

## **Lab notebook: an indispensable resource for researchers**

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### **Abstract**

A lab notebook is one of the most useful documents for a researcher to prove the authenticity of the actual research that has been carried out to establish a new method, technique, procedure etc. It is considered a crucial documented proof for a product that is to be commercialized or patented. The credibility of maintaining a lab notebook in western countries with regulated pharmaceutical markets is well understood and efficiently practiced. In contrast, the laboratories of various these countries have limited and unsatisfactory guidelines for maintain a lab notebook. The practice of lab notebook maintenance in such laboratories still needs much improvement. The present article highlights some of the salient features for maintaining a lab notebook. It attempts to help the researchers to maintain eventually attain an authenticated and well organized lab notebook for their research work and high international standards for lab notebooks.

### **Keywords**

Lab notebook, electronic lab notebook, research notebook, inventor lab notebook, open lab notebook.

### **Introduction**

A lab notebook is a primary record of research. Researchers use a lab notebook to document their hypotheses, experiments and initial analysis or interpretation of these experiments. The lab notebook serves as an organizational tool, a memory aid, and can have a role in protecting any intellectual property that comes from the research [1].

It is important to realize that laboratory record keeping is a learned skill, not a talent. A person acquires a skill only through continued, disciplined practice of an activity. A lab notebook maintained by a skillful researcher should be a useful tool for research organizations, academic research institutions as well as industries that intend to improve and organize their research activities [2]. The role of laboratory notebook goes beyond research and is a mandatory requirement for regulatory compliance and patent filing. It acts as a legal document for example, while seeking approvals and patents for pharmaceutical products or drugs. It is observed that many graduate and postgraduate student consider maintaining lab notebook as a formality and an unnecessary

burden. This presentation needs to be changed and evolved the present article presents a brief introduction of different types of lab notebook and suggests a general guideline and format for their maintenance.

### **Types of lab notebook**

Earlier, the record keeping of research activities were mostly practiced by using a common hard bound paper notebook. This method, however, developed over a long period of time into a well defined protocol for keeping a lab notebook that involved the manual and compulsory maintenance of all the experimental work into the research notebook of the researcher [3]. Presently, with the advancement in the field of computer science, this practice of keeping a hard copy of lab notebook has been modified and developed into an electronic lab notebook that is maintained as a soft copy on the computer of the researcher or the concerned laboratory. Different types or the terminology of lab notebooks are presented below [4]:

#### **1. Research Notebook:**

These are the common hard bound paper notebooks that are used by researchers and students to record their day to day experimental activities. Most institutions and labs have their own format for maintaining the research notebook. These notebooks are issued to the researcher from the concerned department after assigning a lab notebook number to the notebook. The project code on which the researcher is working is also mentioned on the first page of the notebook. The research notebook is the property of the institute or organization for which the scientist works and should be submitted back on completion. Hardbound books with numbered pages show that no pages have been deleted or

added. It can serve as legal evidence in priority disputes.

#### **2. Electronic lab notebook**

An electronic lab notebook is a software program designed to replace paper laboratory notebooks [5]. Electronic lab notebooks are a fairly new technology and offer many benefits to the user as well as organizations. For example electronic lab notebooks are easier to search upon, support collaboration amongst many users, and can be made more secure than their paper counterparts. However, whatever may be the advantages the major drawback of an electronic lab notebook is that it cannot be used as a proof for the concerned research in the court of law [6].

#### **ELNs can be divided into two categories**

1. "Specific ELNs" contain features designed to work with specific applications, scientific instrumentation or data types.
2. "Cross-disciplinary ELNs" or "Generic ELNs" are designed to support access to all data and information that needs to be recorded in a lab notebook [7].

#### **3. Inventor's notebook**

Inventor's notebook is used by inventors, scientists and engineers to record their ideas, invention process, experimental tests and results and observations ([www.wikipedia.com/http://edison.rutgers.edu/](http://www.wikipedia.com/http://edison.rutgers.edu/); December 2011). It is not a legal document but is valuable, if properly organized and maintained, since it can help establish dates of conception and reduction to practice. The information can improve the outcome of a patent or a patent contestation. The notebook is also a valuable tool for the inventor since it

provides a chronological record of an invention and its reduction to practice.

