

## GUIDELINES FOR KEEPING A LABORATORY RECORD

*If you have built a perfect demonstration do not remove all traces of the scaffolding by which you have raised it. Clark Maxwell*

The following is a general description of how to keep a proper laboratory notebook. Requirements for different teaching, research, clinical, or industrial labs will most likely vary. Some institutions/labs will require less stringent record keeping, others will hold you to a very strict protocol. A well kept notebook provides a reliable reference for writing up materials and methods and results for a study. It is a legally valid record that preserves your rights or those of an employer or academic investigator to your discoveries. A comprehensive notebook permits one to reproduce any part of a methodology completely and accurately.

### Outline of procedures

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### Choosing a notebook

For most purposes you may select a *bound* notebook, quadrille-ruled. A teaching lab may require tear-out duplicate pages for making carbon copies. An engineering or industrial research/development lab will likely require a specific type notebook with prenumbered pages and places for date and investigator's and supervisor's signatures on each page. Pads of tear-out graph paper or spiral bound notebooks without pre-numbered pages are not acceptable. It must be impossible to tear out a page without leaving evidence. It is safest to select something that is clearly labeled as a *laboratory* notebook.

### Preparing the Notebook

Please use a ball point pen for all entries, so that the marks will not smear nor will they be erasable.

Put your name, a telephone number and/or address, and project name or course number on the outside front cover of the record. Put that same information on the first page inside, or on the inside front cover. If your notebook does not include a pre-labeled table of contents section, then reserve the next several pages for a table of contents by labeling the top of each page as *Table of Contents* and numbering each page. If your notebook does not have prenumbered pages, you may wish to use lower case Roman numerals, as in a standard publication. Next, number the next several pages with Arabic numerals in sequence, and you are ready to begin recording data.

### **What to enter**

Above all, it is critical that you enter all procedures and data directly into your notebook in a timely manner, that is, while you are conducting the actual work. Your entries must be sufficiently detailed so that you or someone else could conduct any procedure with only the notebook as a guide. Few students (and not that many researchers for that matter) record sufficiently detailed and organized information. The most logical organization of notebook entries is chronological. If a proper chronological record is kept and co-signed by a coworker or supervisor, it is a legally valid record. Such a record is necessary if you or your employer are to keep your rights to your discoveries.

Depending on requirements set by a teacher, supervisor, company, or whatever, you may not have to confine your notebook entries to lab notes only. On the other hand a student might record your class lecture notes, lab lecture notes, ideas, questions, library research notes, and notes that are part of any pre-lab preparation. The bare minimum entries for an academic lab course, for each lab study, should include title of the lab study; introduction and objectives; detailed procedures and data (recorded in the lab itself); summary.

We usually record a lot more information in a laboratory notebook than we would report in a research paper. For example, in a published article we don't report centrifuge type, rpm, rotor type, or which machine was used. However, if a procedure is unsuccessful you may want to check to see that you used the correct rpm or correct rotor. Perhaps the centrifuge itself was miscalibrated. You would need to know which machine you used. In a research paper one does not report which person performed which tasks, because such information is useless to a third party. However in the notebook it is important to note who was responsible for what procedure. Again, you may need such information to troubleshoot your experiments.

### **Making entries**

Someone else may need to consult your notebook sometime, so please make your entries clear and legible.

When you make your first entries of the day, start by entering the date, writing out the month or abbreviation for the month (e.g., 5 Apr '04, or April 5, 2004, but not 4/5/04). The use of numerals only can cause confusion. For example, in Europe the day comes before the month. Thus April 5, 2004 would be written as 5/4/04. When you start each new page of a notebook enter the date next to the page number. Each page should be numbered and dated consistently. Most of us use the upper right corner of each page for date and page number.

Depending on how your notebook is designed you may choose whether or not to use the backs of pages. If you leave them blank, put a corner-to-corner line through them to void all blank spaces. Some people use the backs for rough calculations, then void remaining blank space. You might also decide to save space (and trees) and use both sides of each page. Obviously you cannot use both sides with

notebooks that are designed to make duplicate copies. In situations where you turn in duplicate copies to a supervisor, you obviously must start each new set of entries on a new page.

Write a title for each and every new set of entries. Distinct sets of entries should be separated by using informative headings and by leaving a single space or two between individual sets of entries. Specific information can be more readily located that way. For a new laboratory study, write down a *very brief* introduction to the study, and list the objectives. If you have a specific hypothesis, write it down. The object is to make it completely clear what you intend to do.

Record everything you do in the lab, even if you are following a published procedure. For example, if you started by obtaining a quantity of tissue from an instructor, then write down that you obtained tissue, describe it, note how much, what condition, etc. How much you write down is up to you, but any *relevant* information should be there. For example, it doesn't matter much if you received a chunk of liver in a red ice bucket or a black one. However, it *does* matter that the material was on ice. **If you change a protocol in any way or decide between alternative methods, then the correct information must be recorded in the notebook.** For example, a protocol for tissue fractionation may recommend centrifugation at 9400 x g, but we may decide to use 12,000 x g in the lab. The correct g force must be noted.

