

Application for Mildred Dahne Award Department of Chemistry • Spring 2015

The TCNJ Department of Chemistry has developed a culture of intellectual engagement that is shared by a community of undergraduate students, faculty, and staff. All of our faculty members are teacher-scholars who are dedicated to excellence in teaching and are engaged in the production and dissemination of new scientific knowledge. Using modern pedagogy in the classroom and collaborations between students and faculty in research, it is the Department's goal to instill in all students a sense of scientific inquiry that employs systematic, experimental, and computational approaches to make, model, and measure materials relevant to society and the natural world.

The Department underwent year-long program reviews in 2007-2008 and 2012-2013, which were key elements in our focus on continuous improvement. Each review included a comprehensive self-study component and an external review conducted by national-level experts. Most recently, two national leaders visited campus late in the Spring 2013 semester and prepared a report of their findings and recommendations for continued growth. The external reviewers' report was highly supportive of Department's progress since the last 5-year review, and of its current activities and trajectory. The external reviewers' report stated:

"Extraordinary, remarkable, unfathomable are the words that describe the advances made by the Department of Chemistry at TCNJ since 2008. In an economic climate where most academic units merely attempt to retain their core competencies this department has added instrumentation, grown the number of majors, extensively revised its curriculum, and hired recent PhDs. The department is poised to capture national attention as one of the up and coming departments."

Here, we will highlight three areas of departmental achievement related to the Mildred Dahne Award categories of excellence: Excellence in Teaching, Academic Excellence, and Department Impact.

I. Teaching Excellence

At the heart of TCNJ's mission is the education of our undergraduates. Over the last decade, the number of Chemistry majors has ranged from 120-160 students. In addition to our majors, many of the Department's courses impact non-science majors and many other science majors. We teach over 3,000 students annually.

The Chemistry Department provides a wide range of degree options, including American Chemical Society (ACS)-certified degrees, with the option to conduct credit-bearing authentic research. We also offer several chemistry specializations including in forensics chemistry and in materials science. The latter program, known as the *Chemistry and Physics of Condensed Matter* is a joint, interdisciplinary program between the chemistry and physics departments and provides a unique opportunity for students and faculty to engage in cutting-edge research that aims to develop, identify, and model new materials. The department continues to support the self-designed major in biochemistry and with the hiring of several faculty with expertise in biological chemistry, the department has developed curricula to expand its biochemistry options for TCNJ students. The Chemistry Secondary Education program provides TCNJ students with a B.S. degree in Chemistry and Secondary Education certification. We are now into our second year of official involvement in the College-wide 7-year B.S.-M.D. program, a highly competitive program that allows accepted students to obtain an undergraduate degree at TCNJ at an accelerated pace and to then directly matriculate into NJ Medical School.

I-A. The Chemistry Curriculum

The Department offers a major in one of two B.S. degrees in Chemistry, which both require an integrated curriculum in math, physics, and in each of the five subdivisions of chemistry. Students who successfully complete the requirements for the ACS-certified B.S. degree will receive a certificate from the American Chemical Society (ACS) indicating that their degree meets the standards set by The Committee on Professional Training. To provide more flexibility for our students, the Department engaged in an in-depth review of our curriculum and from this, we developed a non-ACS-certified track to provide more degree opportunities and flexibility for TCNJ students, while maintaining the academic standards expected of our institution. Highlights of our curriculum include the following:

- We teach eight key courses that are key support requirement for a range of majors (four of these are also required for all chemistry majors). These include *General Chemistry I and II* (CHE 201 & 202, HON 201

& 202, [HON courses are the honors equivalent of CHE 201 & 202], *Biochemistry of the Human Body* (CHE 111, for nursing majors), *Organic Chemistry I and II* (CHE 331 & 332), and *Biochemistry* (CHE 350, for non-majors).

