

## A316 Lab Reports

A316 lab reports will consist of the organizational structure used in the journal Analytical Chemistry. Abstract, Introduction, Experimental, Results and Discussion, and Conclusion.

### I. Developing a Title:<sup>1</sup>

Titles should describe contents clearly and precisely, so that readers can decide whether to read the report. Key words for indexing should be provided. Titles should not include wasted words such as "studies on," "an investigation of", use abbreviations and jargon, or use "cute" language.

Good Title: The Relationship of Luteinizing Hormone to Obesity in the Zucker Rat

Poor Titles: An Investigation of Hormone Secretion and Weight in Rats

Fat Rats: Are Their Hormones Different?

### II. Abstract:<sup>3</sup>

This section is a complete but concise summary of your work and should include the following information in less than 200 words.

1) **Motivation:** *Why do we care* about the problem and the results?

2) **Problem statement:** What *problem* are you trying to solve? What is the *scope* of your work (a generalized approach, or for a specific situation)?

3) **Approach:** *How did you go about solving* or making progress on the problem?

4) **Results:** *What's the answer?* Put the result there, in numbers.

5) **Conclusions:** *What are the implications* of your answer?

Writing an efficient abstract is hard work, but will repay you with increased impact on the world by enticing people to read your publications.

### III. Introduction:

“A good introduction is a clear statement of the problem or project and the reasons for studying it. This information should be contained in the first few sentences. Give a concise and appropriate background discussion of the problem and the significance, scope, and limits of the work. Outline what has been done before by citing pertinent literature, but do not include a general survey of semi-relevant literature. State how your work differs from or is related to work previously published.”<sup>3</sup>

The following questions should be addressed in the Introduction section.<sup>1</sup>

Why is the work important?

*What conflict or unanswered question will your research address? What findings are you challenging or extending? Review relevant research to provide rationale.*

What is the purpose?

*What question are you answering by carrying out the experiment?*

What solution do you propose?

*General experiment design or method. Include the scientific theory behind chemistry and instrumentation that enables the experiment to be carried out.*

#### **IV. Experimental:<sup>1</sup>**

Write in sufficient detail so that someone who has already taken A316 could repeat the experiment. Do not describe basic lab procedures such as solution preparation.

Address the following questions.

How did you study the problem?

*Briefly explain the type of scientific procedure used.*

What did you use? (subheaded as Materials or incorporated into text)

*Equipment including manufacturer and model number.*

*Reagents (concentration, manufacturer, lot number)*

How did you proceed?

*Explain the steps you took. Subheadings are appropriate such as sample preparation, instrument parameters, etc.*

#### **V. Results and Discussion:**

Summarize the data collected and their statistical treatment. Include only relevant data, but give sufficient detail to justify conclusions. Use equations, figures, and tables where necessary for clarity and brevity. A reader should be able to look at a figure or table and not need to refer to text to interpret results. Even though results are given in a figure there should be an accompanying written description. The written description should be clear enough that one does not need to view the figure to decipher the meaning. The purpose the discussion is to interpret and compare the results. Be objective; point out features and limitations of the work. Relate your results to the original purpose in undertaking the project. Briefly state logical implications of the results. Suggest further study or applications.<sup>3</sup>

#### *Guidelines for Figures and Tables<sup>2</sup>*

All figures and tables should have descriptive titles and should include a legend explaining any symbols, abbreviations, or special methods used. Figures and tables should be numbered separately and should be referred to in the text by number, for example:

1. Figure 1 shows that the activity decreased after five minutes.
2. The activity decreased after five minutes (fig. 1).

Figures and tables should be self-explanatory; that is, the reader should be able to understand them without referring to the text. All columns and rows in tables and axes in figures should be labeled.

#### **Tables**

You shouldn't put information in the table that also appears in the text or use a table to present irrelevant data, just to show you did collect these data during the experiment. Tables are good for some purposes and situations, but not others, so whether and how you'll use tables depends upon what you need them to accomplish.

Tables are useful ways to show variation in data, but not to present a great deal of unchanging measurements. If you're dealing with a scientific phenomenon that occurs only within a certain range of temperatures, for example, you don't need to use a table to show that the phenomenon didn't occur at any of the other temperatures. How useful is this table?

As you can probably see, no solubility was observed until the trial temperature reached 50°C, a fact that the text part of the Results section could easily convey. The table could then be limited to what happened at 50°C and higher, thus better illustrating the differences in solubility rates when solubility did occur. As a rule, try not to use a table to describe any experimental event you can cover in one sentence of text.

