



**University of Dayton
Chemistry Department
Assessment Plan
September 28, 2011**

Departmental Mission

By means of its Bachelor of Science degrees in Chemistry (CHM), Biochemistry (BCM), and Medicinal and Pharmaceutical Chemistry (MCM), its Bachelor of Arts degree in Chemistry (CHA), and its thesis and non-thesis Masters of Science (M.S.) degree programs, the Department of Chemistry prepares students for a wide range of professions requiring a thorough knowledge of modern chemical theory and technical expertise through a commitment to excellence in teaching, research, and service within the framework of a Catholic and Marianist institution.

As professional teacher-scholars supporting the University's mission to produce distinctive graduates empowered to learn, lead and serve, the Department of Chemistry performs three major tasks. First, it serves students in engineering and science-based disciplines by providing relevant foundational courses in the chemical sciences. Second, it offers to students majoring in the chemical sciences sound programs designed to facilitate the development of analytical problem-solving abilities and advanced research skills while providing a solid technical education based on modern chemical theory, principles and techniques. Third, it contributes to the University's general education program by introducing non-science students to a broad range of topics that relate and integrate chemistry with issues relevant to a technologically informed society.

The Department is dedicated to the promotion and development of teaching excellence at all levels. Its professional integrity and competence to do so are grounded in its research and scholarly activities. These include faculty-mentored student research programs; continuous evaluation of and innovative contribution to the chemistry curriculum in higher education; communication of results of research and other scholarly work to professionals, students, and the public; and engaging in dialogue with other disciplines both within the University and in the broader academic community.

Learning Outcomes

The Chemistry Department has selected a set of assessment outcomes that map into the University-wide Learning Outcomes from *Habits of Inquiry and Reflection* as indicated below:

1. Scholarship: All undergraduates will develop and demonstrate advanced habits of academic inquiry and creativity through the production of a body of artistic, scholarly or community-based work intended for public presentation and defense.

Chemistry Department Outcomes:

- a. Knowledge and Research Skills Base Concomittant with Graduate School or Employment in the Chemical Industry. All CHM, BCM, MCM, and CHA majors will demonstrate the chemical knowledge base and research skills required for graduate school in chemistry and related disciplines, as well as for B.S.-level jobs in chemistry and chemically-related professions.

Measures to be Utilized:

- a. Undergraduate research and thesis.
 - i. Faculty-Directed Student Research Projects. All CHM and BCM majors will complete an original faculty-directed research project in which they demonstrate independent mastery of laboratory, computational, and data analysis skills appropriate to the project, as well as the ability to independently design experiments and execute basic laboratory procedures. MCM and CHA majors will also be encouraged to complete original faculty-directed research projects, though this is not a formal requirement for these programs. MCM and CHA majors who do not participate in faculty-directed student research will develop research skills in their instructional laboratory courses. These skills may be developed in other venues (*e.g.*, industrial coops and/or internships, faculty-directed student research in other departments at UD or external academic institutions, research at WPAFB and other external government research agencies, *etc.*) when deemed appropriate by the Department Chair, the Academic Advisor, and the Undergraduate Research Director.
 - ii. Senior Theses. Each research project will terminate with the composition and submission of a senior thesis. Each thesis will be reviewed and graded for CHM498/499 credit by the student's research advisor. At least 80% of the student researchers will demonstrate a solid understanding of fundamental chemical principles and laboratory instrumentation and procedures, as well as good technical writing skills in their thesis. All theses will be published in the annual Chemistry Senior Research Thesis binder.

