

STRATEGIC PLAN

Department of Chemistry and Biochemistry

University of Maryland, College Park

1. Executive Summary

The Department of Chemistry and Biochemistry implements the missions of the College, University and State by providing world class research and instruction in the molecular sciences. These efforts encompass chemistry and biochemistry as traditionally defined, but are increasingly becoming interdisciplinary in nature. The department supports and informs instruction and research in allied areas such as engineering, the life sciences, medicine, material sciences, agriculture, environmental sciences, and public policy.

After careful examination of its strengths and weaknesses, and based on opportunities that are available, the Department has outlined its plans to strengthen its research by

- **Emphasizing nano-biotechnology in hiring, infrastructure, and curriculum development, including joint hires with national laboratories;**
- **Enhancing structural biology by new hires in biomolecular crystallography and mass spectrometry and increasing access to state-of-the-art instrumentation;**
- **Emphasizing energy in interdisciplinary hiring, infrastructure, and curriculum development; and**
- **Bringing connections of energy to the environment.**

Our plan calls for a two-pronged strategy of hiring faculty and strengthening infrastructure in key areas. The execution of this plan will allow us to achieve world-class stature. These investments will open opportunities for the creation of externally funded Centers and for success in obtaining Training Grants, high-end instrumentation, and graduate student support resources.

The Department of Chemistry and Biochemistry has one of the largest graduate programs (chemistry and biochemistry) at the University of Maryland, but it remains dwarfed by those of our peer institutions. Because the graduate program is the most critical fuel for our research programs, we plan to advance the University's Chemistry (CHEM) and Biochemistry (BCHM) doctoral programs. Specifically, we will

- **Restructure administration of the graduate program;**
- **Establish a new modular graduate course system with innovative curricula and greater interdepartmental cooperation;**
- **Seek to identify resources to establish a Professional Masters Program in the Chemical Sciences, the Biochemical Sciences, or both; and**
- **Leverage linkages to national laboratories through a Joint UMD/Government Laboratory Graduate Opportunity and National Laboratory Internships.**

A result of these initiatives will be the expansion of our graduate programs, increased revenue to the university, and a closer linkage to national laboratories and government agencies.

The undergraduate program is a strength of the Department, and further enhancement will be focused on

- **Undertake extensive evaluation and revision of the 400-level courses for majors, with particular emphasis on the laboratory experience and interdisciplinary courses with Biology and Engineering;**
- **Develop 100- and 300-level courses for non-science majors that will satisfy CORE and Honors obligations for students;**
- **Develop a viable scheme for funding laboratory courses that incorporates lab fee increases, extramural grant funding, and development opportunities;**
- **Develop assessment vehicles for all courses, especially the new 400-level courses; and**
- **Provide every major with a research-level experience that includes critical thinking about modern research topics and presentation of scientific results.**

With adequate numbers and expertise of personnel we will

- **Increase cost-saving operations in purchases,**
- **Enhance compliance with Environmental Health and Safety (EHS) expectations,**
- **Reduce the number of individual orders, making more effective use of chemicals, while reducing shipping costs.**
- **Manage instrument facilities as revenue centers, to recoup operating expenses, and**
- **Continue training opportunities for staff.**

The Department of Chemistry and Biochemistry has partnerships with the National Organization for the Professional Development of Black Chemists and Chemical Engineers (NOBCCChE), the National Institute of Standards and Technology (NIST), and the Food and Drug Administration (FDA). Our high-visibility REACTS and Chemathon outreach for Maryland and area high schools teachers and students impacts chemical education state-wide. These partnerships will be strengthened, and initiatives related to research and education goals will be introduced.

Among other initiatives in international activities, we will focus on our strengths in emphasizing international relations with China and South Korea and develop resources to bring an increasing number of distinguished international visitors to the department and university.

2. Overview of the Department

One of the founding units of the University of Maryland (http://www.chem.umd.edu/About_Us/history/index.html), the Department of Chemistry was launched from its home in Natural Science (1870) in 1876. Since the 1995 National Research Council (NRC) Report of department rankings of research institutions, when the Department was placed in the second quartile, the Department of Chemistry and Biochemistry has advanced to 36th in the 2008 U. S. News and World Report survey – up from 44th just two years earlier.

The Department of Chemistry integrates the Biological Sciences with the Physical Sciences and Engineering in research and teaching. As the principal home for biophysics and biochemistry on campus, the department is the link to biology and bioengineering. As molecules are the fundamental unit for nanoscience, the department is an essential unit in the development of nanostructured materials and in the rise of nano-bio-science and technology on campus. This is also evident in the central relationship that this department has in the education of students who major in the biological sciences, the physical sciences, and engineering; the Department of Chemistry and Biochemistry is a major instructional service unit of the university.

We are a department in transition with faculty who have distinguished themselves nationally and internationally and with newly added faculty who have the drive and potential to continue this reputation.

3. Research and Scholarship

Vision. The evolution of research in the 21st century has shown that the major breakthroughs in science and engineering are occurring at the interfaces between traditional areas, such as chemical biology and materials science. The Department of Chemistry and Biochemistry has a long tradition of working in interfacial areas, and we will build on these strengths to help address problems facing the world community.

