What follows is the Progress Report on the steps taken by the Chemistry Department to fulfill its commitments on the Memorandum of Agreement (MOA) agreed upon and signed in the fall of 2003. This MOA was the result of the fifth cycle of DePaul University's Academic Program Review Process (Cycle 5).

Actions agreed upon for the coming academic year:

1. **Graduate Program Marketing**

   The Chemistry Department will investigate ways to increase the visibility of their graduate programs by exploring potential advertising outlets including direct mailings to industry, web advertising to focused targets, and possibly purchasing advertising space in local professional publications. Incoming students and potential students who contact the department will be monitored to see the effects of the advertising. If real opportunities for the growth of tuition paying students are identified and if evidence that ad placement will increase enrollment is provided to the Dean of the College of Liberal Arts and Sciences, the Dean has indicated a willingness to provide institutional assistance in ad placement.

*What has been done:*

Two faculty members of the chemistry department, Dr. Kharas and Dr. Jin, conducted an exhaustive assessment of the Master Programs offered by the department. For convenience, a copy of their formal report is attached as Appendix 1. An important goal of the assessment was to identify the strengths and limitations of the MS program in comparison with similar programs at the national level. In particular, it was found that the Coatings and Technology option has substantial prestige and visibility. In contrast, the Biochemistry option is not well advertised. In terms of enrollment, it is seen that the general pattern is a decrease in the number of active graduate students enrolled. It was also found that the average number of graduates has decreased from 9 awardees (2000-2001, and 2001-2002) to 6 awardees (2002-2003, and 2003-2004). This reduction in the
number of MS degrees awarded is of serious concern in the Chemistry Department. The Chemistry Department met on May 16, 2005 to reflect on the findings presented in the assessment report. A result of this meeting was the formation of a new departmental committee aimed at finding ways to improve the program in terms of the number of students enrolled and graduated, curriculum, etc. The newly formed committee is composed by the following members Greg Kharas, Lihua Jin, Nithya Rajan, Quinetta Shelby, and Kevin Murray.

**What will be done:**

The newly formed committee will begin activities in the fall of 2005 and will address such aspects as:

a. Offering the MS program at night makes it unique. How can we improve the numbers?
b. Publicity (e.g., profile in the Tribune on DePaul and the uniqueness of the program).
c. Advertising in relevant coatings and biochemistry journals and other publications.
d. Preliminary research on cost to help determine an appropriate budget. A case is to be made to the College for advertising dollars.
e. Outreach to alumni.
f. Establish a mechanism to track the progress of students after graduation from the program. This in turn may eventually be used to make the program more attractive based on the successful careers of its alumni.
g. Send advertising flyers to companies (managers).
h. Increase stipends through grants (seed money through OSPR?).
i. Change curriculum (or at least the emphasis in certain courses) to make it more relevant to prospective students.
j. Advertise the BS-MS joint program to our undergraduates.

The committee will report periodically to the chemistry department. Once a formal report is presented to the department, a meeting will be held to discuss the results and determine the subsequent actions.

2. **Masters of Chemical Education Program Investigation**

A Masters of Chemical Education program may be an opportunity for growth in the Chemistry Department and also an opportunity to provide service to K-12 educators in the Chicago Public School system. The department will investigate the viability of this degree by contacting the department chairs of high schools in the Chicago area with a questionnaire regarding the level and areas of interest their institutions have in this type of program. Should the program be viable, a proposal for the creation of a Masters in Chemical Education program, for six additional courses, and for appropriate resources will be made to the Dean of the
What has been done:

Dr. Nithya Rajan conducted an extensive investigation regarding the importance and viability of an M.S. in Chemical Education. Dr. Rajan found, for example, that there were no dedicated programs to address specific content endorsement in chemistry and pedagogical content knowledge in chemistry at the high school level. This finding is particularly important in consideration of The No Child Left Behind (NCLB) Act of 2001, which requires that by the end of the 2005-2006 school year all teachers teaching core academic subjects must be highly qualified in the subjects they are assigned to teach. In Illinois high schools, for example, the need index for science teachers by 2005 is estimated to be 53%. The need index for chemistry teachers (50%) exceeds that for physics (40.1%), biology (42%) and earth science (42%) as published by the Illinois State Board of Education (ISBE).

The idea for an M.S. in Chemical Education crystallized after many discussions at departmental meetings addressing the findings of Dr. Rajan, and also the apparent lack of preparedness in chemistry among our DePaul students at the freshman-sophomore level. This problem most likely stems from the fact that an overwhelming number of students are taught chemistry by out of field teachers at the pre-college level. In the context of the NCLB legislature, shortage of highly qualified science teachers in Illinois, and DePaul University’s commitment to improving science education, the Chemistry Department developed a proposal for M.S. in Chemical Education to be completed in two years taking six courses a year.