- b. Research Publications. At least 50% of the CHM and BCM majors will assist their faculty research advisors in the preparation and submission of manuscripts detailing their research to peer-reviewed journals, and will appear as co-authors on accepted publications.
- c. Research Presentations.
 - i. All CHM, BCM, MCM, and CHA majors will deliver an oral presentation on a selected, faculty-approved literature topic which integrates chemistry, ethics, and values in the Professional Practice Seminar course (CHM 496). At least 80% of the students will demonstrate a sufficient understanding of scientific and ethical principles and oral communication skills during their presentations, as judged by evaluation forms completed by the Chemistry faculty.
 - ii. All CHM and BCM majors will deliver a 15-20 minute oral presentation of their undergraduate research in the Research Seminar (CHM 497). At least 80% of the students will be judged to demonstrate a sufficient understanding of scientific principles and oral communication skills during their presentations, as judged by evaluation forms completed by the Chemistry faculty.
 - iii. At least 80% of Chemistry undergraduates engaged in research will present their results at the Stander Symposium.
 - iv. At least 50% of Chemistry undergraduates will deliver poster or oral presentations at local, regional, national and international conferences, such as ACS meetings, undergraduate research symposia, *etc.*
- d. Senior Exit Interviews and Alumni Questionnaire.
 - i. At least 80% of CHM, BCM, MCM, and CHA will confirm that they feel (senior exit interviews) and were (Alumni Questionnaire) prepared for graduate or professional school and/or employment in chemical or chemically/related industry.

2. Faith traditions: All undergraduates will develop and demonstrate ability to engage in intellectually informed, appreciative, and critical inquiry regarding major faith traditions. Students will be familiar with the basic theological understandings and central texts that shape Catholic beliefs and teachings, practices, and spiritualities. Students' abilities should be developed sufficiently to allow them to examine deeply their own faith commitments and also to participate intelligently and respectfully in dialogue with other traditions.

Chemistry Department Outcomes: None. Faith-traditions objectives will be accomplished in non-Chemistry courses.

Measures to be Utilized: None. Faith-traditions objectives will be accomplished in non-Chemistry courses.

3. Diversity: All undergraduates will develop and demonstrate intellectually informed, appreciative, and critical understanding of the cultures, histories, times, and places of multiple others, as marked by class, race, gender, ethnicity, religion, nationality, sexual orientation, and other manifestations of difference. Students' understanding will reflect scholarly inquiry, experiential immersion, and disciplined reflection.

Chemistry Department Outcomes:

- a. Professional Practices Seminar (CHM496) Presentations. Although diversity objectives will be accomplished principally in non-Chemistry courses, the Chemistry faculty are considering the incorporation of Diversity and/or Global Learning objectives into CHM496 (our one-hour student "Professional Practices" seminar course which is typically taken in the fall of the senior year) by requiring students to develop and deliver 15-20 minute oral presentations which incorporate diversity- and/or global learning- related topics (*e.g.*, contributions of women, minorities, internationals, and other under-represented groups to chemistry).

Measures to be utilized:

- a. Professional Practices Seminar (CHM496) Presentations. All CHM, BCM, MCM, and CHA majors will develop and deliver 15-20 minute oral presentations in CHM496 related to the history of chemistry, incorporating biographies and achievements of accomplished chemists. Within particular semesters, emphasis will be given to contributions to chemistry from frequently unrecognized societal groups, *e.g.*, women, minorities, other under-represented groups, and/or chemists from outside the United States.

4. Community: All undergraduates will develop and demonstrate understanding of and practice in the values and skills necessary for learning, living, and working in communities of support and challenge. These values and skills include accepting difference, resolving conflicts peacefully, and promoting reconciliation; they encompass productive, discerning, creative, and respectful collaboration with persons from diverse backgrounds and perspectives for the common purpose of learning, service, and leadership that aim at just social transformation. Students will demonstrate these values and skills on campus and in the Dayton region as part of their preparation for global citizenship.

Chemistry Department Outcomes:

- a. Research Collaborations. Students will engage in research collaborations with faculty and peers from Chemistry and (when appropriate) other departments, UDRI, WPAFB, and other external institutions, including private industry.
- b. Membership and/or Participation in Student Organizations and Professional Societies. All CHM, BCM, MCM, and CHA majors will be encouraged to participate in the departmental chapter of the Student Affiliates of the American Chemical Society (SAACS), as well as other student and/or professional organizations (chemical and other, including the UD River Stewards, the Fitz Center, and Campus Ministry projects). Students will initially be informed

about these opportunities during their ASI-150 section in the fall of their first year.