**Table 1. Effect of Temperature on Rate of Solubility.**

Temperature of solvent (°C)	Rate of Solubility (g/sec)
-20	0.0
-10	0.0
0	0.0
10	0.0
20	0.0
30	0.0
40	0.0
50	5.3
60	6.7
70	8.8
80	11.4

## Figures

Although tables can be useful ways of showing trends in the results you obtained, figures (i.e., illustrations) can do an even better job of emphasizing such trends. Lab report writers often use graphic representations of the data they collected to provide their readers with a literal picture of how the experiment went.

### When should you use a figure?

Remember the circumstances under which you don't need a table: when you don't have a great deal of data, or when the data you have don't vary a lot. Under the same conditions, you would probably forgo the figure as well, since the figure would be unlikely to provide your readers with an additional perspective. Scientists really don't like their time wasted, so they tend not to respond favorably to redundancy.

If you're trying to decide between using a table and creating a figure to present your material, consider the following a rule of thumb. The strength of a table lies in its ability to supply large amounts of exact data, whereas the strength of a figure is its dramatic illustration of important trends within the experiment. If you feel

that your readers won't get the full impact of the results you obtained just by looking at the numbers, then a figure might be appropriate.

## **Guidelines for Making Graphical Figures<sup>2</sup>**

- Keep it as simple as possible. You may be tempted to signal the complexity of the information you gathered by trying to design a graph that accounts for that complexity. But remember the purpose of your graph: to dramatize your results in a manner that's easy to see and grasp. Try not to make the reader stare at the graph for a half hour to find the important line among the mass of other lines.
- Plot the independent variable on the horizontal (x) axis and the dependent variable on the vertical (y) axis. Remember that the independent variable is the condition that you manipulated during the experiment and the dependent variable is the condition that you measured to see if it changed along with the independent variable.
- Label each axis carefully, and be especially careful to include units of measure. You need to make sure that your readers understand perfectly well what your graph indicates.
- Number and title your graphs. As with tables, the title of the graph should be informative but concise, and you should refer to your graph by number in the text (e.g., "Figure 1 shows the increase in the solubility rate as a function of temperature").
- Scale the axes of the graphs appropriately. If, for example, the seedlings of your plant grew only 15 mm during the trial, you don't need to construct a graph that accounts for 100 mm of growth. The lines in your graph should more or less fill the space created by the axes; if you see that your data is confined to the lower left portion of the graph, you should probably re-adjust your scale.
- If you create a set of graphs, make them the same size and format, including all the verbal and visual codes (captions, symbols, scale, etc.). You want to be as consistent as possible in your illustrations, so that your readers can easily make the comparisons you're trying to get them to see.

## **Conclusion:<sup>3</sup>**

The purpose of the conclusions section is to put the interpretation into the context of the original problem. Do not repeat discussion points or include irrelevant material. Conclusions should be based on the evidence presented

## **Citing Sources:<sup>4</sup> ACS (American Chemical Society) Style Guidelines Quick Guide**

### **References in the body of a paper can be cited:**

- By superscript

The synthesis of the compound has been described previously.<sup>1</sup>

With numerical citations, references should be numbered sequentially. If a reference is repeated, do not give it another number; rather, use the original reference number.

### **Creating a Bibliography**

- Arrange the references in your bibliography based on the method used for in-text citations. **If numerical citations were used, then arrange references at the end of the paper numerically.**
- All references end with a period.
- Do not leave blank lines between references.
- Journal article titles and book chapter titles are not essential, but they are considered desirable.
- If a book as a whole is used, pagination is not necessary.

### **Book with Author(s)**

Basic Format:

Author, A. A.; Author, B. B. *Book Title (italics)*, Edition (if any); Publisher: Place of Publication, Year; Pagination.

Dill, K. A.; Bromberg, S. *Molecular Driving Forces: Statistical Thermodynamics in Chemistry and Biology*; Garland Science: New York, 2003.

Engel, R.; Cohen, J. I. *Synthesis of Carbon-Phosphorus Bonds: New Methods of Exploration*; CRC Press: Boca Raton, FL, 2004; pp 54-56.

Zumdahl, S. S. *Chemical Principles*, 4th ed.; Houghton Mifflin: Boston, MA, 2002; p 7.

### **Book with Editor(s), and Entire Book is Referenced**

Basic Format:

Editor, A. A., Editor, B. B., Editor, C. C., Eds. *Book Title (italics)*; Series Information (if any, including series number); Publisher: Place of Publication, Year.

Lin, Q., Pearson, R. A., Hedrick, J. C., Eds. *Polymers for Microelectronics and Nanoelectronics*; ACS Symposium Series 874; American Chemical Society: Washington, DC, 2004.