Overall Research Program. The Department of Chemistry and Biochemistry maintains strong links among the biological sciences, the physical sciences, and engineering sciences. The traditional divisions of the chemical sciences are represented by our faculty: analytical - 8, biochemical - 12, inorganic - 3, organic - 8, and physical - 7. However, they are further subdivided into interfacial areas that include biophysics, chemical physics, materials chemistry, catalysis, environmental and nuclear chemistry (see: <http://www.chem.umd.edu/Research/>).

Our faculty has averaged about 3.3 publications per year in peer-reviewed journals (Figure 3-1) and, on average, one of these publications is in a “high impact” journal (Impact Factor > 5 is appropriate for the diverse areas in the chemical sciences). Areas of highest impact include those that are interfacial with the biological, physical, and materials sciences, although strengths in the traditional areas of chemistry are also evident.

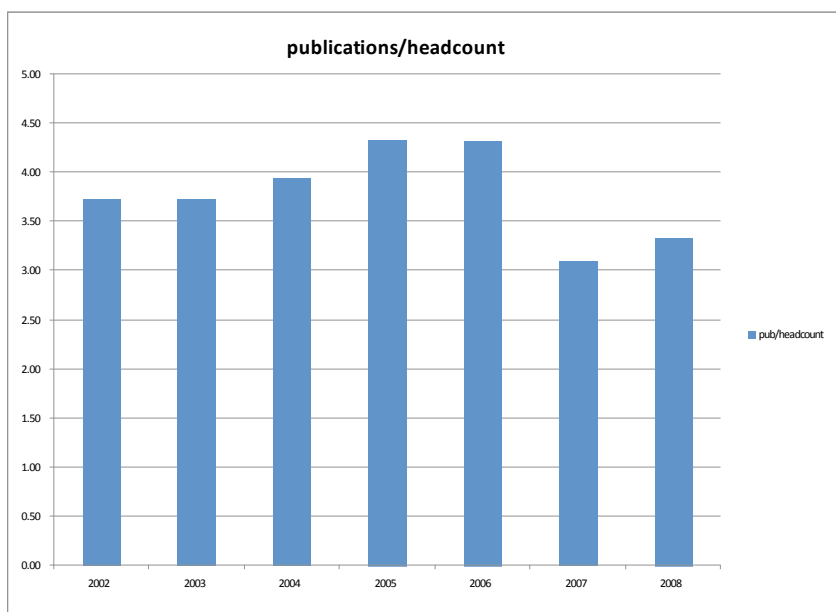


Figure 3-1. Total number of publications per faculty, 2002 - 2008.

With major funding received from federal sources having funding cycles of three to five years, faculty in the Department of Chemistry and Biochemistry on average submit 1.5 to 2.0 proposals per year with a relatively high success rate. Established faculty have more than twice the funding success rate as those who are establishing their research programs, and their success rate is greater than national averages. About fifty awards per year, including annual installments on multiple year grants, are received by about eighty percent of faculty in our department who

have 50% or greater appointments. The total amount of grant dollars received for FY2002 through FY2008 is near \$8M per year (Figure 3-2).

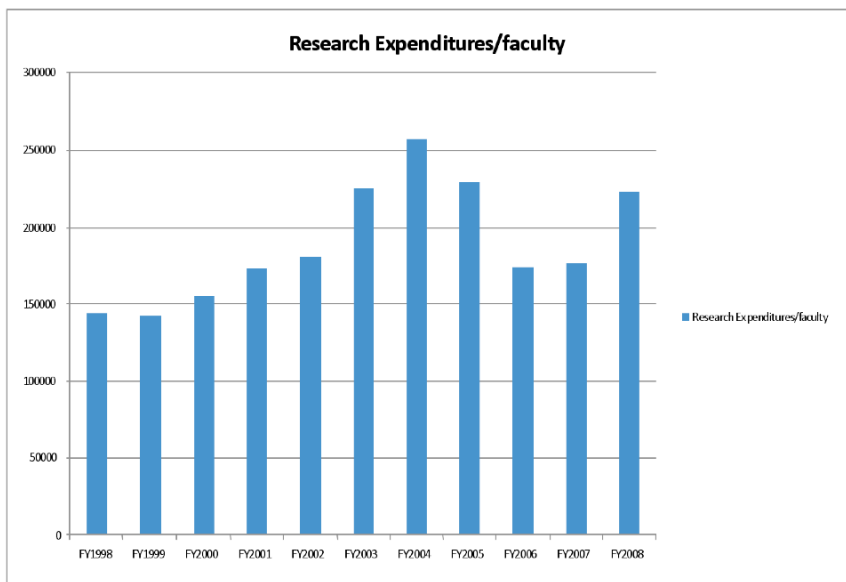


Figure 3-2. Research expenditures per faculty member, 1998-2008.

Strengths. The Department of Chemistry and Biochemistry has served the University to provide a knowledge base in many areas.