If you make a mistake, put a line through the mistake and write the new information next to it. *Never* erase or obliterate an entry. When you finish a page, put a corner-to-corner line through any blank parts that could still be used for data entry. Every bit of every page must be legible and filled, either with information or with a mark that voids the section (see examples).

### The summary

When you have finished a project, summarize what you have accomplished. You don't have to draw conclusions, just indicate what sort of data or observations you collected, samples you saved (and where and how you saved them), or any other relevant information that wraps up the study. For a continuing study keep the summary extremely brief. In fact, if the notes are well organized and it is obvious where the study left off, you need write nothing more than "To be continued..." Summaries help maintain continuity. They indicate where the work left off and how it might resume.

### Organization

#### Doing two things at once?

What if you are conducting two long procedures at once, each with long waiting periods? For example, suppose you are conducting a protein assay and preparing a gel for your samples out in the laboratory. Back in the cell culture room, you are harvesting and processing tissues for primary culture. Both procedures involve waiting periods, yet you will complete both tasks by the end of the day.

Simply use your best judgment. You could divide each page into columns and keep your two records side-by-side. You might date two consecutive pages, keeping both records separately. In either case, when you leave the laboratory for the day cross out any unused parts of a page that precede the last entry.

### Continuation pages

What if you need more than one page for a project? With continuing research, that will always be the case. Proper use of continuation notes makes it possible to follow your path through a long experiment or series of experiments without having to leaf through every page of your notebook.

For example, let's say you labeled some protein samples with the radioisotope S-35, ran a gel, and placed the gel in a film cassette in order to produce an autoradiograph. During the two days your film is in the freezer, you devote all of your time to a cloning project that is part of an unrelated study. After you put your film cassette in the freezer, simply write *Continued, page \_\_\_\_*, then enter the date and title of your other project, and continue to record information.

When you resume work on the protein samples, enter the date, write *Continued from page \_\_\_\_*, and enter your autoradiography results. This way, everything you do in the laboratory is recorded chronologically, yet someone interested in following your progress could start from the beginning and follow every procedure on just that one study, from start to finish.

### **Are things getting too sloppy?**

Perhaps your data records are scattered throughout the notebook, and you would like to summarize them. Go ahead. You may re-enter tables or figures any time you wish to organize your work a bit better. To prevent confusion over duplication of data you may put a line through a table or figure you intend to re-draw, initial and date the change, and note the page on which the re-organized data can be found. Just don't obscure any of the original entry.

### **Repeated procedures**

So far you have been advised to record each step you perform in the laboratory, regardless of whether the procedure is published somewhere. However, once you carry out a procedure, you can refer to that part of your notebook, and only note changes you make. For example, the first time you prepare a sequencing gel you should write down the exact formulation, how you mix the gel, how long you let it cure, etc. The next time, just refer to the name of the procedure and the appropriate page(s) of your notebook.

### **Loose materials**

Suppose you enter raw data into a computer and have a printout with 400 pieces of data. Or, suppose you generate a graph using a software program. You might even have a silver-stained gel that you wish to refer to frequently, or a fluorescence photomicrograph that sums up your results nicely. Some investigators prefer to attach such materials to the notebook itself, but too many such items make a sloppy notebook and can stress the binding. Loose data should be kept in a separate folder or notebook, with location noted in the book.

### **Table of Contents**

Record all entries in the table of contents as you go along. You can organize it anyway you like but it is advisable to include multiple levels in a table of contents, that is, indicate where a new study starts and include subheadings for specific parts of a study, methods, sets of data, etc. The idea is to enable someone (such a supervisor, grader, or yourself a year from now) to find anything quickly. List each set of entries with dates and page numbers. If you are seriously anal-retentive, you might record every experiment in chronological order, then use the remaining blank space to cross reference the contents experiment by experiment.

For a teaching lab you might list each and every set of entries made in your notebook, in chronological order, including complete and informative titles. Examples of sets of entries include an introduction, a summary, a set of procedures for a specific preparation, a complete data set, calculations for diluting samples or preparing assay standards, etc. A grader should be able to find any specific entry quickly, without flipping through pages.

### Notebook Checklist

As you record your activities in the laboratory, ask yourself, "Did I..."

- Keep up with the table of contents?
- Date each page?
- Number each page consecutively?
- Use continuation notes when necessary?
- Properly void **all** blank pages or portions of pages (front and back)?
- Enter all information **directly** into the notebook?
- Properly introduce **and** summarize each experiment?
- Include complete details of all first-time procedures?
- Include calculations?