Although the proposal was approved at the college level, the Committee on Curriculum Programs had concerns about the design of the courses and lack of collaboration with the School of Education. Presently, the Chemistry Department has put this proposal on hold and will retool the program significantly with less cross-listing of courses with existing courses; provide more evidence of expertise in pedagogical education in the sciences; document more specifically our plans for the proposed courses; and establish a more appropriate relationship with the School of Education.

3. General Chemistry Sequence Structure

The Chemistry Department is committed to examining its general chemistry sequences in order to improve student inclusiveness and assist students who need to improve their math skills prior to or as they begin their coursework in the Chemistry Department. Possibilities include consolidating the two current chemistry sequences into one, requiring calculus (Mat 130) as a pre- or co-requisite for the Chemistry sequence, staggering courses in the fall and winter quarters to allow more than one entry point per year, and providing a summer
sequence so students selecting the major later in their careers are not unduly delayed in completing the required coursework. Additionally, the Chemistry Department will continue to work with the Mathematics and other science departments, as appropriate, to enhance students’ math preparedness.

**What has been done:**

The Chemistry Department has implemented two general chemistry sequences. The topic materials covered in the two sequences are the same. An important difference between the sequences is that while one sequence (CHE 131, CHE 133) is a two-quarter sequence starting in the winter quarter, the other sequence (CHE 111, CHE 113, CHE 115) is a three-quarter sequence starting in the fall. Another differentiating factor between the sequences is that the two-quarter sequence has MAT 130 as a prerequisite, whereas MAT 101 is the prerequisite for the three-quarter sequence. By having the two sequences beginning in a staggered manner, students are allowed more than one entry point per year. The Chemistry Department is also providing a summer sequence CHE 131 and CHE 133. By so doing, students selecting the major later in their careers are not unduly delayed in completing the required coursework. Additionally, students who failed either portion of the CHE 131-133 sequence have an opportunity to retake the course or courses right away rather than waiting for an entire year.

**What will be done:**

The Chemistry Department will conduct a comparative assessment for the CHE 111-115 and the CHE 131-133 sequences. To have a more complete set of data, the Department will offer the two sequences for two consecutive academic years, of which the first one is about to finish. Once the objective assessment is performed, a Departmental meeting will be held to discuss the results and determine the appropriate course of actions.

4. **Mathematical Preparation**

The Department will strongly encourage students to take MAT 260 and MAT 261 (Multivariable calculus I and II) prior to taking the upper level chemistry courses, namely CHE 210-211-215, where a solid background in the multivariable calculus taught in these math courses is necessary. The department will track students to see if any differences between the performances of those who take the additional math courses and those who do not are sufficient to justify including the courses as an additional requirement. Currently, with the exception of students interested in the American Chemical Society Accreditation, the MAT 260-261 courses are not part of the program requirements.

**What has been done:**
In an effort to improve students’ awareness of the importance of a solid mathematical background in chemistry, the following message has been added in the description of common core courses in chemistry

**MAT 260 and 261, Multivariable Calculus I and II, are strongly recommended. (MAT 260 is required for some B.S. chemistry options.)**

The description of the common core courses as well as any relevant information can be found in the website of the Chemistry Department. It should be mentioned that Faculty teaching any of the general chemistry sequences have been advised to inform students of the positive impact that the mathematical background provided by the MAT 260 and 261 will have in their future coursework in chemistry.

**What will be done:**

The department will track students to see if any differences between the performances of those who take the additional math courses and those who do not are sufficient to justify including the courses as an additional requirement. The first round of analysis will be performed using data from the CHE 210-215 sequence of the academic year 2004-2005. A second round of analysis will be performed using the sequence for the academic year 2005-2006. Once the two sets of data are properly revised and analyzed, a departmental meeting will be held to discuss and determine pertinent actions.

5. **Laboratory Reports**

The Chemistry Department is committed to help students enhance their ability to write high quality lab reports.

   a. Faculty will collaborate in the development of a unified template/model of what a good lab report should look like and make the model accessible on its website. The lab report model will be adjusted to fit the particular expectations of the chemistry sub-disciplines; namely, general chemistry, organic chemistry, inorganic chemistry, physical chemistry, and biochemistry.

   b. The Department will also consider using the writing workshops being sponsored by TLA and Academic Affairs during the fall and winter of 2003-2004, especially, those with a focus on writing in the sciences, to find ways to develop students’ writing abilities.

**What has been done:**

Dr. Niedziela and Dr. Matthew Dintzner from the Chemistry Department developed a unified template of what a good lab report should look like. Such a
model is available in the website of the Chemistry Department and a copy is provided as Appendix 2.