- One of our strengths is **Theory and Computation** where the Department of Chemistry at the University of Maryland is nationally recognized relative to our peer institutions. Four of these faculty (Alexander, Jarzynski, Thirumalai, and Weeks) have joint appointments in the Institute for Physical Science and Technology (IPST), Weeks has been elected to the National Academy of Sciences, and both Alexander and Weeks hold the rank of Distinguished University Professors.
- A second strength is **Nanoscience and Supramolecular Chemistry** with the involvement of eleven faculty (including Davis, DeShong, Doyle, Eichhorn, Fourkas, Isaacs, S. B. Lee, Reutt-Robey, Rokita, Sita, Wang) whose sponsored projects expenditures were \$1.5M in CY 2008; many in this core strength are leading participants in the campus nano-biotechnology initiative.
- With \$1.4M in expenditures for CY 2008 nine faculty with research focus in **Biophysics** (Allewell, Beckett, Dayie, Fushman, Kahn, LaRonde-LeBlanc, Lorimer, Thirumalai, Tugarinov) constitute yet another visible strength in the department.

The Department of Chemistry and Biochemistry has a long and successful history of working with National Laboratories and Federal Agencies to advance common goals and leverage infrastructure. Collaborative outreach to the National Laboratories and Federal agencies impact all aspects of our program, including biochemistry (NIH, NIST, Brookhaven), energy science (NIST, NRL, NSWC-IH, ARL, ORNL, LANL, LBL), nuclear chemistry (Argonne, ORNL, NIST, Brookhaven), as well as atmospheric and climate change science (NOAA, NASA, NIST).

The department is one of only a handful in U.S. universities that has nuclear chemists (Mignerey and Walters). In addition, catalysis (Doyle, Eichhorn, Sita, Vedernikov), environmental science (Blough, Ondov, Salawitch), and bioorganic chemistry (Cropp, Rokita, Sintim) are developing areas of strength. The NMR, X-Ray/Powder, and XPS/AFM facilities provide a strong underpinning for the existing research areas.

Chemists need sophisticated analytical tools to identify, measure, and quantify the materials with which they work. The Department of Chemistry and Biochemistry has five core facilities, whose capital investment is estimated at \$6.5M, with five facilities managers or directors to maintain and operate the instrumentation.

The condition of the chemistry building for modern chemistry research is a matter of concern. The planned refurbishment of our aging facility leading to a modern state-of-the-art physical plant will aid greatly in the successful recruiting of outstanding faculty and attraction of highly qualified graduate students.

Opportunities. With existing key faculty contributors and enhanced facilities the Department of Chemistry and Biochemistry is poised to advance in reputation among peer institutions. Opportunities exist to attract talented faculty through joint hires, especially with selected government laboratories.

Action Plan. The Department has identified **Biological Chemistry** and **Energy Science** as the two areas that will guide our resource allocation, faculty hiring, student recruitment and facilities development during the next ten years. The components of this plan include:

- **Emphazing Nano-biotechnology in hiring, infrastructure, and curriculum development.**

Given the critical mass of researchers working on nano-biotechnology and bioanalytical chemistry in the Department and external to it, we are poised to become a recognized leader in this field. We will further strengthen our research and training ties with NIH and NIST in this field, and we will pursue large-scale multi-investigator grants for research, training, and instrumentation. We will also develop a new curriculum, both graduate and undergraduate, to support these efforts.

- **Enhance Structural Biology.**

The completion of efforts to achieve a critical mass in this area require three component additions, the first of which has already been completed and the third is in the process of being rectified: *(i)* A *second X-ray crystallographer* hired this year, Paul Paukstelis, when linked with the previous hire of Dr. Nicole LaRonde-LeBlanc, gives us further strength in crystallography, provides a complementary research association with that from solution biomolecular NMR studies, and maximizes return on investment for the core biomolecular X-ray facility. *(ii)* The addition of *a faculty member in biological mass spectrometry* would bring our department to the cutting edge of structural biology in which a range of systems from relatively small proteins and RNAs to large multi-biomolecular assemblies could be studied at both the structural and dynamic levels. *(iii)* The Department has three groups working in the area of Biomolecular NMR (Fushman, Dayie, Tugarinov) that would employ *higher field* (≥ 800 MHz) *NMR spectrometers* to conduct their research and reach a top international leadership position of which they are capable.

The Department of Chemistry and Biochemistry has strong core activities in the **energy sciences**. In addition to individual research efforts, faculty also participate in interdisciplinary energy groups on campus including the University of Maryland Energy Research Center

(UMERC), the Materials Research Science and Engineering Center (MRSEC) and the Nanocenter. Adding to these strengths will coalesce core groups of researchers who will be competitive for targeted collaborative grants and will further strengthen interdepartmental ties with Engineering and Physics. Research areas include:

- **Emphasizing Energy in interdisciplinary hiring, infrastructure, and curriculum development.**

(i) *Energy storage* is a critical problem that is one of President Mote's targeted *Centers of Excellence*. Active chemistry groups in this area include Vedernikov, Zachariah, Reutt-Robey, and S.B. Lee. A *strategic hire* will establish the critical mass of this group in our Department.