Zaikov, G. E., Jimenez, A., Eds. *Quantitative Level of Chemical Reactions*; Nova Science Publishers: New York, 2003.

### **Authored Chapters in a Book with Editor(s)**

Basic Format:

Author, A. A.; Author, B. B. Chapter Title. In *Book Title (italics)*; Editor, A. A., Editor, B. B., Eds.; Series Information (if any, including series number); Publisher: Place of Publication, Year; Volume number (if any), Pagination.

Downs, G. M.; Barnard, J. M. Clustering Methods and Their Uses in Computational Chemistry. In *Reviews in Computational Chemistry*; Wiley: Hoboken, NJ, 2002; Vol. 18, p 11.

Lenhart, J. L.; Fischer, D. A.; Sambasivan, S.; Lin, E. K.; Soles, M. A. Utilizing Near Edge X-ray Absorption Fine Structure to Probe Interfacial Issues in Photolithography. In *Polymers for Microelectronics and Nanoelectronics*; Lin, Q., Pearson, R. A., Hedrick, J. C., Eds.; ACS Symposium Series 874; American Chemical Society: Washington, DC, 2004; pp 98-117.

### **Encyclopedia Article**

Basic Format:

Article Title. *Encyclopedia Name (italics)*, Edition number; Publisher: Place of Publication, Year; Volume Number, Pagination.

Psychopharmacological Agents. *Kirk-Othmer Encyclopedia of Chemical Technology*, 4th ed.; Wiley: New York, 1996; Vol. 20, pp 455-457.

### **Handbooks**

Basic Format:

Editor, A. A., Editor, B. B., Eds. *Handbook Title (italics)*, Edition number [Online if online]; Publisher: Place of Publication, Year; Pagination or other identifying information.

Budavari, S., O'Neil, M. J., Smith, A., Heckelman, P. E., Kinneary, J. F., Eds. *The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals*, 13th ed.; Merck & Company: Whitehouse Station, NJ, 2001; entry 5066.

Lide, D. R., Ed. *CRC Handbook of Chemistry and Physics*, 84th ed. [Online]; CRC Press: Boca Raton, FL, 2003; p 83.

### Journal Articles

Basic Format:

Author, A. A; Author, B. B; Author, C. C. Title of Article. *Journal Abbreviation (italics)* [Online if online] **Year (boldface)**, *Volume (italics)*, Page numbers.

Borman, S. Protein Sequencing For The Masses. *Chem. Eng. News* [Online] **2004**, 82, pp 22-23.

Slunt, K. M.; Giancarlo, L. C. Student-Centered Learning: A Comparison of Two Different Methods of Instruction. *J. Chem. Educ.* **2004**, 81, pp 985-988.

Takahashi, T. The Fate of Industrial Carbon Dioxide. *Science* [Online] **2004**, 305, 352-353.

The standard list of journal abbreviations is published in *CASSI*, the *Chemical Abstracts Service Source Index*. A copy is kept at the Chemistry Library circulation/reference desk.

### Newspapers

Basic Format:

Last name, First Name; Last Name, First Name. Article Title. *Newspaper Title (italics)*, Complete Date, Page numbers.

Jones, Margot. Panel Urges NASA to Save Hubble Space Telescope. *New York Times*, July 16, 2004, p A1.

### Websites

Basic Format:

Author, A. A. (if any). Title of Site. URL (accessed date), other identifying information. (No need to include URL of subscription sites).

ChemFinder.Com. <http://chemfinder.cambridgesoft.com> (accessed July 14, 2004).

The Combined Chemical Dictionary database, web version 2004 (1); CRC Press: Boca Raton: FL (accessed July 16, 2004).

References:

1. University of Wisconsin Writing Center

[http://writing.wisc.edu/Handbook/SciRep\\_Disc.html](http://writing.wisc.edu/Handbook/SciRep_Disc.html) (accessed August 2010)

2. University of North Carolina: Guide for Writing Scientific Reports

[http://www.unc.edu/depts/wcweb/handouts/lab\\_report\\_complete.html](http://www.unc.edu/depts/wcweb/handouts/lab_report_complete.html) (accessed August 2010)

3. Coghill, A., Garson, L. (2006). *The ACS Style Guide: Effective Communication of Scientific Information* 3<sup>rd</sup> Ed., Oxford University Press, pg. 23.

4. **ACS (American Chemical Society) Style Guidelines Quick Guide**

This web guide is based on the second edition of *The ACS Style Guide: A Manual for Authors and Editors* (1997). <http://www.lib.berkeley.edu/CHEM/acsstyle.htm>