#### 4. Open lab notebooks

In recent years, lab notebooks kept online have started to become available to the world as they are to the researcher a trend often referred to as Open Notebook Science, after the title of a 2006 blog post by chemist Jean-Claude Bradley. The term is frequently used to distinguish this aspect of *Open Science* from the related but rather independent developments commonly labeled as Open Source, Open Access, Open Data and so forth.

([http://en.wikipedia.org/wiki/Lab\\_notebook](http://en.wikipedia.org/wiki/Lab_notebook)).

#### Other types of lab notebooks:

##### 5. Formal and informal lab notebook

The informal report differs from the formal report in three major respects. The informal report omits: (1) the abstract, (2) description of procedure (except where there were significant deviations from the procedures of the instruction manual), and (3) exposition of the science underlying the experiment.

##### Need of a lab notebook:

1. The lab notebook contains the evidence of your research work.
2. The lab notebook is evidence of good laboratory practice.
3. The lab notebook is a resource for further reference by future scientists who would continue the research work.
4. The lab notebook is not a copy of the experimental script but a record of actual observation made by the scientist during the research.

#### General guidelines for maintaining a lab notebook [8, 9]

1. Good lab notebooks should be well organized.
2. The data should be recorded carefully and completely.
3. Notebooks should be clearly identified on the outside cover.
4. The first page of the lab notebook should include the information such as name of institute, laboratory/department, supervisor(s), project scientist etc.
5. A code should be assigned to the project and the lab notebook.
6. Date of issue and commencement of the project should be entered.
7. This page should be followed a list of instructions to be followed while recording the data in the lab notebook.
8. A table of contents page should be included so as to enter the title and page number of the experiments.
9. All the pages used for data entry should be numbered.
10. The significance of each experiment, as well as the observations, results and conclusions of the experiment should be included while carrying out the experiment.
11. Each trivial detail may prove to be of critical importance at a later stage so, nothing should be omitted and every detail should be included.
12. Any outcome should be analyzed immediately after it was observed to prevent any error or miss-interpretation.
13. All experiment whether successful or unsuccessful should be entered in your notebook. An initially judged unsuccessful experiment may prove to be successful later in an un-anticipated way.
14. A lab notebook is a confidential document so keep it safely.
15. Any mistake should be crossed by a single line so that the information is not hidden and remains legible.

16. The corrected part should be signed and dated. If applicable, the reason for the correction should be provided.

17. This extra care is worthwhile because of the necessity of original data to prove priority of new discoveries.

18. The text should not contain incomplete sentences or other basic grammatical errors.

19. No page should be removed or torn from the lab notebook. Instead any such unwanted page should be crossed by(x) and the word cancelled should be written on it with date, signature and reason.

20. Always use permanent ink to record your entries and never a pencil.

21. Ideas should be recorded in the laboratory notebook, as these may prove to be useful in determining the date of invention.

22. After each experiment, the record should be signed and dated both by the performance and project leader.

23. While recording the experiment include heading, subheading, purpose, procedure, diagram, calculations, layout, new ideas, observation, results, discussion, conclusions and references and only other remarks.

### General format for a research lab notebook:

Different labs follow different protocols to maintain their lab notebooks [1, 10]. However, most of the entries are more or less similar and target to include as much information as possible in their records. A general format for a lab notebook is presented here and diagrammatically represented in figure 1.

1. Title
2. Date
3. Project code
4. Experiment/batch number

5. Name of lab partner/project supervisor
6. Aims/background/objectives
7. Method & explanation of experimental decisions.
8. Sketch of experimental equipment/used (if relevant).
9. Table of data & column headings
10. Graphs (if applicable)
11. Numerical calculations with appropriate units.
12. Comments/observation/results and discussion.
13. Conclusions.
14. Any special remarks.
15. A restatement of the questions posed, and your answers.
16. References.
17. Date of experiment performed and signature.

**Figure 1: A diagrammatic representation of a research notebook**

### First page

Company/lab logo	
Company/lab address	
Company/lab email id	
Lab Notebook	
Lab Notebook (LNB) No.	
Assigned To (Name, Phone, Email)	
Date Issued	
Project Title	
Project Code	
Client's Name	
Client's Address, Phone, Email	

Note: This Lab Notebook and any work reported in it is the property of XYZ.....



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