(ii) Solar cells and fuel cells are emerging technologies that are poised to become important components of the nation's new-tech energy infrastructure (Eichhorn and Reutt-Robey). The *hiring of materials chemists* working in related areas will have major impacts on the energy initiatives of the Department and University.

- **Bring connections of energy to the environment.**

Energy and the environment are inevitably linked. The study of the environmental effects of energy generation will continue to be an issue for the state, the nation and the world for the foreseeable future. Our growing expertise in the areas of atmospheric chemistry (Ondov, Zachariah, Salawitch, Dickerson) and water chemistry (Blough, Mignerey) provides the seeds for continued growth in the areas of global importance and high growth potential, and *additional faculty will strengthen this area*.

4. Graduate Education

Overview. The Department of Chemistry & Biochemistry offers two graduate programs. The graduate program in Chemistry originated 1925, and the Biochemistry graduate program followed in the 1970s. The two graduate programs have distinct academic requirements that reflect the different academic traditions of the Chemistry and Biochemistry Ph.D. Both programs are directed by the Associate Chair for the Graduate Programs who works with the Graduate Program Coordinator. The Graduate Program Committee, consisting of the Associate Chair and nine additional faculty, performs recruiting, admissions and oversight functions.

Currently, there are 170 graduate students in the Department of Chemistry and Biochemistry (approximately 4 per faculty member), with 127 students in the Chemistry graduate program and 43 in the Biochemistry graduate program, and these numbers have grown by twenty percent over the past five years (Figure 4-1). The approximate 3:1 ratio between chemistry and biochemistry graduate students has held for many year, and this ratio of students reflects the relative sizes of the chemistry and biochemistry faculty. More than half of our students are female, and 14% come from underrepresented groups. The department has developed a national reputation as a prime destination for chemistry and biochemistry PhD students of color, and we expect these numbers to grow in the coming years. We have worked to forge strong connections to top international universities that have led to a recent increase of top-quality international students entering our programs. Since 2003, students have been admitted solely to the PhD program, except in unusual circumstances (e.g., MS degrees earned by active military personnel or under industrial support).

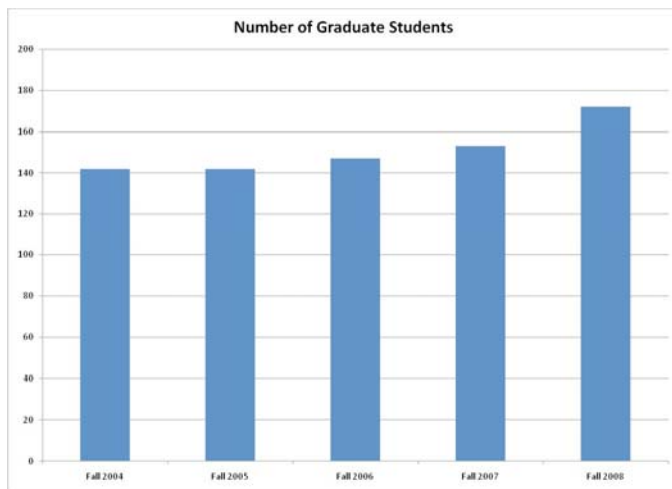


Figure 4-1. Number of graduate students in chemistry and biochemistry, 2004-2008.

Time to Ph. D. degree at the University of Maryland has been less than the national average (5.5 years) for chemistry and biochemistry degrees and is now approaching 4 years (Figure 4-2). An increasing percentage of graduate students have research assistant and fellowship support. Students leaving the University of Maryland with degrees in chemistry and biochemistry find employment at government laboratories or chemical and biotech industries, and most enter postdoctoral positions prior to their future employment.

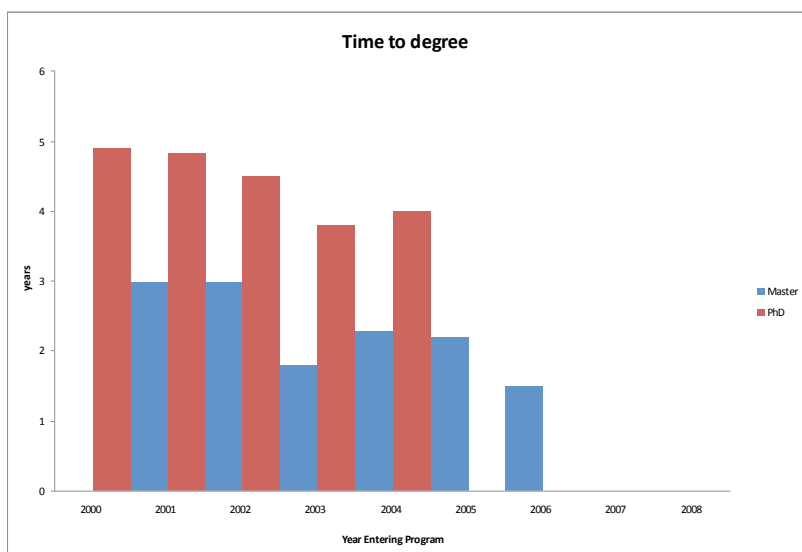


Figure 4-2. Time to degree for chemistry and biochemistry students entering the University of Maryland in the designated years.

