# Chemistry

The chemistry major within the Department of Chemistry and Biochemistry offers up-to-date, rigorous yet flexible training in both the theory and the experimental practice of chemistry. A separate information sheet describes the biochemistry major.

**A brief tour through the major.** There are three entry points into the chemistry major. (1) Most potential chemistry majors start by taking Oberlin's year-long general chemistry course. (2) Students with high scores on a chemistry placement examination (given during first-year orientation) can start with a separate one-semester general chemistry course. Students with Chemistry AP scores of 3 or higher can start with either the one-semester general chemistry course or the second semester of the one-year course. (3) Students with Chemistry AP scores of 4 or 5 can skip general chemistry altogether and start with organic chemistry.

Student chemistry majors next take four one-semester, core courses in chemistry: analytical, inorganic, organic, and physical chemistry. The core courses are available in any order. Two of the four core courses make use of prerequisites beyond general chemistry: the analytical chemistry core course requires one semester of college-level calculus, and the physical chemistry core course requires second-semester college calculus and a year of college-level physics. All the core courses have laboratory as well as classroom components.

To complete their chemistry majors, students take another 9 credit hours of intermediate and advanced chemistry courses of their choosing. All the intermediate-level courses have laboratory components.

Many chemistry majors pursue their interests in chemistry beyond the major requirements, taking additional intermediate and advanced courses in chemistry, taking additional courses in other sciences and mathematics, serving as laboratory teaching assistants, attending talks and often meals with outside researchers, and participating in research with Oberlin College faculty members.

**Faculty members as teachers.** Oberlin College chemistry faculty members take their teaching seriously. They treat students as individuals, and they use a variety of teaching techniques to help students learn to think productively and critically in the classroom and in the laboratory. Faculty members regularly refine and revise their teaching materials and methods, and many courses involve extensive, Oberlin-originated materials that supplement or replace commercial textbooks.

**Faculty members as research mentors.** Research participation is an excellent way for students to consolidate the chemistry they have learned in courses. The department encourages all its majors to gain research experience. Research students work as junior colleagues with faculty members on the faculty members' on-going research projects. Some students engage in experimental or computational research as early as their first Winter Term at Oberlin, although most student researchers are juniors or seniors. Each summer, about a dozen students are paid for full-time research activities. All the department faculty are active in research. Many faculty publications have student co-authors. The department's faculty members and samples of their recent publications are listed at the end of this document.

**Departmental facilities.** Chemistry laboratories in the Science Center are well equipped with sophisticated instruments and computers. Departmental instrument rooms house three gas chromatographs (one with a mass spectrometric detector), a liquid chromatograph, two Fourier-transform infrared spectrophotometers and a Fourier-transform Raman/infrared spectrometer, two ultraviolet-visible spectrophotometers, an atomic absorption spectrophotometer, 200-MHz and 600-MHz nuclear magnetic resonance spectrometers, an electroanalytical system, and an x-ray diffractometer (shared with the Department of Physics and Astronomy). Still other instruments are located in laboratories for specific courses. The department also houses a 70-node, parallel supercomputer assembly, as well as a computer laboratory equipped with Macintosh G5 computers.

The Science Library holds thousands of chemistry books and subscriptions to more than 300 science journals (with electronic access to thousands more).

**What do Oberlin College chemistry majors do after college?** A chemistry major's training provides a solid foundation in a key science and serves as valuable preparation for a variety of careers. The department prides itself in preparing future Ph.D.s and M.D.s. Oberlin chemistry majors with strong records of achievement are accepted into the best graduate and medical schools. In addition to those who have gone on to graduate programs in chemistry or biochemistry or medicine, recent chemistry graduates have entered graduate programs in chemical engineering, chemical physics, computer science, forensic science, molecular biology, geochemistry, art conservation, public health, and law. Oberlin graduates in chemistry are faculty members at universities and colleges, practice medicine at medical schools and in private practice, do research in the chemical and pharmaceutical industries, and use their technical knowledge in the practice of law. Three Oberlin graduates in chemistry have served as presidents of the American Chemical Society, and many others have received awards for their professional achievements.

