

Department of Chemistry  
Undergraduate Research Form  
CHEM 4160

For \_\_\_\_\_ Semester, 20\_\_\_\_\_

Name \_\_\_\_\_ ID \_\_\_\_\_

Address \_\_\_\_\_

Mobile Phone \_\_\_\_\_ Email \_\_\_\_\_

I understand that Chem 2410 (or equivalent) is a prerequisite for enrollment in Chem 4160. I also understand that Chem 4160-4170 must be taken in separate semesters.

All students taking CHEM 4160 are required to give a presentation (~20 minutes) describing their research. This talk is to be given during the last semester the student is enrolled in senior research. The student and faculty advisor are to schedule the talk. This presentation may be given at an area specific group meeting.

I understand that to work in the lab, I must complete hazardous waste training. I also understand that I must successfully complete the CITI online training (minimum: Physical Science modules; others if applicable) during the first week of the term (can be done before term starts) if not already completed (submit printout of scores to the Director of Undergraduate Studies).

I understand that I must develop a plan for the proposed Senior Research project in conjunction with my faculty research advisor before beginning the project. The plan should include (1) title of project, (2) name of student, (3) name of faculty advisor, (4) purpose, (5) possible methods of attack, and (6) pertinent literature references.

I further understand that since this is a writing intensive course, a final written report must be submitted to the faculty advisor on or before the first day of exams week describing progress in the course. The research advisor will provide feedback until the final rewritten report meets ACS standards, etc. The departmental Director of Undergraduate Studies will also review the final paper for style and suggest revisions if necessary before a grade will be issued. The Undergraduate Director will also review documentation of completion of Hazardous Waste training and CITI training.

I also agree to employ good techniques, to be careful and to observe all safety rules and policies while working in the laboratory. I understand that law requires safety glasses to be worn whenever I am in the laboratory. I further understand that the Chemistry Department of Georgia State University does not assume responsibility for any injuries or property damages sustained due to my own negligence or misconduct.

Chem 4160 requires submission of an approval final report. A grade of "C" or higher is passing. This final report, after approval as for 4160 by the research director and Director of Undergraduate Studies, will be on file in the Chemistry Office. A grade of "I" (Incomplete) will be awarded to all students who do not meet this requirement.

Student Signature \_\_\_\_\_ Date \_\_\_\_\_

Faculty Advisor Signature \_\_\_\_\_ Date \_\_\_\_\_

Director of Undergraduate Studies \_\_\_\_\_ Date \_\_\_\_\_

## Guidelines for Preparing Research Report

Research experience for the undergraduate chemistry student is as close to a professional problem-solving activity as anything in the curriculum. It gives the student exposure to research methodology and an opportunity to work closely with the faculty advisor. It usually requires the use of advanced concepts, a variety of experimental techniques, and state-of-the-art instrumentation. A good research experience develops intellectual curiosity and is an important stimulus toward a career in science.

Ideally, undergraduate research should focus on a well-defined project that stands a reasonable chance of completion in the time available to the student. A literature survey alone is not a satisfactory research project. Neither is a repetition of established procedures. Research is genuine exploration of the unknown that leads to new knowledge, which often warrants publication. But whether or not the results of a research project are publishable, the project should be communicated in the form of a student-written research report. It is important for the student to realize that science depends on precise transmission of facts and ideas. To communicate effectively, the research project must be described in writing. Preparation of a comprehensive written research report is an essential part of a valid research experience, and the student should be made aware of this requirement at the outset of the project. Interim reports may also be required, usually at the termination of the semester. Sufficient time should be allowed for satisfactory completion of reports, taking into account that initial drafts should be critiqued by the faculty advisor and corrected by the student at each stage.

Guidelines on how to prepare a professional-style research report are not routinely available to undergraduate students. For this reason, the following information on report writing with a suggested format is provided to be helpful to undergraduate researchers and to faculty advisors.

### A Useful Text

*The ACS Style Guide*, Dodd, J.S., Ed.; American Chemical Society: Washington, DC, 1986

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 typefaces 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 of Technical Communicating*, Cain, B.E.; ACS Professional Reference Book, American Chemical Society: Washington, DC, 1988.

### Organization

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  
Conclusion  
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 (e.g., Mry B. Chung) should follow the title on a separate line, followed by the author's affiliation (e.g., Department of Chemistry, Georgia State University, Atlanta, GA 30302) and possibly the origin of the report (e.g., In partial fulfillment of a Senior Thesis Project under the supervision of Professor Danielle F. Green, May, 2006 and/or the course number and term, e.g., Chem 4160, Spring 2006).

All of the above could appear on a single cover page. Acknowledgements and a table of contents can be added as a 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. The length of the abstracts varies but seldom exceeds 200 words.

The research student should understand that 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. The student should also know that if the report were 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. Author abstracts are often published verbatim in *Chemical Abstracts*.

## **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 will be understood.

## **Experimental Details**

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.

If the experimental section is very lengthy and very 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, observation, and findings are summarized. Tabulation of data, equations, charts, and figures can be used effectively to present results clearly and concisely.

## **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**

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.

## **Summary**

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 acknowledgements. However, there is no rule about this, and research reports or senior thesis frequently place acknowledgements following the title page.

## **References**

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

## **Preparing the Manuscript**

Personal computers have made manuscript preparation and revision a great deal easier than it used to be. Students should always type their reports and use graphics software to allow numerical data to be graphed, chemical structures to be drawn, and mathematical equations to be represented. These are essential tools of the technical writer. All manuscripts should be routinely spell checked and carefully proofread before being submitted. Preliminary drafts should be edited by the faculty advisor and revised by the student before the report is presented in final form.

## Laboratory Safety Certificate

Please follow the links below and complete the following trainings in order to get the Laboratory Safety Certificate before the initiation of your senior research.

1. Right to Know Basic Training  
<http://www.usg.edu/facilities/rtk-ghs>
2. Online Bloodborne Pathogen Training  
<http://www.usg.edu/facilities/training/pathogens/>
3. CITI Certificate Completion (due with research final project)  
<https://www.citiprogram.org/>
  - Select "Create Account"
  - Step number 1 states, "Select your institution or organization". Under "Participating Institutions", select Georgia State University. Then scroll down to step number 2.
  - Complete the subsequent steps

If you have any questions or concerns regarding laboratory safety and/or training, please do not hesitate to contact Arefeen Chowdhury via the following contact information.

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Georgia State University  
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