Vision. The quality of our graduate programs is the most important determinant of our stature and ranking. High-quality, well-trained graduate students enable faculty to pursue more ambitious research agenda with a greater emphasis on high risk/high reward science. The initiatives discussed below will improve the quality of our educational product and advance our standing in national rankings.

Strengths.

We have one of the most diverse student bodies in any Research 1 graduate chemistry program.

- We are known for our successful job placement of Ph.D. students in diverse areas of industry, federal labs and academic institutions.
- We have instituted “Visit Maryland Day” for prospective students who have been admitted to graduate school at Maryland and the “Symposium on Chemical Research at Undergraduate Institutions” whose speakers are select faculty at undergraduate institutions to acquaint them with Maryland and inform our graduate students about academic careers in predominantly undergraduate institutions.
- The Milligan Fellowship, joint with NIST, attracts talented underrepresented students to apply to the chemistry and biochemistry programs at the University of Maryland.
- The DOE-funded GAANN Program (Chemistry Scholar Educator) provides support for five Chemistry Ph.D. students in a Supervised Teaching Experience that imparts critical skills for a competitive academic job market.
- The biochemistry graduate program instituted “rotations” in 2007. Rotations (experience in several labs prior to selection of research mentor) are required by NIH Training grant programs.

Opportunities. The growing reputation of the University of Maryland as a leading national and international research university and in selected areas of the chemical sciences provides advantages. The University’s strategic placement in the greater Washington area with its access to national laboratories and to biotechnology is a major attraction. The racial and ethnic diversity of the greater Washington area is an attraction for graduate students.

Action Plans. We will

- **Restructure administration of the graduate program for increased efficiency/effectiveness.**

Added personnel are needed to manage the increasing workload. Increasing the staff size initially to 1.5 FTE and then working to match the expertise and function of the BiSi program that handles a comparable number of graduate students.

- **Seek resources to establish a new modular graduate course system with innovative curricula and greater interdepartmental cooperation.**

Graduate courses will be offered in modules of 1, 1.5 or 2 credits in order to reduce redundancies, update course content, increase the number and sophistication of our offerings. This will allow us to more effectively participate in modules offered by other departments (*e.g.*, Materials Engineering or CBMG) who cover related topics from a different perspective.

- **If suitable resources are available, establish a Professional Masters Program in the Chemical Sciences, the Biochemical Sciences, or both.**

This ambitious goal would require significant resources but will provide a needed service to the regional scientific community, expanding our course offerings and raising revenue for the Department. With the location of NOAA, FDA, ATF and ARL in the College Park area, there is a large concentration of scientists seeking professional advancement and retraining.

- **Enhance linkages to national laboratories.**

To raise our profile, enhance our recruiting efforts and leverage our strategic location, we will pursue two initiatives to strengthen our ties with the national laboratories via the education and training of graduate students.

(i) **Joint UMD/Government Laboratory Graduate Opportunity.** Incoming graduate students will be provided with the opportunity to do their graduate work jointly with a faculty member from the University of Maryland and a designated research mentor from an allied national laboratory.

(ii) The second initiative is to establish a **National Laboratory Internship** program as part of our graduate education mission. This program would allow a graduate student to spend a semester or a summer performing research at a national laboratory that is related to, but is not necessarily a direct part of, his or her thesis project.

5. Undergraduate Education

Overview. The Department of Chemistry and Biochemistry endeavors to improve the scientific literacy of non-majors, service the instructional needs of students in allied science and engineering programs, as well as to enhance the ability of our majors at obtaining professional employment and placement in top graduate programs. The largest clientele for instruction in chemistry and biochemistry is students in allied science and engineering programs who account for more than 70% of credit hours for the department. However, the number of chemistry and biochemistry majors is now nearly 450, which is an increase of 50% over the past five years (Figure 5-1). Students who graduate with majors in chemistry and biochemistry have reached 80 per year, an increase of nearly 30% in five years, and the majority of these students major in biochemistry.

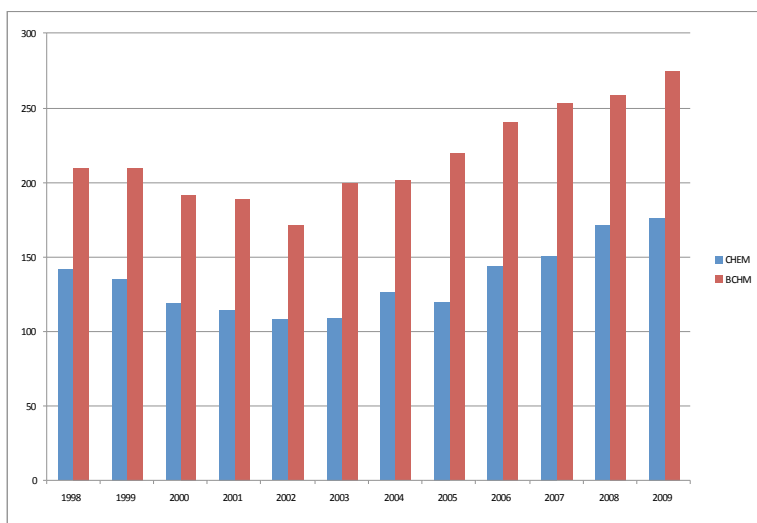


Figure 5-1. Chemistry and biochemistry majors, 1998-2008.

