READ THROUGH THE LAB BEFORE CLASS and see what the techniques will teach us about the organisms. State the purpose of the experiment along with a brief statement of basic principles involved and the method to be used.

Methods: **Summarize** experimental steps of the lab, emphasizing any deviations from the lab manual. You may use a flowchart of outline if you wish. Also summarize any special information needed to work safely and efficiently with each substance or bacterial species that you handle. Provide enough explanatory information so that someone else with your knowledge of microbiology could, *from your notebook alone*, enter the lab and repeat your work precisely. This means including details like incubation times and temperatures, names of bacterial species, names of reagents, etc.

Results: Qualitative observations and quantitative data are best entered in a running commentary. This commentary should be recorded in the lab, as the experiment proceeds. High prose standards are not expected. Do not discuss your data or present explanations here – just the facts, please! Save the discussion and interpretation for the next section.

If repeated measurements are made using the same procedure, a table provides the best presentation. Some qualitative observations are best presented as sketches or photographs (e.g., what a certain specimen looks like at 1000X using your microscope). Notes such as Gram staining results are included here. If the experimental work is done jointly it must be noted and reported independently. Your notebook must list your co-workers and identify (with initials) who did what.

Calculated results are also included in this section. Write your calculations clearly and include a brief explanation for each step. **Remember to include units.** If the same calculation is done repeatedly, write one sample calculation in your notebook and report the results of other calculations in a table. Data and associated graphs and calculations *quantitatively* gauge how successful your laboratory technique was.

Discussion: A discussion of the experiment should include qualitative and quantitative comments on your results. Were your objectives met? Do your results differ from expected results, if so, why? Were there any sources of error in your experiment? If you were to repeat the experiment, how would you troubleshoot? What is the relevance of your results? If your results differ wildly from the expected results or those of most of your classmates, record the results of another classmate and discuss potential sources for the variation in results.