- To provide our students with cutting edge courses, we teach two to three upper-level special topics courses per semester. These are taught by our full-time faculty members and include:
Inorganic Chemistry—Reactions and Mechanisms (O'Connor) | *Instrumental Analysis* (Huang) | *Chemical Biology* (Guarracino) | *Forensic Applications of Mass Spectrometry* (Allison) | *The Wonders of Asymmetric Synthesis* (Bradley) | *Kitchen Chemistry and Chemical Crystallography* (Chan) | *Spins—Nuclear Magnetic and Electron Spin Resonance* (Hirsh) | *Insect Biochemistry and Toxicology* (Sen) | *Principles of Medicinal Chemistry* (Hunt) | *Methods in Biophysical Chemistry* (Bunagan) | *Supramolecular Chemistry & Crystal Engineering* (Abourahma) | *Heterocyclic Chemistry* (Hunt) | *Computational Chemistry* (Baker) | *Bioinorganic Chemistry* (O'Connor).
- We consider it critically important that students receive extensive exposure to research and problem-solving activities. No chemistry major can graduate without having an in-depth experience in these, either through enrollment in research courses or summer research experiences, and enrollment in laboratory-based courses that include multi-week, hypothesis-driven projects.
- We have developed a comprehensive seminar program for our majors. The program spans three of the standard four year curriculum and incorporates discussions of the roles and responsibilities of chemists in today's society and focuses on such topics as chemical safety, scientific ethics, career exploration/preparation, and information literacy. This program has received national attention and has been described in several peer-reviewed publications.
- J. Allison has developed and taught an honors course for the first year seminar program (FSP, *The Art and Science of Color!*). L. Bradley, in collaboration with Elizabeth Mackie (Art Dept.), also developed and taught an FSP course, which was offered as a Maymester course in England (*Exploring London Through the World of Art and Chemistry*).
- All chemistry faculty teaching our core courses consistently have excellent rating on student evaluations. For example, the average value for the summary question that appeared on Fall 2014 student evaluation form, which asked for an overall evaluation of the quality of instruction, was 4.2 out of 5.0. Furthermore, the average for the same question regarding our entry-level course (*General Chemistry*) was 4.1 out of 5.0.
- Our students consistently score well above the national average for the ACS General Chemistry Examination. For example, in 2014 all TCNJ students scored within the 85th percentile (chemistry majors within the 94th percentile), while the national average was 37%.

I-B. The Student-scholar

A central goal of our program is to provide each student with the opportunity to engage in original scholarship. Indicators of our success in fostering our student-scholars are below:

- Unless they receive teaching certification, almost all of our chemistry majors participate in scientific research for academic credit by the time they graduate (83% of all graduating seniors in 2014). To receive academic credit, students must present a poster at our fall annual poster session and/or the *Celebration of Student Achievement*, and they must submit a research paper that follows the requirements and format of the American Chemical Society. The Department encourages research involvement as early as freshman year. During the 2013-2014 academic year, 55 Chemistry majors enrolled in independent research courses, and many of these students were involved in research for more than two semesters.
- Each year, students are co-authors on posters presented at national and/or international conferences, and on peer-reviewed publications (since 2011, more than 60 undergraduates have been co-authors on presentations, and 41 students were co-authors on peer-reviewed publications).
- Chemistry students have received awards for their scholarship and academic achievements. This includes awards from the American Chemical Society, the American Crystallographic Association, the New Jersey Institute of Chemists, and the Biophysical Society.
- Since 2012, three of our students have been nominated for Goldwater awards of which one received honorable mention.
- In 2014, six Chemistry graduates were members of Phi Beta Kappa.

I-C. Student and Alumni Outcomes

Another indicator of our success is the accomplishments of our students and alumni. The selected highlights of these accomplishments outlined below speak for themselves in terms of the excellent preparation that we have provided to our students.