The department has mandatory advising for all majors each semester, which is coordinated by the Director of Undergraduate Studies. In addition, the department supports summer orientation by advising greater than 100 students who express an interest in majoring in chemistry or biochemistry. Additionally, the department provides personnel support to Health Professions Advising.

Strengths.

- A complete revision of the lower-division four-course chemistry sequence for all students was implemented in 2006. This new approach eliminates repetition of material covered in high school courses, and introduces thermodynamics and kinetics in the context of biology to second year students.
- Renovation of organic chemistry laboratories (2003) and introductory chemistry laboratories (2008-2009).
- A complete revision of the curriculum for biochemistry majors was implemented in 2005, increasing exposure to physical principles and fundamental understanding of nucleic acid structure and function.
- The WDF (Withdraw, and D,F grade) frequency for students in the introductory chemistry course was lowered by 50% since 2003.
- Provide uniform student advising of all chemistry majors.

Opportunities. (1) Growing enrollments in Engineering, Biology and Chemistry mean that we will continue to engage a large fraction of UMD students. (2) Proximity to both government labs and the local biotech industry provide undergraduate research opportunities, as well as employment opportunities for our BS graduates. (3) Stimulus related increases in the NSF budget provide an opportunity to improve labs (e.g., NSF-CCLI program). (4) A growing body of student assessment information provides an opportunity to improve our course offerings using non-anecdotal data. (5) Our research facilities can be leveraged to provide educational opportunities at the undergraduate level. For example, our Departmental NMR lab, which previously focused solely on research support, has recently introduced an advanced “hands-on” NMR lab course that is offered at the undergraduate level.

Action Plan.

- **Undertake extensive evaluation and revision of the 400-level courses for majors, with particular emphasis on the laboratory experience and interdisciplinary courses with Biology and Engineering.**

Action Items. The department has begun a 400-level course audit that will identify challenges and opportunities. The department will prioritize courses/activities that should be undertaken, then revise courses having the highest priorities.

- **Develop 100- and 300-level courses for non-science majors that will satisfy CORE and Honors obligations for students.**

The resurrection of Chem 121 (Chemistry in the Modern World), then development of the 300-level course. Possible topics include pharmacology, nanotechnology, food chemistry, energy technology and policy, and forensics.

- **Develop a viable scheme for funding laboratory courses that incorporates lab fee increases, extramural grant funding, and development opportunities.**

(i) An increase in student lab fees will be requested, and differential funding of labs will be considered. (ii) A list of “shovel-ready” laboratory projects for the department will be provided for the college's development staff with information for the cultivation of donors. (iii) Obtain

extramural funding from federal agencies (DoE or NSF). At least one funding request annually will be written to the appropriate funding agency for the support of the labs.

- **Develop assessment vehicles for all courses, especially the new 400-level courses, aimed at improving integration with the offerings of other departments and on preparation for future education/employment.**

(i) In conjunction with the College CUPC Committee, the department will establish a rubric for the assessment of students in Chem 481 (Introduction to Thermodynamics) and 483 (Introduction to Experimental Physical Chemistry). (ii) Other major features of the assessment strategy will be (a) development of an "Exit Survey" for all graduating seniors, and (b) post-graduation assessment for majors (3-5 years post graduation).

- **Provide every major with a research-level experience that includes critical thinking about modern research topics and presentation of scientific results.**

(i) The department will encourage more of our majors to undertake research with the faculty. (ii) In addition, Chem 395 (Professional Issues) will be converted to a 2-credit course and the curriculum will be enhanced substantially.

6. Administrative Infrastructure and Academic Support

Vision. Staff are the facilitators of the business and technical operations of the Department of Chemistry and Biochemistry. Their functions are similar to those in a small chemical company with expectations of productivity, efficiency, technical and business services, marketing, management, and environmental and health safety.

Strengths. Staff members of the Department of Chemistry and Biochemistry are organized into traditional units (e.g., Administrative Office, Business Office, Undergraduate Services, Facilities) that serve the functioning of the department well even at current minimal staffing levels. Evaluations are performance based, and objectives are service and efficiency. Training and enrollment in academic courses are encouraged.