- c. Service to the Local Community. CHM, BCM, MCM, and CHA majors will serve the Dayton area schools and other components of the local community on an annual basis via practical educational and/or service projects.

Measures to be Utilized:

- a. Research Collaborations. All CHM and BCM majors will engage in research collaborations with faculty and (frequently) student peers during their undergraduate careers at UD. As many MCM and CHA majors as department funding allows will be encouraged to participate in collaborative research.
- b. Membership and/or Participation in Student Organizations and Professional Societies. At least 60% of CHM, BCM, MCM, and CHA majors will actively participate in the departmental chapter of SAACS for one or more years during their undergraduate careers at UD.
- c. Service to the Local Community. At least 50% of those participating in SAACS will serve the Dayton area schools and/or other components of the local community in practical projects, practical educational and/or service projects on an annual basis.

5. Practical wisdom: All CHM, BCM, MCM, and CHA majors will develop and demonstrate practical wisdom in addressing real human problems and deep human needs, drawing upon advanced knowledge, values, and skills in their chosen profession or major course of study. Starting with a conception of human flourishing, students will be able to define and diagnose symptoms, relationships, and problems clearly and intelligently, construct and evaluate possible solutions, thoughtfully select and implement solutions, and critically reflect on the process in light of actual consequences.

Chemistry Department Outcomes:

- a. Practical Knowledge of Current Best Practices in Chemistry. As an outgrowth of their faculty-directed research projects and/or professional internships or coops, chemistry graduates will acquire an understanding of foundational chemical principles, chemical instrumentation, and current best experimental practices adequate for graduate school in chemistry and related disciplines, including environmental and forensic science, medicine (both human and veterinarian), other professional disciplines including but not limited to patent law and intellectual property rights, and chemical industry. To facilitate these outcomes, faculty-directed student research projects and instructional laboratory curricula will to the extent possible be designed to intersect with current practical challenges, including but not limited to the development and applications of advanced materials, medicines, pharmaceuticals and medical treatments, and energy- and environmental technology and sustainability, drawing upon the inherent relationship of chemistry to these fields.

- b. Chemical Safety. Students will learn about and utilize proper safety practices in the laboratory, in accord with Section 7.3 “Laboratory Safety Skills” on pp. 14-15 of the document entitled *Undergraduate Professional Education in Chemistry: ACS Guidelines and Evaluation Procedures for Bachelor’s Degree Programs* from the American Chemical Society Committee on Professional Training, dated Spring, 2008.

Measures to be Utilized:

- a. Participation in applied research projects.
- i. Faculty-Directed Student Research Projects. At least 80% of the students involved in these applied projects will be able to effectively articulate the relationship of chemical fundamentals to their research projects as well as their practical outcomes and implications for human society in private conversations with their research advisor and to the Department Chair during senior exit interviews.
 - ii. At least 75% of student research participants will indicate that they were adequately prepared for applied research in graduate/professional school and/or chemical or chemically-related industries during Senior Exit Interviews and post-graduate alumni surveys.
- b. Chemical Safety. At least 90% of the CHM, BCM, MCM, and CHA majors will answer at least 80% of the safety-related questions on exams and lab and pre-lab exercises in the general and organic chemistry laboratory courses, and on a post-test for chemical safety which is currently in development and will be administered in conjunction with the senior exit interviews.

6. Critical evaluation of our times: Through multidisciplinary study, all undergraduates will develop and demonstrate habits of inquiry and reflection, informed by familiarity with Catholic Social Teaching, that equip them to evaluate critically and imaginatively the ethical, historical, social, political, technological, economic, and ecological challenges of their times in light of the past.

Chemistry Department Outcomes:

- a. Demonstrated Understanding of Important Societal Issues Related to Chemistry. Undergraduate students will demonstrate comprehensive understanding of important social issues in areas which are inherently related to chemistry, including but not limited to advanced materials, health- and medicine-related issues, and energy/sustainability.