In 2003, Dr. Dintzner submitted a grant proposal to the Teaching, Learning and Assessment Committee to promote writing in the disciplines ("Writing in DePaul's Chemistry Curriculum") and this was funded for $1000. During the winter and spring quarters of 2004, Dr. Dintzner met weekly with the students enrolled in experiential learning (CHE 251) for a "common hour" session and worked on chemistry related writing assignments. He also worked with these students on how to communicate research results orally and collectively they gave a presentation to the department at the end of spring quarter. The department has since made such oral presentations a requirement for all students earning experiential learning credit and the presentations are evaluated as part of the student's grade for the course. Students take these presentations very seriously and as a result have focused more seriously on understanding their research.

6. Advising

The Department will continue initiatives to improve advising. The Chemistry Advising Open House, in which students are invited to discuss registration/prerequisites issues with faculty, will continue so that students can obtain information as to what courses they should take and when they should take them. The web site and e-mail lists will be used to communicate with students about advising concerns/opportunities. The department will, as needed, address the issue of improving summer advising.

What has been done:

The Chemistry Department has continued with the quarterly Advising Open House. It is noteworthy to mention that the advising has been expanded to include all science majors, not just chemistry majors. It is found that the advising Open House is well received by the students, so much that the number of students taking advantage of this resource continues increasing since the department started offering. Dr. Dintzner, who has been an advisor in the Advising Open House in many occasions states: “In my experience, the students who use this service the most are first- and second-year biology or chemistry majors, which is good because we want to make sure they're on the right track as soon in their careers as possible.” During the advising sessions, students are advised with regard to the chemistry courses they need to take and when, what math courses are required and when they should take them. Additionally, students interested in getting just a minor in chemistry are also advised to make sure they can get it within a reasonable amount of time.

Advising Open Houses are typically held during the first week of registration for the up-coming quarter; our last one was on April 28, 2005.

What will be done:
The Chemistry Department will continue its commitment to advising by improving upon such aspects as better advertising, more faculty participation, and more upper level chemistry majors involved

7. Assessment

Assessment of student outcomes is currently being used by the Chemistry Department as a diagnostic tool in courses aimed at majors. The Department Chair will continue to encourage use of the American Chemical Society’s standardized assessment tests for the purpose of enhancing individual courses and being able to compare the program to national norms. However, during the next academic year, the department has decided to develop ways to assess student learning for non-science majors. To this end, they will consult with TLA (the Teaching, Learning, and Assessment Committee). Areas of particular interest to the department include such issues as critical and creative thinking, and historical consciousness. The department will report in next year’s progress report on the uses made of the results of its various assessment efforts, including the American Chemical Society’s assessment tests.

What has been done:

The Chemistry Department has conducted assessment of student learning for both non-science majors and chemistry majors. The former was performed in the Assessment Plan for Academic Year 2003-2004, whereas the latter was conducted in the Assessment Plan for Academic Year 2004-2005. The corresponding Assessment reports were submitted to the Teaching and Learning Assessment Committee.

For non-science majors, the Chemistry Department was interested in assessing such issues as quantitative reasoning skills, creative thinking, and historical consciousness. The assessment were carried out by analyzing random samples of exams and homework assignments from students taking any one of the CHE 100-102 general chemistry series for non-science majors. The samples were evaluated based on a rubric developed by the Chemistry Department Assessment subcommittee.

For the science majors, the Chemistry Department was particularly interested in assessing our students’ ability to write in the discipline. To do this, we randomly sampled laboratory reports from students taking CHE 211 (Physical Chemistry II) during the 2005 winter quarter. The samples were evaluated according to a rubric developed by the Chemistry Department Assessment subcommittee. The assessment focused on various scientific writing components such as the use of proper grammar, the appropriate use of graphs and tabulated data, the application of quantitative reasoning skills, and the ability to construct logical scientific discussions. It should be noted that CHE 211 is populated with third- and fourth-year chemistry majors who presumably have participated in our lower level
courses. An assessment of their work at this point will give us some indication on how successful we are in teaching our majors how chemists communicate through the written word.

8. **Career Development**

The Chemistry Department will seek ways to make its students more aware of the variety of professional/career opportunities potentially available to them, including possible collaboration with similar efforts in the other science departments, especially the Environmental Science Programs, and with the Career Development Office. The department will maintain the fall event, “Life after DePaul,” in which students receive information about graduate/medical school, government positions, laboratory and forensics employment and non-traditional work as well as hear speakers from a variety of backgrounds and career settings. A link on the Chemistry Department’s website connecting students to a variety of career and educational opportunities will be created and maintained by the department.

*What has been done:*

The Chemistry Department created and currently maintains up-to-date website links to important information regarding the future professional development of our graduates. These links are specifically oriented towards the following topics: Careers in Chemistry, Education, Research, and Graduate and Medical School Info. These links are found in the department website under the category “After DePaul …”

9. **Diversity**

The Chemistry Department has an excellent history in diversity initiatives and efforts to recruit a diverse faculty. The department will continue these efforts when new faculty lines become available.

*What has been done:*

The Chemistry Department remains as one with strong race and gender diversity.

