Chemistry & Biochemistry

Chemists study the material world and its transformations through insight and experimentation. The study of chemistry reveals how the behavior of atoms and molecules can explain the properties and processes of matter, including living systems. As members of the most interdisciplinary science, chemists are employed in a wide range of industries. Chemistry and biochemistry play a vital role in addressing many issues in society, such as developing alternative sources of energy or new materials that have applications for national security, health care, environmental remediation, and many other areas.

THE PROGRAM

The Department of Chemistry and Biochemistry offers **Bachelor of Science** (B.S.) degrees in **chemistry** (63 credits) and **biochemistry** (69-70 credits) and a **Bachelor of Arts** (B.A.) degree in **chemistry** (53 credits).

There are different options available for the B.S. degrees. In chemistry, the American Chemicasl Society (ACS)-approved requires a **senior research thesis** as a capstone experience, as do the ACS or American Society for Biochemistry and Molecular Biology (ASBMB)-approved biochemistry B.S. degrees. Alternatively, students can complete a senior literature review for a B.S. degree that does not include a thesis. The B.S. degrees with thesis options are recommended for students aspiring to earn graduate degrees in chemistry, biochemistry, or related disciplines.

A B.A. degree is offered for those students seeking a strong background in chemistry, but with less specialization than the B.S. programs. The **B.A. in chemistry** (53 credits) allows students to complete a variety of elective courses in other disciplines and is popular among students pursuing careers in the health sciences, as well as those planning careers as chemistry teachers. A 27-29 credit minor in chemistry is also offered.

For students interested in environmental science, the Department recommends a B.A. degree in chemistry combined with a major or minor in environmental studies and supporting courses in biology and civil engineering. While Gonzaga does not offer a program in chemical engineering, students can combine a B.S. in chemistry with supporting engineering courses, followed by an M.S. or Ph.D. degree in chemical engineering from a post-graduate institution.

As empirical sciences, chemistry and biochemistry require extensive **laboratory experimentation**. Thus, most of Gonzaga's chemistry and biochemistry courses have both a lecture and laboratory component. Knowledgeable and dedicated faculty teach all courses. The program is built on a strong laboratory curriculum, student-centered faculty, high academic standards, and modern equipment for teaching and research.

Department faculty members strongly encourage students to conduct **research**. Seniors pursuing an ACS-approved degree complete an **extensive undergraduate thesis**. Students have full use of the Department's most advanced equipment, including various spectrometers (nuclear magnetic resonance, mass, infrared, fluorescence, ultraviolet/visible, inductively-coupled plasma, circular dichroism, and atomic) and gas and liquid chromatographs.

Challenging coursework, dedicated faculty members, and small classes encourage students to explore all aspects of chemistry. Developing strong oral and written communication skills is a key objective of the program. The Department hosts a weekly seminar series that invites academic and industrial speakers to campus throughout the year; students participate as well, presenting research and literature seminars in their senior year. Many students also develop communication skills by working as teaching assistants in our laboratory classes.

An active **internship program** led by a full-time director provides additional research and industrial opportunities for students. The Department operates an 11-week summer research program in which students can work closely with Gonzaga faculty and gain research experience while earning a competitive stipend or academic credit. Many students are members of Student Affiliates of the American Chemical Society (SAACS) and participate in local outreach activities, grade-

school demonstrations, and field trips to regional science facilities. All of these activities accelerate students' professional development by helping them mature and focus their career goals.

OUTCOMES

Gonzaga chemistry and biochemistry graduates pursue careers in a wide variety of fields requiring strong backgrounds in science, problem-solving, and analysis. Recent graduates have accepted jobs, for example, in actuary work, chemical sales, pharmaceutical research and development, medical technology, and teaching. Our graduates are also involved in service positions within the Jesuit Volunteer Corps and AmeriCorps. Approximately 60% of all Gonzaga chemistry and biochemistry graduates go on to graduate study, including medical, dental, veterinary, pharmacy, physician assistant, and even law school. (See more information about graduate schools and employers of Gonzaga chemistry and biochemistry graduates at the bottom of the page.)