- Administration of the staff that brings members to their potential.
- Examples include (1) encouragement and facilitation of staff to enhance and broaden their knowledge by attending workshops and taking university courses; (2) creation of an "intern program" to allow existing staff to learn the operations of other positions in the department; and (3) coordinate cross discussions by department administrative units so that all units are aware of departmental operations and costs.
- Innovative and useful computer programs that serve the department with great efficiency and are also offered for use to other departments.
- Examples of software-enabled efficiencies include (1) the web-based process through which the department currently conducts its faculty searches is evidence of how technology can be used to make an otherwise laborious task manageable; (2) software through which faculty, staff, or their designates can submit orders for chemicals and supplies electronically from their office or lab with cost transfer to the appropriate account; (3) on-line access for faculty to their grant/contract accounts with monthly updates and warnings of pending budget restrictions.
- The Department of Chemistry and Biochemistry operates five facilities with managers/directors who facilitate instrumentation research requirements of faculty and, in

some cases, local industry/government (Chemical NMR, Biomolecular NMR, Mass Spectrometry, X-Ray and Powder Diffraction, and XPS/AFM).

Opportunities. Increased efficiencies and effectiveness will occur when sufficient numbers of talented personnel are available to solve problems with straightforward and innovative solutions. Continued improvements in communication, efficiencies in operations, and planning are now possible in IT developments and effective management planning. In addition, our instrumentation centers can serve as magnets for local area technical service, especially for startup companies.

Action Plan.

- **Increase cost-saving operations in purchases.** Recognizing that the vast majority of orders go to a few suppliers, agreements with suppliers are being sought to implement an operational procedure where orders are bundled and transportation costs removed or significantly reduced.
- **Enhance compliance with Environmental Health and Safety expectations.** Systems are being considered that will export the list of chemicals purchased by faculty into their chemical hygiene plan.
- **Reduce the number of individual orders.** Knowing what the repeat purchases are on a department level will tell us which items should be placed in our Chemistry Store thereby reducing the number of individual orders to the suppliers and cutting down on freight costs.
- **Manage Instrument Facilities as revenue centers** with expected return of operating cost for the facility from instrument use charges.
- **Continue training opportunities for staff.** Continue to provide training opportunities for all staff, and create opportunities for the advancement of staff through positions within the department to lessen loss of institutional knowledge when someone leaves.

7. Partnerships, Outreach and Engagement

Strengths.

- Partnership with the National Organization for the Professional Development of Black Chemists and Chemical Engineers (NOBCCChE)
- In 2008 the University of Maryland became the first partner in the NOBCCChE Educational Partnership program, which provides the University with membership benefits, student prospects and conference sponsorship opportunities.
- Partnership with the National Institute of Standards and Technology (NIST)
- In partnership with NIST, the Department of Chemistry and Biochemistry instituted the nationally competitive Milligan Fellowship, an innovative program to attract underrepresented minorities as graduate students to UMD and to share costs in the award and recruitment of students. Some faculty members in the department have research collaborations with NIST scientists.
- Partnership with the Food and Drug Administration (FDA)

- The Food and Drug Administration determined more than a decade ago that it could partner with the Department of Chemistry and Biochemistry. Recognizing UMD strength in nuclear magnetic resonance analyses, the FDA added a 400 MHz NMR instrument to those already existing and stationed one of their employees (Dr. Gene Mazzola, an expert in NMR spectral interpretation) permanently in the department.
- REACTS and Chemathon for Maryland and area high schools.

The Department of Chemistry and Biochemistry is host to REACTS, "Reaching Educators for the Advancement of Chemistry Teaching Statewide", and to Chemathon. REACTS is a network of chemical educators in Maryland dedicated to improving the teaching of chemistry in K-12. REACTS activities include an annual conference on teaching methods for high school students, an online bulletin board for K-12 educators, on-line seminars and classes, information relating to professional development for K-12 educators, and information for beginning educators, including mentoring assistance. The Chemathon is an annual chemistry competition for high school chemistry students in Maryland, Northern Virginia, and the District of Columbia. The Chemathon competition is organized by a committee of area high school chemistry teachers and chemists, and is held at the University of Maryland at College Park at Maryland Day.

Partnerships and outreach in the department are held together by individual faculty members, including lecturers, and staff who are willing to spend the time and effort with no direct reward to extend the university professionally to the entire community served by the University of Maryland. The success of these programs relies on the dedicated efforts of a few individuals.

Opportunities. Continued association with NOBCCChE offers our department unique opportunities in the recruitment of graduate students of color. With enhanced opportunities to fund these students through fellowships (e.g., NIH, Ford, Pfizer, Merck, DuPont), there are cost advantages for the faculty and students; and with enhanced employment opportunities for these students, all who are involved benefit. Partnerships with NIST and other government research centers offer opportunities to broaden student and faculty opportunities in research, including program and student support, as well as instrument acquisition.

Action Plan. The Department of Chemistry and Biochemistry will actively pursue partnerships that enhance our capabilities and our reputation. An example of efforts underway is the 44th International Chemistry Olympiad (IChO) at the University of Maryland, College Park, in July 2012. The campus will provide laboratory space and lodging for nearly 300 high-school-age competitors and their mentors representing 60-70 countries.

The Department of Chemistry will initiate efforts to provide incoming graduate students with the opportunity to do their graduate work jointly with a faculty member from the University of Maryland and a designated research mentor from an allied organization (initial efforts are with NIST). The desired outcomes are opportunities for collaboration and funding, as well as enhancement of visibility for the department and career opportunities for the students.