10. **K-12 Future Science Teacher Preparation**

The department will be open to and will initiate collaborative efforts with the School of Education to improve the preparation of science teachers for primary and secondary schools.

*What has been done:*

The chemical education specialist in the Chemistry Department, Dr. Rajan, is actively working with science education personnel in the School of Education to establish effective collaboration on the subject matter.
Introduction

In the process of evaluation of our M.S. program it was of interest to peruse communications of the ACS Committee on Professional Training (CPT) which is charged with examining graduate education in chemistry, M.S. and Ph.D. training. According to CPT recent surveys of programs and participants “there are obvious indicators that the Master's degree in chemistry is alive and well” (1). The number of M.S. degrees is comparable to the number of Ph.D. degrees awarded. The ACS Directory of Graduate Research records that the number of M.S. degrees awarded annually has increased steadily over twenty years to 2000, about one-third of them are from institutions in which the Master’s is the terminal degree (2). The employment picture for M.S. graduates is healthy with 66% opting for business/industry, 25% education, and 9% government (3). The annual salary survey conducted by the ACS shows a consistent and significant added value of the M.S. degree for professional chemists as they enter the workforce (1).

These are highlights of the CPT surveys. “The mean values of both the reported minimum time toward the degree (1.7 years) and the average time (2.5 years) are the same at Master's and doctoral universities. The average course credit hour requirement, (about 29), roughly equivalent to a year of course work, is quite common. Some schools require two years of coursework, and a few have no firm course requirement. Requirements for the Master's degrees vary. It is not uncommon to have multiple tracks. Frequently, schools offer both a coursework-only Master's, and a research-based Master's. Coursework-only Master's degrees are offered at 25% of the Master's-level schools, and at 42% of the Ph.D. schools. Specific courses for Master's students and specific exams for Master's students are prevalent, but far from universal.”

“Like Ph.D. programs, most Master's programs are designed broadly to accomplish a variety of goals: preparing students for jobs in industry, in education, and to go on to further study. In some cases, there are separate tracks, with separate degree requirements, but that is not common. About one third of Master's programs report teacher-training as one of their goals. This number is about the same at Master's and Ph.D. schools. Special programs for in-service teachers seem to be more prevalent at non-Ph.D. schools. Preparation for work in industry is a common objective for Master's programs: 59% of Ph.D. schools and 89% of Master's schools reported this goal. But the number of programs with a specific industrial focus is small. About 4% of respondents described their program as preparing for a particular sector of industry, and 6% reported industry partnerships. While the numbers are small, Master's programs with a particular industrial emphasis or with specific connections to industry can be attractive to both students and to industry. Examples include a program in Coatings Technology and Polymer Chemistry at DePaul University, a program in Industrial Chemistry at the University of Central Florida, the Lehigh Educational Satellite Network, which allows Lehigh courses to be offered to employees at multiple corporate sites, and the University of Colorado Denver's program with an
Environmental and Biotech-Pharmaceutical emphasis. Several schools offer combined B.S./M.S. degrees, including Idaho State and Vassar.”

The conclusion from ACS surveys is that clearly, the Masters’ degree in chemistry is a major part of graduate education and an important source of professional chemists.

The objective of this analysis is to consider state of the program in terms of the quality of educational experience provided, and attempt to identify its strengths and limitations in comparison with M.S. programs on the national level.

**Purpose of the Programs**

The degree of Master of Science in Chemistry is designed to prepare students for advanced work in the profession of chemistry or biochemistry and for further graduate study.

To provide multiple opportunities the department offers seven M.S. program options: two standard MS degree (thesis and non-thesis), three biochemistry (thesis, library thesis, and non-thesis), polymer chemistry and coatings technology, and BS/MS.

Polymer Chemistry and Coatings Technology (PCCT) option established in 1985 is designed to provide students with specialized skills necessary for work in research and development in the polymers and coatings field.

An important feature of the program is that it is geared to part-time students (about 80% of all graduating students) by offering classes in the evening. Some students comment that the program does a great community service by providing opportunity for education and advancement to those who employed in local industries.

**Administration of the Program**

The program administered by the department chair. The chair is responsible for response to phone calls, e-mail, and in person requests from prospective students seeking additional information, review of applications, guidance of potential students through application process, acceptance to the program, graduation check as well as hiring part-time instructors, advertising, and logistic and financial issues of the program.

Dr. Kharas is serving as a coordinator of PCCT program. His responsibilities include responds to phone calls, e-mail, and in person requests from prospective polymer and coating students seeking additional information, liaison with local and national polymer chemistry and coatings technology organizations, and industry, as well as advertising and promotion of the MS option.

**Advising**

Academic advising is provided by Drs. W. Wolbach, L. Lin (biochemistry options), and G. Kharas (PCCT). Graduate open house is conducted at least once a year.
Advertising and Promotion

Program information is available on the departmental website. Nationally, the program is listed in web-based ACS Registry of Chemistry-Based Master’s Degree Programs.