- The Department graduates a very large number of highly qualified Chemistry majors each year. TCNJ's Chemistry Department is usually ranks in the top 4% of Chemistry programs nationally (out of ~653 in the U.S.) in graduation of American Chemical Society (ACS)-certified bachelor's degree chemistry graduates and is the top producer of ACS-certified bachelor's degree chemistry graduates for primarily undergraduate institutions (PUIs) in the Northeast and in the State of NJ.
- Our TCNJ Student Chemists Association was featured on the cover of the national magazine, *inChemistry*.
- Our TCNJ Student Chemists Association has been recognized by the American Chemical Society in receiving two national awards: "Outstanding Chapter Award" and the "Green Chemistry Award" for the last three years.
- Each year, many of our graduating students apply to graduate programs (e.g., 58% of our graduating seniors in 2012), and each year they gain admittance to the top Ph.D. programs in the country. For example, in 2012 our students were accepted at Brown U., Princeton U., Duke U., Harvard U., U. of Connecticut, Yale U., U. of Rochester, U. of South Carolina, U. of Pennsylvania, Michigan State U., U. of California–San Francisco, U. of North Carolina– Chapel Hill, Emory U., Johns Hopkins U., U. of Florida, U. of Chicago, U. of Delaware, U. of Michigan, and Northeastern U.
- Each year, several of our majors apply to medical school (or related field), with remarkable success – over 95% of those students are accepted to medical school. In 2014, students were accepted to medical school at Albert Einstein College of Medicine, Rutgers U., and Cooper Medical School; and dental school at Temple U., Rutgers U., U. of Pittsburgh, U. of Maryland, New York U.
- Our graduates are highly successful in their graduate studies and have been awarded research fellowships. In 2014, Joe Macor (graduate 2009) received the Seaborg Fellowship to work at the Los Alamos National lab, Michael Grasso (graduate 2013) received a Ruth L. Kirschstein National Research Service Fellowship Award from the National Institutes of Health, and both John Ferrie (graduate 2013) and Rachel Roesch (graduate 2012) received National Science Foundation Graduate Research Fellowships.

II. Academic Excellence

Our faculty embraces the model of teacher-scholar, valuing the integration of teaching and scholarship into the daily activities of our faculty and students. The Chemistry Department has undergone significant scholarly growth during the past several years. Almost half of the faculty is new to the department, and they bring a wide range of new expertise. For the category of Academic Excellence we focus on excellence in scholarship. Our faculty engage in scholarship/creative/professional activity by conducting research, authoring scientific publications, writing grant proposals, and presenting their findings at professional meetings and through invited talks. Faculty are expected to be excellent mentors and to develop high-visibility research programs that involve undergraduate students. As shown below, all full-time faculty members in Chemistry are actively engaged in this form of scholarship.

II-A. External Grants Awarded (since 2008; over \$3.1 million funded, of 42 grant proposals submitted)

- National Science Foundation, *Prenylcysteine Metabolism and Phytohormone Signaling in Arabidopsis*, S. Sen (co-PI) and D. Crowell (PI, Idaho State U.), \$570,702, 2008-2012.
- The Camille and Henry Dreyfus Foundation, *Spectroscopic Study of Hemoglobin Unfolding and Conformational Dynamics*, M. Bunagan, \$29,543, 2008-2013.
- National Science Foundation, *PERSIST in biology and chemistry (Program to Enhance Retention of Student in Science Trajectories in biology and chemistry)*, D. Lovett (PI, TCNJ Biology Dept.), L. Bradley, B. Chan, S. Nayak (TCNJ Biology Dept.), and J. Osborn (TCNJ School of Science), \$599,960, 2008-2013.
- American Chemical Society Petroleum Research Fund, *Building Block Approach to Chalcogenide Material Discovery*, B. Chan, \$55,000, 2009.
- National Science Foundation, *MRI Acquisition of a Single Crystal X-ray Diffractometer for Undergraduate Research and Training*, B. Chan (PI), H. Abourahma, S. Sen, D. Hunt, G. Arvanitis, \$257,740, 2010-2012.