8. Engaging the Global Community: International Programs

Strengths.

International presence and collaborations. The faculty in the Department of Chemistry and Biochemistry has a strong international presence in China, Japan, India, South Korea, and

Europe. A compilation of invited visits by faculty to Asian countries from 2003 through 2008 listed 52 university seminars or conference presentations by 8 faculty members in China, 15 by 8 faculty members in Japan, and a fewer number in South Korea and India. Several of our faculty have productive research collaborations with faculty outside the borders of the United States; and one of our faculty has a joint appointment with the leading research center of South Korea (KAIST). One of our faculty is chair of oversight and evaluation units in Hong Kong. Two of our faculty members have their origins in Ghana and are building opportunities for future interactions.

Grants for collaborative activities. Two of our faculty have continuing grants from the US-Israel Binational Science Foundation.

International Adjunct appointments. The department has made adjunct appointments to faculty in Germany (Prof. Dr. Henri Brunner, University of Regensburg) and France (Prof. Rinaldo Poli, University of Toulouse).

Graduate student recruitment. As a result of aggressive recruiting efforts, we have attracted an increasingly talented cohort of graduate students from the leading universities of China. Personal interviews are conducted with international students using cameras via computer technology.

Opportunities. Enhancing the international reputation of the Department of Chemistry and Biochemistry is integral to our mission and to our development. We are among the top ten chemistry departments recognized in China and South Korea and can foresee enhanced attraction of the most talented graduate students from these countries. China has a special program that supports students to take part of the research training for their Ph.D. degree overseas, and we are beginning to see a few of these students; we expect that these numbers could grow.

Action Plan. Focus on our strengths in emphasizing international relations with China and South Korea. Develop resources to bring an increasing number of distinguished international visitors to the department and university. Encourage faculty to volunteer to organize symposia, Gordon Conferences, and other events to which they could invite distinguished scientists from outside United States. Faculty holding international grants will provide opportunities for scientists from partner countries to visit the University of Maryland. Begin to provide opportunities for scientific collaboration in Africa. Also, although the strategic plan recognizes the growing importance of collaborations with Asia and the developing world, the Department realizes that the Eurozone represents the strongest science outside the United States. It is consequently essential to maintain and expand faculty collaborations with European scientists.

9. External Relations, Development, and Communications

Strengths. The Department of Chemistry created a cohort of external advisors who have met with the department at least once per year since 2004. Named “The Committee of Distinguished Advisors (CODA)” and consisting of alumni and friends of the department from industry, publishing, government and academe, this cohort advises the department on issues as far ranging as marketing, personnel, curricular matters and student career development (http://www.chem.umd.edu/About_Us/CODA.php). The CODA has advised the department on research directions that are included in this Strategic Plan, and their advice has enriched this document.

The department also produces an Annual Report that is directed to alumni, friends, and those wishing for personalized information about the department and its annual operations. Produced for the department's web site (http://www.chem.umd.edu/About_Us/Newsletter/2008/), the Annual Report provides faculty information, staff highlights, undergraduate student programs, graduate student programs, alumni and contributions to the department. The department's web site serves as the major communications link to our constituencies.

Timely recognition of donations, personal events and recognition of alumni, and showcase events for the department are arranged by the department whenever feasible. For example, we maintain a booth to advertise the University of Maryland at annual meetings of the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers. When faculty members receive national awards we host a reception honoring them at the meetings at which they are honored.

Opportunities. Among the sciences at the University of Maryland, the Department of Chemistry and Biochemistry has one of the strongest alumni cohorts, and contact with them promotes future giving as well as opportunities for our students. At the same time, our ability to market the department strongly influences our rankings among chemistry and biochemistry departments, the attraction of talented graduate students, and the impression that undergraduate applicants have of our department. Increased efforts in the recruitment of graduate students and in the placement of both graduate and undergraduate students will enhance visibility.

Action Plan. As funding becomes available we will hire a person who has capabilities as meeting coordinator, communications director, and overall alumni liaison.

10. Summary

The Department believes that it can enter the top-30 departments if we add six faculty, sustain an entering graduate student enrollment of 50 per year (70% domestic), and add four staff positions. To reach the top-20 requires considerable additional resources, including completion of the promised renovation of Wings 1 and 2 of the current chemistry building, additional faculty and staff, and continually updated resources. The department is committed to advancing in ranking and prestige, and its faculty and staff are committed to the completion of those projects that are described in this Strategic Plan.

Many of the action plans that are included in this document have already been initiated. Others are based on developing linkages, especially with area national laboratories, and the availability of external funds.

The Department of Chemistry and Biochemistry has the basic cohort of nationally and internationally distinguished faculty to maintain its current ranking among state research universities. The Department is a major contributor to the teaching mission of the university, and notable programs have originated in the department that add visibility to the university in administration, international activities, outreach, and partnerships. The Department is making structural changes that will increase the number and quality of graduate students, increase external funding, and bring efficiencies to its operations.