PCCT program is advertised (free of charge) at least once a year in mailings of Chicago Society of Coatings Technology (CSCT) (about 700 members) and nationally, once a year in the coatings technology education issue of Journal of Coatings Technology, professional magazine of the Federation of Societies of Coatings Technology (FSCT).

Compared to the coatings option, the biochemistry option is not as well advertised. On average we get 3 students per year in this option for the last three years.

Career Advising

Internships, part time and full time jobs are posted regularly on the department website. Kevin Murray and Vadim Krongauz are successful industrial chemists (together with Greg Kharas, who spent several very productive years as an industrial scientist) give a lot of advice to students and lecture on carriers in industry.

At least half of the biochemistry option students are already employed during their study and the rest of our students had no problem finding employment.

Relationships with Industry

A key asset in the coatings graduate program is the business/industry advisory committee of CSCT and FSCT. These committees open a consumer’s view to faculty on course content and sets of skills thus providing input into curriculum. They enhance credibility of the program within the business community and help with internships and employment of the program graduates. The CSCT member businesses send their own employees to the program. Our graduate students are regularly invited to CSCT educational and technology meetings. CSCT and FSCT funds regularly contribute to coatings research projects for graduate students. Our students are invited every year to attend CSCT professional presentations, workshops, and educational programs.

Almost every year we present a research poster at the annual International Coatings Technology Conference. These activities provide our students with excellent opportunities to peek into industrial (real life) world, to establish contacts, and receive industrial orientation.

In summary, our coatings program has substantial prestige and visibility in the field.

Although the Biochemistry option is less visible than the Coatings Technology, it has been, for last 5 decades, serving employees of the area industries in furthering their education and upgrading their knowledge in the field. Many of our alumni are on key posts in the field, a vice president at Abbott, a head chemist at Evanston Hospital, a senior scientist at Eli Lily, just to
name a few. Our own lab coordinator is a graduate of our program, who is making a great contribution to the teaching at the department.

**Curriculum: Content**

The course credit hour requirement for all MS options is 44-quarter hours. Degree requirements and course offerings for chemistry and biochemistry options were developed according to structure of chemical science, standards generally accepted by comparable programs in similar four-year colleges, and needs of the students. For MS options with a thesis a research experience is required.

Degree requirements and course offerings for PCCT option has been set up with cooperation of the CSCT and are comparable to similar graduate programs in coatings technology. The program is reviewed annually at the CSCT board of directors, as well as at the annual meeting of educators, sponsored by Educational Committee of the FSCT.

Degree requirements and course offers for the Biochemistry option is comparable to similar programs of both MS and Ph.D. institutions including St. John, University of Scranton, Ohio State University, California State University at Fullerton and Baylor University.

**Curriculum: Methodologies**

Major instructional methodologies involve lecture and laboratory instruction, which are monitored via peer reviews and student evaluations for relevance and adherence to appropriate departmental standards.

Development of communication skills and creative thinking, some of the classes (e.g. CHE 434), involve an independent research project which includes written communications (reports) and an oral (a power point) presentation. The program provides opportunities for experiential learning.

One of the two Advanced Biochemistry courses train students in literature reading, writing and publishing scientific papers, study of advanced and most up to date research in selected research areas, and in researching and presenting research findings. This course therefore prepares students well for further research and for scientific communication.

**Faculty**

Six full-time faculty, all Ph.D. teaching in the program.

Two part-time faculty, (one Ph.D. and one M.S.) teach two lecture and two laboratory courses biannually in the polymer chemistry and coatings technology M.S. option. Both are successful industrial chemists.

Dr. V. Krongauz is associated with the department for about 12 years. He is teaching biannually two lecture courses in Coatings Technology. He is an expert in coatings technology and is employed now by Baxter.
Mr. K. Murray is teaching biannually one lecture course and two laboratory courses in polymer synthesis and coatings applications. He has a MS degree in Coating Technology from DePaul. He is an expert in coatings technology and owns a coatings business, Applied Polymer Systems. Both instructors have consistently high student evaluations.

L. Jin teaches the two advanced biochemistry courses biannually to students of both Biochemistry and the Coatings Technology option.

**Student Demographics**

Based on the data from 1997 to 2001 academic year we have awarded on average 11.4 MS degrees a year compared with 5.0 MS degrees nationally, as 1998 ACS survey reports. The number of graduates in recent years is 9 for 2000-2001, 9 for 2001-2002, 6 for 2002-2003, and 6 for 2003-2004.

The typical time to graduation for part-time students is 2-3 years.

On average there are about a hundred inquires received annually for the program.

On average there are 30 applicants annually.

On average we have 26 enrolled annually. At the moment we have 25 active graduate students.

Applications to and enrollment in program are stable over the last five years.

There are about 10% of foreign students in the program.