Measures to be Utilized:

- a. Oral Presentations in the Professional Practices Seminar (CHM496). All CHM, BCM, MCM, and CHA majors will deliver oral presentations on topics with social, ethical, diversity, or historical implications in the Professional Practices Seminar course (CHM 496).

7. Vocation: Using appropriate scholarly and communal resources, all undergraduates will develop and demonstrate ability to articulate reflectively the purposes of their life and proposed work through the language of vocation. In collaboration with the university community, students' developing vocational plans will exhibit appreciation of the fullness of human life, including its intellectual, ethical, spiritual, aesthetic, social, emotional, and bodily dimensions, and will examine both the interdependence of self and community and the responsibility to live in service of others.

Chemistry Department Outcomes:

- a. Faculty-Directed Student Research. All CHM and BCM majors desiring careers in academic or government research will pursue research in the laboratory of a faculty member of the Chemistry Department (or other venues when deemed appropriate by the Department Chair, the Academic Advisor, and the Undergraduate Research Director). These same opportunities will be made available to as many MCM and CHA majors as department funding allows.
- b. Corporate Internships and/or Coops. CHM, BCM, MCM, and CHA majors desiring careers in chemical and/or chemically-related industries will be encouraged to pursue corporate internships and/or coops to maximize their chances of employment immediately upon graduation.

Measures to be Utilized:

- a. Senior Exit Interviews. At least 80% of graduating CHM, BCM, MCM, and CHA majors will be able to clearly articulate (i) how their career objectives connect with their responsibility to live in service of others and (ii) how their appreciation for one or more of the dimensions of life (intellectual, ethical, spiritual, aesthetic, social, emotional, and/or bodily) grew during their undergraduate career, and how these same dimensions relate to their career objectives during their senior exit interviews.

Assessment Responsibilities

Assessment Committee Chair.

1. Develops an Annual Assessment Report based on
 - a. senior exit interviews conducted by the Department Chair,
 - b. a compilation of presentations, publications, and senior theses authored or co-authored by current undergraduate students or recently graduated chemistry majors communicated to him/her by the Department Chair no later than June 1,
 - c. a record of student internships and coops, and
 - d. a compilation of results from a UD Chemistry Alumni Follow-Up Questionnaire sent to alumni three years after the date of their graduation.
2. Transmits the completed Annual Assessment Report along with a brief summary of its contents to the Department Chair by June 15 each year.
3. Presents the Annual Assessment Report to the faculty for review and discussion at the first faculty meeting of the fall semester each academic year, at which point the entire faculty re-evaluates the existing assessment process.

Department Chair.

1. The Department Chair incorporates pertinent aspects of the Annual Assessment Report into the Annual Departmental Report, and submits both documents to the Dean by June 30 each year.

Tenure-Track Faculty.

1. Re-evaluates the existing assessment process during the first faculty meeting of the fall semester each academic year.

Assessment Schedule

1. End of Each Academic Semester

The Department Chair conducts Senior Exit Interviews with all graduating students and submits results to Assessment Committee Chair.

2. End of Each Academic Year

In conjunction with the Director of Undergraduate Research and the departmental administrative assistants, the Department Chair compiles and tabulates presentations, publications, and senior theses authored or co-authored by current or recently graduated students and submits them to the Assessment Committee Chair by June 1.

The Assessment Committee Chair (i) mails post-graduate survey to alumni three years after their graduation date, (ii) tabulates, evaluates, and incorporates pertinent responses into the Annual Assessment Report, and (iii) submits Annual Assessment Report to the Department Chair by June 15.

3. By June 30 each year:

The Department Chair submits the completed Annual Departmental Report and Annual Assessment Report to the Dean.

The Assessment Committee Chair submits the Annual Assessment Report to the University Assessment Committee.

4. First faculty meeting, Fall Semester:

The Assessment Committee Chair presents the Annual Assessment Report to the faculty for discussion, during which the existing assessment process will be discussed and re-evaluated.