- National Science Foundation, *MRI: Acquisition of a 400 MHz NMR Spectrometer for Undergraduate Research and Training*, Sen, S.E. (PI), D. Hunt, L. Bradley, D. Guarracino, and A. O'Connor, \$261,086, 2012-2014.
- Marshall Univ. School of Medicine, *Development of Drugs and Novel Transport Methods Enabling Penetration of the Blood-Brain Barrier for the Treatment of Alzheimer's Disease*, D. Hunt (PI), J. Weinstein (Marshall U.), R.D. Egleton (Marshall U.), E Gonzalez (Marshall U.), \$330,000, 2010-2012.
- Marshall Univ. George and Rolfa Rogers Neudegenerative Diseases Program, *Development of Drugs for the Treatment of Alzheimer's Disease*, D. Hunt, \$20,000, 2011.
- Research Corporation– Cottrell College Science Award, *Single-Molecule Investigation of Multi-Domain Folding: A Fluorescence Correlation Spectroscopy Study*, M. Bunagan, \$35,000, 2011-2013.
- National Science Foundation, *PERSIST 2.0 in Biology and Chemistry (Program to Enhance Retention of Students In Science Trajectories in Biology and Chemistry)*, B. Chan (PI), L. Bradley, S. Nayak (TCNJ Biology Dept.), D. Lovett (TCNJ Biology Dept.), \$639,000, 2013-2016.
- National Science Foundation, *REU: Integrated Computational and Experimental REU Site*, A. O'Connor (Co-PI), J. Evanseck (PI, Duquesne U.), \$300,000, 2013-2015.
- American Chemical Society Petroleum Research Fund, *Synthesis of Cationic Nickel(II) Complexes Containing Hemilabile Arms for use as Alkene Hydrogenation Catalysts*, A. O'Connor, \$50,000, 2013-2015.

II-B. Internal Grants (since 2012)

- Ten faculty members have received Support of Scholarly Activity (SOSA) awards: H. Abourahma (2012, 2014), M. Bunagan (2012), B. Chan (2013), A. O'Connor (2013, 2015), J. Allison (2014), S. Sen (2014), J. Baker (2015), and D. Guarracino (2015).
- H. Abourahma received funding through the TCNJ Advance Program (Travel Grant, 2012 ; External Mentorship Award, 2010).
- Eight faculty received funding to support 18 undergraduate students through the TCNJ Mentored Undergraduate Summer Experience Award (MUSE): M. Bunagan (2012, 2014), H. Abourahma (2013), D. Hirsh (2013), D. Hunt (2013), A. O'Connor (2012, 2013, 2014), S. Sen (2012, 2014).
- Two faculty received School of Science Mini Grants: D. Hirsh (2012, 2014), D. Guarracino (2014).
- Three faculty were awarded sabbatical leave to conduct scholarship activities: D. Hirsh, (2014), D. Hunt (2014), and B. Chan (2015).
- A. O'Connor received an AFT Career Development Award.

II-C. Publications in peer-reviewed journals (since 2008; 44 papers):

Abourahma...*Journal of Chemical Education* (2014), *Crystal Engineering Communications* (2012, 2011)
Allison*Journal of Forensic Sciences* (2013, 2010, 2008), *Analytical and Bioanalytical Chemistry* (2009), *American Laboratory* (2008)
Bradley*Journal of Chemical Education* (2014), *Tetrahedron Letters* (2010), *Organic Preparations and Procedures International* (2010)
Bunagan.....*Chemical Communications* (2011)
Chan*Acta Crystallographica* (2014, three publications in 2013, 2010)
Guarracino...*Journal of Biomolecular Structure and Dynamics* (2015), *Bioorganic & Medicinal Chemistry Letters* (2013)
Hirsh*Journal of Physical Chemistry* (2013), *Review of Scientific Instruments* (2010), *Journal of Inorganic Biochemistry* (2009)
Hunt.....*International Journal of Medicinal Chemistry* (2014), *Tetrahedron Letters* (2014, two publications in 2013, 2010, 2009), *Organic Preparations and Procedures International* (2010), *Acta Crystallographica* (2010), *Organic Communications* (2009)
Huang*Journal of Liquid Chromatography & Related Technologies* (2011, 2009, 2008), *Petroleum Science and Technology* (2010)
O'Connor.....*Journal of Chemical Education* (2014), *Organometallics* (2013, 2011)
Sen.....*Insect Biochemistry and Molecular Biology* (2013, 2012), *Molecular Plant* (2010), *Biochemistry* (2009), *Bioorganic & Medicinal Chemistry* (2009), *FEBS Letters* (2009)

II-D. Other Publications and Scholarly Outcomes (since 2008):

- D. Hunt was author and inventor on a scientific patent (WO 2008092817).
- S. Sen, H. Abourahma, and J. Allison were invited to write reviews on their area of scholarship.

