

4 The Laboratory Report

While the laboratory notebook is the primary record of a scientist's work, it is not the way that the scientist conveys the results of that work to the world at large. Any report on your work, such as a scientific paper or other document, will be separate from the notebook.

The biggest difference between the notebook and the report is the intended audience. The notebook is written primarily for your own use, but the report is addressed to others. It might take the form of a paper in a scientific journal, intended for the scientific community at large, or it might be a written report prepared for management or clients.

The report is more selective than the notebook. All data and observations that seem relevant are recorded in the notebook. In the report, you should be more selective. You choose the data and observations that accurately convey the results of the experiment to the readers. You use the data from your notebook as the basis for the report, but you add explanations and discussion of the work to support your conclusions. These should be at an appropriate level for the intended readers, who are competent chemists who are not familiar with the specific experiment you have performed.

Selectivity and accuracy are both important in report writing. No one has the time or the inclination to sift through many lines of numbers to search for the few important ones. The same principle applies to the non-data sections. Don't use three sentences to say what could be said in one. Be selective about what you include, but avoid the tendency to include only favorable data and results. Don't omit data that do not fit your conclusions or preconceived ideas about what the results should be. That type of "selectivity" is unethical.

FORMAT

There are a number of formats that are acceptable for lab reports in general. Usually, a particular journal publisher will define the format to be followed in that journal. ***In this class we require you to follow a particular format, which is described below.*** Your instructor may be grading a hundred or more reports per week. He or she will expect to find them in the following format and may deduct points from or refuse to grade reports that are not in this format.

Here are some comments on the sections you will be required to include in your lab report. Additional instructions on writing lab reports follow this section.

1. Title of Experiment

As in the lab notebook, the title can come straight from this manual or the course syllabus.

2. Your Name

3. Date

This is the date on which you write the report.

4. Introduction

This section serves as an introduction to the report by explaining why the experiment was done and discussing some of the theoretical background of the experiment. It should be no longer than one or two paragraphs and must not be copied from any other source. It is not the same as the purpose statement in the lab notebook.

5. Equations and Structures

If you identify an unknown as part of your experiment, give the structure of the compound here.

If you run a chemical reaction, give the equation or equations for the reaction or reactions. Equations should be balanced and include structural formulas for the organic compounds involved.

If you purify a compound but do not synthesize it, do not include an equation (because there is none). Do not include structures of any compounds that are neither unknowns nor part of the equations.

6. References

Include a bibliographic reference to each of the sources where the procedure, theories, and analytical methods needed for your conclusions were found. Normally these would be the lab manual you are reading now, your textbook, and perhaps resources posted on the departmental or other web sites.

The reference to a lab manual or textbook should include: author or editor, title, publisher, city of publication, year of publication, and page number(s). Here is an example: Crago, Kathleen, *et al.*, ***Organic Chemistry Laboratory Manual***, 6th edition, Wiley, New York, 2005, p. 22.

The reference to a web site should include: author or editor, title of web page, the electronic address or URL in angle brackets, the name of the institution sponsoring the web page, and the year of electronic publication. Example: Crago, K., et al., "The Laboratory Report," <<http://www.xula.edu/chemistry/organic/Labbook/04Report.pdf>>, Xavier University of Louisiana,

2005.

7. Data

The data in this section should be selected from the data recorded in your notebook. In fact, for most experiments the notebook data and the final report data will be the same. Sometimes some of the data and observations recorded in the notebook will prove to be irrelevant to the final result of the experiment, especially if you perform an experiment more than once to get it right. Such first attempts as preliminary melting points may not belong in the report.

However, do not eliminate data merely because it does not fit in with your conclusions. Your instructor may give you further guidance on how to select which data should be included and which should be omitted.

When writing this section, think about the best way to present the data. Usually, numerical data are most easily understood if they are presented in a clearly labeled table arranged in some logical order. Do not forget to include units. Observations may also be placed in tables, but often they can be presented in narrative form instead.

8. Calculations

Most scientific reports do not have a calculations section. Such things as percent recoveries and percent yields are normally included as part of the data. However, your instructors need to be sure you know how to perform these calculations. You should show every calculation you perform for your report in this section.

In your final report, keep the calculations section separate from the data section. In experiments that do not involve any calculations, you should still include a heading for this section with the statement that there were no calculations in the experiment.

9. Conclusions

In this section, come to some conclusions about the results of the experiment. These conclusions should be related to the purpose that you wrote in your lab notebook.

If the purpose included identifying an unknown, then the conclusions must include the identity of the unknown. Give your evidence, and explain how and why it is consistent with your proposed identity and not others.

If the purpose was to purify a compound, the conclusion should state whether or not you were successful. Give the percent recovery, and if your percent recovery was not 100%, explain where the missing material might have gone (or where extra material might have come from). Also, give your data about the recovered material (melting point, boiling point, refractive index, infrared spectrum), and explain what it indicates about the purity of

your product.

If the purpose was to synthesize a particular compound, then the conclusions should state whether you successfully made the compound, the percent yield, and the quality of the product. If your percent yield was not 100%, you should explain where the missing material might have gone (or where extra material might have come from). Also, give any data you may have about the product, and explain what this evidence indicates about the purity of your product.

You must have experimental evidence to support your conclusions, but your conclusions must go beyond merely restating the data. This is also the appropriate place to compare your data to literature data.

For example, melting point range is one measure of the quality of a product. You would have listed the melting point range in the data section. In the conclusions section you might have a statement such as the following. "Because the melting point range of 122-132°C that was obtained for the product was so wide, and because it was so much lower than the literature melting point of 139°C, the product is most likely impure." Notice that this statement stated a conclusion (the product was impure), gave a reason (wide and low melting point range), and cited the particular experimental data that supported the statement (the melting point range of 122-132°C) as well as the literature melting point.

Other Lab Report Requirements

The laboratory report should be done on a computer using a word processing program. The document that you turn in must be a good quality printout. The font size for the text in the main body of the report should be 10 or 12. You can make the title larger if you so desire. A typed report is also acceptable. However, under no conditions will a handwritten or hand-printed report be accepted.

Occasionally some item in the report, such as a chemical structure, may have to be added by hand. Please do this only when necessary, however. Reports with excessive amounts of handwritten additions that could have been word processed or typed will be downgraded.

The report must be entirely your own work and an honest report of that work. In some cases, the data in the report will have been obtained with a lab partner. In that case, you and your partner will necessarily have the same data. However, your partnership must not extend to the writing of the report. If material from another source is legitimately included, it must be properly attributed and the source cited in a footnote.

Presenting another person's work as your own by copying it and not properly giving credit is plagiarism. It is a serious offense in any scholarly and scientific community, and it can result in your receiving an F in this course. In the same vein, all data must be your own and reported just as obtained in the laboratory. Any copying, altering, inventing, or fudging of data is also unethical and will be treated as cheating.

When writing the report, imagine that the reader will be a competent chemist, but unfamiliar with the experiment that you are describing. Don't explain general things that a chemist would know, but do explain the particular experiment.

Don't leave necessary things out, but try to be brief and to the point. Your instructor will not be impressed with flowery language and is an expert at recognizing padding. The lab report is not the place for poetry or creative prose. Complete but concise writing will lead to the highest grades.

You must follow the rules of grammar and good writing. Use complete sentences and correct punctuation. Your instructor may deduct points for poorly written lab reports. If you discover that you need help with the writing aspects of the notebook, your instructor can give you a referral to the Writing Center, or you can take the initiative and go yourself.