About 15% of part-time students earned their bachelor's degrees outside the U.S.

There are about 50% of women students in the program.

**Student Progress and Assessment of Student Learning Outcomes**

Students are required to pass regular objective quizzes and exams to demonstrate the extent the learning outcomes are achieved.

The program defines a successful graduate as the one that is employed after graduation or goes for further education. In this respect, the follow up of graduation, though based on anecdotal evidence, indicates success of the program. In most cases, the graduates were offered employment even before they graduated and those that applied to graduate schools were accepted into best graduate schools in the country.

There is no established mechanism to track the progress of students after graduation from the program. Some of the students keep in touch and keep us posted of their successes.
Graduate Research

Graduate students are provided with numerous opportunities to enhance their learning experience by participation in faculty’s research. Thesis option is more often exercised by day-time students though occasionally part-time students do it as well.

Over the last ten years 10 grad students coauthored 17 papers; 14 grad students coauthored 26 presentations at ACS meetings, Pittsburgh Conferences on Analytical Chemistry, Annual Meetings of Federation of Societies for Coatings Technology. These opportunities significantly contributed to their carrier development.

Limitations and suggestions for improvement and growth

Except coating option, other options in the master's programs lack visibility. We have to explore potential sources for advertisement of our program. Professional organizations are the best sources.

We should expand our program to encompass in-service teachers (which is according to ACS report, is prevalent at non-Ph.D. schools. We should look into the example at Bucknell University, where high school teachers can earn a Master's degree in chemistry after three summers at Bucknell.

We should advertise in the Chemical Bulletin of Chicago section of ACS at least once a year and monitor incoming students if they were attracted by this way.

In terms of growth, more options with various industrial sectors, like materials, biomaterials, pharmaceutical/computational, etc., could be attractive options for potential students.

The success of the coatings option indicates avenues for growth of the MS program. We have to increase visibility of biochemistry option, maybe look for biotech/pharmaceutical emphasis. We have to find specific connections with specific industries and build student base there.

No doubt we can boost enrollment if we offer fellowships to foreign students. This can be done by a concerted effort of the department and OSPR in applying for external funding.

It is suggested to more closely monitor our program as well as national trends and innovations with an objective to look for opportunities in the graduate education.

Relationship with Environmental Sci., Biology could be developed with MS program in mind.

Faculty Satisfaction Survey

Below are faculty responses to the survey.

What aspects of the MS program are most satisfying to faculty?
- I have liked the students I have encountered very much.

- A positive feature about the program: graduate assistants working for the department.

- Teaching advanced courses provides faculty with an excellent opportunity for professional development.

- It gives faculty the chance to direct advance work with better students.

- I am proud that DePaul has a graduate program – it distinguishes it from a parochial school and goes well with the DePaul’s ambition of “the largest Catholic university in the nation and the largest private institution in Chicago. The program also responds well to the DePaul’s “own distinctive purpose: all curricula emphasize skills and attitudes that educate students to be lifelong, independent learners.” (DePaul Webpage).

- Why keep the MS program? (i) it's an opportunity for our seniors to get more advanced training & good for our faculty to keep up with latest developments in the field, and (ii) it gives us more students to do research.

- An important advantage of having the MS program is its contribution to the advancement of faculty’s research and teaching agenda. Firstly, it allows for application for funding from NSF and NIH, which otherwise would not fund undergraduate research only. I have received NIH funding only because I included MS students into the write-up. Secondly, teaching advanced courses leads to professional development of an undergraduate educator.

- Consistent with DePaul’s mission, our MS program serves area professionals as well as new graduates in preparing for further education, transition to a related field, or simply updating their knowledge. These students are a valuable venue for advertising DePaul. Anecdotally, one of my students with a full time job is earning an MS at DePaul so he can go on for a Ph.D. in order to become a professor in theoretical chemistry. Another former student who took a undergraduate course in the department is now at a transition of her career and is coming back to earn a MS to broaden her career opportunities.- This program allows some BS students to earn a MS with only one additional year. The BS/MS students I have worked with were popular in the job market. The close faculty – student interactions at DePaul also serves students well. Teaching advanced courses and advising MS students also forces me to keep current in the general field of my sub discipline, which in turn benefits my research and teaching of undergraduate courses.

What aspects of the MS program are least satisfying to faculty?

- My personal experiences with the program are almost all negative, I am afraid, but I admit that I have not supervised any MS research students (which might be positive). I certainly like a lot of our students personally, however the vast majority were mediocre college students and what little theoretical chemistry they learned there was forgotten by the time they started the classes I taught. I therefore spent considerable time doing what I consider remedial instruction (gen chem type topics, like Lewis dot structures) instead of teaching them MS-level material. I suppose I
should say that it is satisfying to supply a credential to students to allow them to get a raise a work, but I would be much more satisfied if I thought they were getting a good education, and I am not convinced of that. I personally do not feel there is a need for a MS in chemistry, at DePaul or anywhere else.