II-E. Recent Scholarly Presentations

Faculty and students are regularly involved in presenting their work at national meetings. In 2014, 8 faculty members and 33 student co-authors attended the American Chemical Society (ACS) national meetings and presented their original research. Since 2012, the Department's faculty members and undergraduate students have been disseminating the results of their scholarship through more than 55 presentations at national and international meetings.

III. Department Impact

The Chemistry faculty and staff contribute both to the mission of the Department and to the College community. Many of our faculty and staff members serve in leadership roles on campus, as indicated below. Our faculty members are also involved in a wide range of national organizations, as well as with local organizations and K-12 schools.

III-A. Leadership Roles at the College (past 10 years):

- *Faculty Senate:* Three faculty members have served on the Faculty Senate (L. Bradley, B. Chan, D. Hunt), L. Bradley served on the Senate Executive Board, and D. Guarracino is currently a Senator.
- *Board of Trustees:* J. Allison was faculty representative to the Board of Trustees.
- *College-Wide Standing Committees:* L. Bradley served as member and chair of the Committee on Student and Campus Community (CSCC); D. Hirsh, J. Allison, and D. Hunt served as members (D. Hirsh as vice-chair, and D. Hunt as chair) of the Committee on Faculty Affairs (CFA).
- *College-wide Councils:* M. Bunagan and B. Chan were members of the Athletic Advisory Council; D. Hunt and B. Chan were members (B. Chan was chair) of the Faculty-Student Collaboration Council; A. O'Connor is currently chair of the Honors and Scholars Council; L. Bradley was member and co-chair of the Enrollment Management Council; S. Sen was and M. Bunagan is member of the Teaching and Learning Council; H. Abourahma is member of the Healthy Campus Council; D. Hirsh is member of the Advising and Student Support Council; J. Allison served the Cultural and Intellectual Community Council.
- *College-wide Faculty Reward and Recognition Committees:* D. Hunt and S. Sen served as members of the Support for Scholarly Activities Committee (SOSA); D. Hunt was member of the Sabbatical Committee; J. Allison was and B. Chan is member of the College Promotions Committee (CPC).
- *Other College-wide Committees and Boards:* L. Bradley was and D. Hunt is member of the Medical Careers Advisory Committee; D. Hunt was and M. Bunagan (as chair) is member of the Goldwater Scholarship Selection Committee; L. Bradley served on the Committee on Teaching Excellence; B. Chan is a charter member of the Sarnoff Museum Committee; M. Krichten is student conduct advisor; D. Guarracino is member of the Academic Integrity Board; D. Hunt was member of the Provost's Committee on Mentoring of Scholarship; J. Allison was member of the Campus Town Planning Committee.
- *College-wide Directors:* B. Chan is the current director of Faculty-Student Scholarly and Creative Collaboration.
- *Staff Senate:* L. Duminak served on the Staff Senate.

III-B. Leadership Roles at the National and Regional Levels (past 5 years):

- *American Chemical Society (ACS), National:* B. Chan served as Chair of the Younger Chemist Subdivision for the Division of Professional Relations Executive Committee of ACS.
- *Council for Undergraduate Research (CUR), National:* S. Sen served as a nationally elected Councilor of CUR's Chemistry Division.
- *American Society for Mass Spectrometry (ASMS), National:* J. Allison served as a member of ASMS Program Committee Annual National Meeting.
- *American Chemical Society (ACS), Trenton Section:* Several faculty serve (or have served) leadership roles in this organization, including M. Bunagan (chair, director, and newsletter editor), B. Chan (chair and newsletter co-editor), D. Guarracino (board member and newsletter editor), and A. O'Connor (chair).