

The Laboratory Notebook¹

A scientific notebook should hold a permanent record of the experimental work. Consequently, the pages should be securely bound and entries made in ink at the time work is done. The pages are numbered and the entries are dated. The format of the entries must be such that the book could be read by any scientist who is familiar with quantitative chemical work. Readability of the original data is essential. Neatness is convenient but not central. Neatness is not a grading criterion for the notebook. Too much neatness is often a sign that the information has not been actually written during the lab.

It is common practice to record data on the right hand page and to use the left hand page for preliminary readings, notes and calculations. The left hand page is the only place you are allowed to write scratch notes (you do not have this option because of the duplicates). **Any evidence of recording data on scratch paper, lab manual pages, paper towels, etc. will result in a lab notebook grade of 0 for the experiment.**

Errors are a part of scientific work. Data is frequently invalid - experimental conditions may not be adequately controlled, reagents may be contaminated, instruments may not be operating correctly, scales of instruments may be incorrectly read, etc. If results have more than the anticipated variation, the first reaction may be to discard the whole thing and start over. Later more significance may be read into the data. All data - including data that is known to be invalid - remains a part of the laboratory record. To correct an entry, draw a single line through it and enter the correct value above the original value which remains readable. If the reason for the change is not obvious, an explanation should be recorded. If a large section of the work is considered invalid, a single line is drawn diagonally across the page and the reason for discarding the work stated. All entries remain readable. **Under no circumstances is a page removed from the book. To erase or block out data, or to remove a page from a notebook is considered a violation of scientific integrity.** In research, valid notebooks are the basis of determining priority of scientific discoveries and the granting of patent rights.

At the end of a determination, the work is summarized in a table which includes the data and calculated values for all trials. The pages on which the data, the calculations and the summary occur are cross referenced if the pages are not consecutive. With experience, it is possible to record essentially all data directly in this summary table. These tables, particularly if they show intermediate values in the calculations, are helpful in discovering trends and locating errors in calculations. One of the chief sources of errors in quantitative determinations is the incorrect treatment of the data. Calculations are as much a part of a determination as any measurement. **One example of each calculation with all units must be included in the notebook. *Replicate calculations should not normally be included.***

The correct use of significant figures requires alertness and judgment. The most

common error is the copying of all of the digits on the computer or calculator printout. The use of computers and calculators require careful attention to the correct entering of data followed by careful consideration of the number of figures to be retained in the final answer. One additional figure should be retained in all intermediate values of a calculation and the final answer reduced to the correct significance. It takes hard work to get good data. Don't invalidate the results with sloppy calculations.

Anyone can keep an accurate notebook if they put their mind to it. Here are some suggestions which may help organize the notebook so it is easier to read.

1. Plan what you are going to do before you start writing.
2. Don't try to put too much on one page. Leave plenty of space.
3. Use one end of your bench space for your notebook and the other for wet work - which depends on whether you are right or left handed and also the position of the sink.
4. When not in use, keep the notebook closed and off of the desk top. If a disaster occurs, data may be transferred. Draw a single line across the first page and cross reference the two pages.
5. Run through calculations on scrap paper first. This is quite permissible since calculations can always be repeated as long as the data are available. Show only one example calculation in your notebook to allow later verification of the method used.
6. Data and calculated values should be presented in tables. Even though instrument recording and computer printouts are attached to the reports, significant values should be included in the tables.

Tables of results are possibly the most crucial part of the notebook. A well organized student can often prepare the table prior to beginning the experiment. This saves laboratory time and indicates a thoughtful, orderly approach to the experiment. A well thought out table will simplify recording and subsequent calculation of results.

The importance of establishing a pattern of careful notebook keeping is difficult to overemphasize. Most industrial laboratories engaged in analytical chemistry are required to follow Good Laboratory Practice standards (GLP's) established by professional groups or government agencies. In some laboratories, for example, every weighing, buret reading, etc., must be witnessed and countersigned. This would be a little extreme in this course. An almost universal practice is to have each page witnessed at the end of each days work (***It is your responsibility to have your instructor sign the notebook at the end of each lab period.***)

¹ Portions of this material are derived from the work of Prof. A. J. Harrison and Prof. E. Weaver of Mt. Holyoke College and Prof. Susan K. Henderson of Quinnipiac College.