Conclusions

The graduate program in the department is set up in the Vincentian spirit providing educational opportunities for the community (most of the night students are employed by local industries).

The program has a significant record of scholarly publications and presentations coauthored by MS students.

The program’s is effective as an educational institution as compared with national averages.

There is a significant interest among the students in opportunities to do research thus providing opportunities for faculty to use more mature students.

For faculty the graduate program provides more opportunities for teaching and research

References

1. Graduate Education in Chemistry. The ACS Committee of Professional Training; Surveys of Programs and Participants. ACS. 2002.


Many of the courses offered by the Department of Chemistry require students to write reports about their laboratory activities. All too often, students see such reports as yet another hoop to jump through in order to receive a good grade. However, they are much more than that. Written reports are one of the principal means of disseminating information to other scientists, hence you should see your assigned laboratory reports as an opportunity to prepare for your future career. The ability to write quality reports is certainly something that you will take with you even after you receive your diploma!

The following sections provide some general laboratory report elements you will want to think about as you write. The elements required in your particular course may vary, therefore, you need to carefully read through your syllabus to find out what your instructor requires. Links to specific course requirements are found elsewhere on this site.

Grammar and Punctuation

Abstracts

Introductions

Procedures (Materials and Methods)

Results

Calculations

Graphs and Tables

Discussions

Conclusions and Summaries
Grammar and Punctuation:

All undergraduate students at DePaul University are required to take composition classes at some point during their first year (ENG103 and ENG104). You need to use the skills obtained in these classes when writing your laboratory reports. Proper grammar, spelling, and punctuation are expected at all times and lack thereof will usually be penalized. Needless to say, avoid the use of slang or jargon.

Be aware of the fact that laboratory reports are technical documents. While ENG103 and ENG104 teach you basic skills, they do not emphasize technical writing which includes the proper usage of technical terms and integration of items such as graphs and tables within the body of the text. Technical writing skills are developed over time and require both practice and patience. As a result, lower-level chemistry courses are usually a little more forgiving in their technical skills expectations.

Abstract:

An abstract may or may not be a required component of your lab report. Most published scientific papers now include an abstract, which is a completely self-contained summary of the actual results and conclusions of the experimental work. The abstract is a brief but thorough statement of the outcome(s) of the experiment and should therefore be no more than one to three sentences long. The abstract should be written in the present tense and passive voice. If an abstract is required for your lab report, it should be the first block of text that appears after the title. Even though the abstract appears first in your lab report, it is often useful to write this section last, after you've made sense of and come to some conclusion(s) about your results.

Example: Benzophenone is synthesized in 75% yield from benzene and benzoyl chloride using a Friedel-Crafts acylation. The product is a white, crystalline solid (MP 100 °C) after recrystallization from 95% ethanol, and gives an IR spectrum consistent with an authentic sample.

Introduction:

The introduction is the beginning of the body of your lab report. This section should give the reader a detailed background on the what and why of the experiment, and put the experiment into a broader context. Attempt to put into words your response to the following questions. What was the purpose or objective of the experiment? Why was the experiment conducted in a particular manner? Why was it important in a broader context? Refer to your textbook or other sources of information to help you put the experiment into context. The introduction section should not simply state the obvious (for example, This experiment was conducted in order to learn the technique of recrystallization...).

Procedure (Materials and Methods):

Most of the experiments that you will perform use well-known procedures and have well-characterized results. As such, you are not performing cutting edge research and do not have to detail every step you performed in the laboratory. It is therefore sufficient to simply reference the source of the procedure in your laboratory report. You must, however, list any exceptions to the procedure. For example, your instructor may change a procedure slightly by substituting one chemical substance for another or having you use a different instrument. Such changes are important to know in case anyone needs to replicate your work and verify your results.
Example: The surface tension of tert-butanol solutions was measured using the procedure presented in Shoemaker, et al.1 with the following exceptions:

- The tert-butanol was purified via fractional distillation prior to use.
- The capillary tube was not cleaned with nitric acid at the outset of the experiment.

**Results:**

This is the core section of your lab report and before you begin writing it, you should gather together any and all data and/or observations you made during the experiment. Numerical data are best represented in tables or graphs. State only your results in this section. The discussion section is the place to comment on the results and make conclusions; don’t do that here. Your results should state only what you found in your experiment, not what you expected to find or what you were supposed to have observed. Be sure to write in the past tense, passive voice, and avoid use of the pronouns ‘I’ and ‘we’.

Example: The recrystallized benzoic acid appeared as a powdery, white solid weighing 0.67 g (54% recovery) and had a melting range of 98-101 °C.

**Calculations:**

You may be required to provide sample calculations in your laboratory report. These calculations are meant to demonstrate your ability to use raw, experimental data to determine the value you set out to measure. When you place a sample calculation in your report, always keep significant figures and units in mind. Your calculation may include a general word description of the mathematical operation or a displayed equation.