**Chemistry and Biochemistry Department Faculty**

**JASON M. BELITSKY,** Assistant Professor (B.A., Amherst, 1997; Ph.D., California Institute of Technology, 2002), teaches general chemistry, biochemistry, and chemical biology. He does research on synthetic analogs of the human pigment eumelanin and their use in environmental remediation. He uses techniques from organic and biochemistry as well as atomic absorption spectroscopy.

**MATTHEW J. ELROD,** Associate Professor (B.A. Grinnell, 1989; Ph.D. Berkeley 1994), teaches general chemistry, environmental chemistry, and physical chemistry. He does research on reactions involved in air pollution and global climate change. He uses the techniques of kinetics, mass spectroscopy, and computational chemistry.

**WILLIAM H. FUCHSMAN,** Professor (B.A., Harvard, 1963; Ph.D., Johns Hopkins, 1967), teaches general chemistry, bio-organic chemistry, and cancer biochemistry. He does research on the catalytic properties of hemoglobins and related proteins, including plant hemoglobins. He uses the techniques of ultraviolet/visible spectroscopy, isoelectric focusing, and kinetics.

**ALBERT R. MATLIN,** Professor (B.A., Bard, 1977; Ph.D., Yale, 1982), teaches general chemistry and organic chemistry. He does research in synthetic and mechanistic organic chemistry. He uses photochemical techniques to generate and study reactive intermediates.

**MANISH A. MEHTA,** Assistant Professor (A.B., Wabash, 1986; Ph.D., Yale, 1990), teaches general chemistry and physical chemistry. He does research on the effects of solvent on peptide secondary structure. He uses the techniques of experimental solid-state nuclear magnetic resonance and computational quantum chemistry.

**MICHAEL W. NEE,** Associate Professor (B.S., Santa Clara, 1977; Ph.D., California Institute of Technology, 1981), teaches general chemistry and organic chemistry. He does research on the chemistry of compounds encapsulated in large macrocyclic structures. He also does research on the synthesis and characterization of catalysts that control the chirality of oxidation reactions.

**CATHERINE M. OERTEL,** Assistant Professor (B.A., Oberlin, 1999; Ph.D., Cornell, 2005), teaches general chemistry and inorganic chemistry. She does research on the synthesis of new inorganic-organic hybrid materials and on the corrosion of metals in historic cultural objects. She uses the techniques of solvothermal synthesis, x-ray diffraction, and scanning electron microscopy.

**ROBERT Q. THOMPSON,** Professor (B.A., Wooster, 1978; Ph.D., Michigan State, 1982), teaches general chemistry, analytical chemistry, and forensic chemistry. He does research on the analysis of explosives residue and on the analysis of the spicy components of hot peppers. He uses

the techniques of solid phase extraction and liquid chromatography.

**REBECCA J. WHELAN,** Assistant Professor (B.A. Lawrence University, 1996; Ph.D., Stanford University, 2003), teaches general chemistry and analytical chemistry. She does research on the detection of protein markers for ovarian cancer by antibodies and by single-stranded DNA. She uses the techniques of the polymerase chain reaction, capillary electrophoresis, and surface plasmon resonance spectroscopy.

**NORMAN C. CRAIG,** Emeritus Professor (B.A., Oberlin, 1953; Ph.D., Harvard, 1957), taught general chemistry, environmental chemistry, and physical chemistry. He does research on the structures of carbocations and small hydrocarbons and fluorocarbons. He uses the techniques of infrared and Raman spectroscopy and computational analysis of high-resolution infrared and microwave spectra.

**Recent Research Publications by Faculty and Students***

N.C. Craig, P. Groner, and D.C. McKean, "Equilibrium Structures for Butadiene and Ethylene: Compelling Evidence for Pi-Electron Delocalization in Butadiene," *Journal of Physical Chemistry A,* 2006, *110,* 7461-7469.

