Research experience is as close to a professional problem-solving activity as anything in the chemistry curriculum. It provides exposure to research methodology, and usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation. Research is the exploration of the unknown, leading to new knowledge that often warrants publication. Science depends on precise transmission of facts and ideas. As part of the experience in this course, **all students are required to communicate their results in the form of a formal research report.**

Initial drafts must be critiqued by the faculty advisor and corrected by the student at each stage, and the final version of the report must be submitted by the last day of classes of the semester. Guidelines on how to prepare a professional-style research report are found below. These were adapted with permission from guidelines provided by the American Chemical Society.

**Organization of the Research Report**

Most scientific research reports, irrespective of the field, parallel the method of scientific reasoning. That is: the problem is defined, a hypothesis is created, experiments are devised to test the hypothesis, experiments are conducted, and conclusions are drawn. This framework is consistent with the following organization of a research report:

- Title
- Abstract
- Introduction
- Experimental Details or Theoretical Analysis
- Results
- Discussion
- Conclusions and Summary
- References

**Title and Title Page**

The title should reflect the content and emphasis of the project described in the report. It should be as short as possible and include essential key words.

The author's name should follow the title on a separate line, followed by the student author's affiliation (Department of Chemistry, Xavier University of Louisiana, New Orleans LA 70125), the date, the origin of the report (In partial fulfillment of the requirements of Undergraduate Research, CHEM 4083), and the mentor's name and affiliation.

All of the above should be on a single cover page. Acknowledgments and a table of contents can be added as preface pages if desired.

**Abstract**

The abstract should, in the briefest terms possible, describe the topic, the scope, the principal findings, and the conclusions. It should be written last to reflect accurately the content of the report. An abstract seldom exceed 200 words.
A primary objective of an abstract is to communicate to the reader the essence of the paper. The reader will then be the judge of whether to read the full report or not. Were the report to appear in the primary literature, the abstract would serve as a key source of indexing terms and key words to be used in information retrieval. More detail is available in a separate departmental handout on this subject.

Introduction

"A good introduction is a clear statement of the problem or project and why you are studying it." (The ACS Style Guide. American Chemical Society, Washington, DC, 1986.)

The nature of the problem and why it is of interest should be conveyed in the opening paragraphs. This section should describe clearly but briefly the background information on the problem, what has been done before (with proper literature citations), and the objectives of the current project. A clear relationship between the current project and the scope and limitations of earlier work should be made so that the reasons for the project and the approach used will be understood.

Experimental Details or Theoretical Analysis

This section should describe what was actually done. It is a succinct exposition of the laboratory notebook, describing procedures, techniques, instrumentation, special precautions, and so on. It should be sufficiently detailed that other experienced researchers would be able to repeat the work and obtain comparable results.

In theoretical reports, this section would include sufficient theoretical or mathematical analysis to enable derivations and numerical results to be checked. Computer programs from the public domain should be cited. New computer programs should be described in outline form.

If the experimental section is lengthy and detailed, as in synthetic work, it can be placed at the end of the report or as an appendix so that it does not interrupt the conceptual flow of the report. Its placement will depend on the nature of the project and the discretion of the writer.

Results

In this section, relevant data, observations, and findings are summarized. Tabulation of data, equations, charts, and figures can be used effectively to present results clearly and concisely. Schemes to show reaction sequences may be used here or elsewhere in the report.

Discussion

The crux of the report is the analysis and interpretation of the results. What do the results mean? How do they relate to the objectives of the project? To what extent have they resolved the problem? Because the "Results" and "Discussion" sections are interrelated, they can often be combined as one section.

Conclusions and Summary

A separate section outlining the main conclusions of the project is appropriate if conclusions have not already been stated in the "Discussion" section. Directions for future work are also suitably expressed here.

A lengthy report, or one in which the findings are complex, usually benefits from a paragraph summarizing the main features of the report - the objectives, the findings, and the conclusions.
The last paragraph of text in manuscripts prepared for publication is customarily dedicated to acknowledgments. However, there is no rule about this, and research reports or senior theses frequently place acknowledgments following the title page.

References

Literature references should be collated at the end of the report and cited in one of the formats described in The ACS Style Guide (see below) or standard journals. Do not mix formats. All references should be checked against the original literature.

Preparing the Manuscript

All reports must be prepared by means of word processing. Computers are available on campus for this purpose if you do not have your own. Xavier University is providing all faculty and students with a site license for the use of ChemBioOffice Ultra. This software can be downloaded on any computer. The subscription information can be found on blackboard. Using this program you not only can draw chemical structures and reaction schemes, but you can also perform many other tasks. All manuscripts must be checked for spelling (spell check programs are helpful, but will not recognize specialized chemical terminology). All manuscripts should be carefully proofread before being submitted. Preliminary drafts must be edited by the faculty mentor before the report is presented in final form.

Two Useful Texts

Writing the Laboratory Notebook, Kanare, Howard M., American Chemical Society, Washington, DC, 1985.

This book describes, among other things, the reasons for note keeping, organizing and writing the notebook with examples, and provides photographs from laboratory notebooks of famous scientists.


This volume is an invaluable writer's handbook in the field of chemistry. It contains a wealth of data on preparing any type of scientific report and is useful for both students and professional chemists. Every research laboratory should have a copy, and it should be as accessible as the Handbook of Chemistry and Physics. It gives pointers on the organization of a scientific paper, correct grammar and style, and accepted formats in citing chemical names, chemical symbols, units, and references.

There are useful suggestions on constructing tables, preparing illustrations, using different type faces and type sizes, and giving oral presentations. In addition, there is a brief overview of the chemical literature, the way in which it is organized and how information is disseminated and retrieved. A list of other excellent guides to technical writing is also provided. See also The Basics or Technical Communicating. Cain, B. E.; ACS Professional Reference Book, American Chemical Society: Washington, DC, 1988.