Example: The theoretical mass of hydrogen that can be obtained from 24.32 g of water is

\[
24.32 \text{ g } \text{H}_2\text{O} \times \frac{1 \text{ mol } \text{H}_2\text{O}}{18.0152 \text{ g } \text{H}_2\text{O}} \times \frac{2 \text{ mol } \text{H}}{1 \text{ mol } \text{H}_2\text{O}} \times 1.0079 \text{ g } \text{H} \text{ mol}^{-1} = 2.721 \text{ g } \text{H}
\]

In Word, you can insert special mathematical operators by selecting Symbol, from the Insert menu option. Switch the font drop-down box to Symbol and double click on the character you wish to insert in your text.

To get superscripts in Word, highlight the desired character(s) and press Shift-Ctrl-= (or Ctrl-+). Subscripts may be obtained by highlighting the text and then pressing Ctrl-=. These effects can also be applied to highlighted text by selecting Font, from the Format menu option and checking off the relevant boxes.

Advanced Word users may also elect to use Equation Editor to insert more complex mathematical equations into your document. This is done by selecting Object, from the Insert menu option and then clicking on Equation Editor. A new window will open at this point that will allow you to enter the equation you need. Displayed equations are usually centered on the page and are referenced by an equation number in the right-hand margin of the page. Be aware that Equation Editor does not support automatic equation numbering and you have to perform some tricks to get the desired effect.

**Graphical and Tabular Presentations:**
Tables are used to list related data and should be formatted with readability and efficiency in mind. Use the table feature of Word to prepare neatly organized tables. This is done by clicking on the Table menu option, followed by Insert, and then Table. A dialog box will open which will allow you to choose the dimensions of the table. Always select one more row than your need. The top row will be used to label each column. Labels should be as short as possible, yet provide enough information such that the reader understands the content of each column. Units should also be given when applicable. All tables should be consecutively numbered for easy reference within the text of your laboratory report.

Example:

Table 1: Summary of recrystallization experiment

<table>
<thead>
<tr>
<th>Sample</th>
<th>% yield</th>
<th>MP (C)</th>
<th>Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>57.23</td>
<td>135.2</td>
<td>White, crystalline</td>
</tr>
<tr>
<td>2</td>
<td>55.27</td>
<td>136.0</td>
<td>powder</td>
</tr>
<tr>
<td>3</td>
<td>55.98</td>
<td>135.8</td>
<td>Slightly yellow</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>crystals</td>
</tr>
</tbody>
</table>

Graphs are also used to visually present data. When generating a plot, you should always use appropriate labels and make sure that its size is appropriate. Graphs the size of postage stamps simply cannot be read, so use as much of the page as you need to! Excel can be used to generate simple graphs, but more complicated data sets may require advanced data analysis and presentation software. Data points are shown as just that, points! Do not connect the points with lines. You may, however, fit your data to determine its trend (indeed, Excel calls this a trend line). If you have estimates of the uncertainty in your data points and your software is capable of doing so, show the uncertainty as error bars through your data points. Just as in the case of tables, number your graphs consecutively in order to reference them in your report. You should also provide a caption below each figure.

Discussion:

The discussion section is the place to reflect on your actual data and observations as they relate to the experiment in a logical manner. You must write about your results in a way that describes how they support (or not) the objective(s) of the lab. Exclude those points that are not relevant to your experiment. This is the part of the lab where you can explain or rationalize errant data or describe possible sources of error and how they may have affected the outcome of the experiment. Even if your experiment was a complete disaster you can still write an excellent lab report, as long as you understand what went wrong and can explain it, and the discussion section is where you can do that. In the end you should relate back to the introduction section and come to a definitive conclusion. Write in the past tense and use technical prose. Avoid opinions and feelings, and use of the personal pronouns "I" and/or "we."

Conclusion/Summary:

Some laboratory reports will require a conclusion or a summary. As its name suggests, this section provides a recap to the reader and is in some ways analogous to the introduction section.
This section should not be longer that a few sentences and should reiterate the findings of your experiment.

References/Citations and Notes:

You are encouraged to use as many references in writing your lab report as possible, especially when writing the introduction where you are providing background and context. The internet is a valid source, as are texts and scientific journals. The following are examples of properly formatted source references. When referencing an author's or editor's name, it's proper to give the last name followed by a comma and then the first and middle initials (ex.: Smith, A. B.)

Books with Editors:

Author 1; Author 2. In Book Title; Editor 1, Editor 2, Eds.; Publisher: Place of Publication, year; volume, chapter, pages.

Books without Editors:

Author 1; Author 2. Book Title; Publisher: Place of Publication, year; volume, chapter, pages.

Scientific Journals:

Author 1; Author 2. Journal Title year, volume, pages.

Internet

Reference the exact URL.