N.C.Craig, M.C. Moore*, A.K. Patchen*, and R.L.Sams, "Analysis of Rotational Structure in the High-Resolution Infrared Spectrum and Assignment of Vibrational Fundamentals of Butadiene-2,3-$^{13}C_2$," *Journal of Molecular Spectroscopy,* 2006, *235,* 181-189.

R.M. Garland, M.J. Elrod, K. Kincaid, M.R. Beaver, J.L. Jimenez, and M.A. Tolbert, "Acid-Catalyzed Reactions of Hexanal on Sulfuric Acid Particles: Identification of Reaction Products, *Atmospheric Environment,* 2006, *40,* 6863-6878.

A.R. Matlin, "Photocycloaddition/ Trapping Reactions of Cross-Conjugated Cyclic Dienones: Capture of Oxyallyl Intermediates," *The CRC Handbook of Organic Photochemistry and Photobiology*, 2nd Edition; W. Horspool and F. Lenci, Editors, CRC Press LLC, New York, 2004, 81.1-81.12.

A.R. Matlin, K.F. Brinton*, and B.T. Nivaggioli*, "Rule of Five Cyclizations in 5-Hexenyl Radicals and Photocyclizations of 1,5-Hexadienes: Effect of 4-Oxa Substitution," *Journal of Physical Organic Chemistry,* 2007, *20,* in press.

M.A. Mehta, E.A. Fry*, M.T. Eddy*, M.T. Dedeo*, A.E. Anagnost*, and J.R. Long, "Structure of the Alanine Dipeptide in Condensed Phases Determined by $^{13}C$ NMR," *Journal of Physical Chemistry,* 2004, *108,* 2777-2780.

A. Nelson, J.M. Belitsky, S. Vidal, C.S. Joiner, L.G. Baum, and J.F. Stoddart, "A Self-Assembled Multivalent Pseudopolyrotaxane for Binding Galectin-1," *Journal of the American Chemical Society,* 2004,*126,* 11914-11922.

C.M. Oertel, L.L. Rayburn, S. Jin, and F.J. DiSalvo, "Monotopic Binding Modes for Ditopic Ligands: Synthesis and Characterization of $W_6S_8L_6$ (L=4,4'-bi-pyridine,bis(diphenylphosphinoethane)) Cluster Compounds," *Comptes Rendus Chimie,* 2005, *8,* 1779-1788

C.M. Oertel, R.D. Sweeder, S. Patel, C.M. Downie, and F.J. DiSalvo, "Synthesis and Characterization of Hydrogen-Bonded Assemblies of $W_6S_8L_6$ Clusters," *Inorganic Chemistry,* 2005, *44,* 2287-2296.

R.Q. Thompson, K.W. Phinney, L.C. Sander, and M.J. Welch, "Reversed Phase Liquid Chromatography and Argentation Chromatography of the Minor Capsaicinoids," *Analytical and Bioanalytical Chemistry,* 2005, *381,* 1432-1440.

R.Q. Thompson, M.J. Pennino*, M.J. Brenner*, and M.A. Mehta, "Isolation of Individual Capsaicinoids from a Mixture and Their Characterization by $^{13}C$ NMR Spectrometry," *Talanta,* 2006, *70,* 315-322.

R.J. Whelan, R.K. Sunahara, R.R. Neubig, and R.T. Kennedy, "Affinity Assays using Fluorescence Anisotropy with Capillary

Electrophoresis Separation," *Analytical Chemistry,* 2004, *76,* 7380-7386.

L.Y. Yeung*, M.J. Pennino*, A.M. Miller*, and M.J. Elrod, "Kinetics and Mechanistic Studies of the Atmospheric Oxidation of Alkynes," *Journal of Physical Chemistry A,* 2005, *109,* 1879-1889.

*Oberlin student co-authors

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