THE PEOPLE

Faculty members are committed to their students, providing knowledgeable guidance, clear instruction, and enthusiasm for their subject area. They hold regular office hours and serve as advisors and mentors, guiding students along their chosen personal career paths.

SAMPLES OF FACULTY & STUDENT RESEARCH

Schwarz, B.H., Driver, J., Peacock, R.B., Dembinski, H.E., Corson, M.H., Gordon, S.S., Watson, J.M. (2014). "Kinetic characterization of an oxidative, cooperative HMG-CoA reductase from Burkholderia cenocepacia." Biochimica et Biophysica Acta. 1844:457-464.

Gonzalez, J.D., Levonyak, N.S., Schneider, S.C., Cremeens, M.E. (2014). "Using infrared spectroscopy of a nitrile labeled phenylalanine and tryptophan fluorescence to probe the a-MSH peptide's side-chain interactions with a micelle model membrane." J. Mol. Struct. 1056-1057:7-12.

Gidofalvi, G., Mazziotti, D.A. (2014). "Molecule-optimized basis sets and Hamiltonians for accelerated electronic structure calculations of atoms and molecules." J. Phys. Chem. A. 118:495-502.

Stumetz, K.S., Nadeau, J.T., Cremeens, M.E. (2013). "Potential Non-adiabatic Reactions: Ring-opening 4,6-Dimethylidenebicyclo [3.1.0]hex-2-ene Derivatives to Aromatic Reactive Intermediates." J. Org. Chem. 78:10878-10844.

Warren, G.L., Do, T.D., Kelley, B.P., Nicholls, A., Warren, S.D. (2012). "Essential considerations for using protein-ligand structures in drug discovery." Drug Discovery Today. 17(23-24): 1270-1281.

Lonjers, Z.T., Dickson, E.L., Chu, T.T., Kreutz, J.E., Neacsu, F.A., Anders, K.R., Shepherd, J.N. (2012). "Identification of a new gene required for the biosynthesis of Rhodoquinone in Rhodospirillum rubrum." Journal of Bacteriology. 194:965-971.

Szalay, P.G., Müller, T., Gidofalvi, G., Lischka, H., Shepard, R. (2012). "Multiconfiguration self-consistent field and multireference configuration interaction methods." Chemical Reviews. 108:108–181.

Warren, G.L., Warren, S.D. (2011). "Chapter 16: Scoring Drug-Receptor Interactions." In Drug Design Strategies: Quantitative Approaches. Eds. David J. Livingstone and Andy Davis. Royal Society of Chemistry Publishing. 440-457.

Hickert, A.A., Durgan, A.C., Patton, D.A., Blake, S.A., Cremeens, M.E. (2011). "A B3LYP investigation of the conformational and environmental sensitivity of carbon–deuterium frequencies of aryl-perdeuterated phenylalanine and tryptophan." Theoretical Chemical Accounts. 130:883-889.

Pelzer, K., Greenman, L., Gidofalvi, G., Mazziotti, D.A. (2011). "Strong correlation in acene sheets from the active-space variational two-electron reduced-density-matrix method: Effects of symmetry and size." Journal of Physical Chemistry. 115:5632-5640.

Smieja, J.A. (2011). "Household water treatments in developing countries." Journal of Chemical Education. 88:549-553.

Ross, E.E.; Mok, S.W., Bugni, S.R. (2011). "Assembly of lipid bilayers on silica and modified silica colloids by reconstitution of dried lipid films." Langmuir. 27:8634-8644.

GRADUATE SCHOOL

Chemistry

Mayo Graduate School
Northwestern University
Oregon Health & Science University
Oregon State University
University of Arizona
University of California, Berkeley
University of California, Irvine
University of California, San Diego
University of Chicago
University of Colorado, Boulder
University of Illinois
University of Oregon
University of Utah
University of Texas, Austin
University of Washington

Medical School

Creighton University
Loyola University Chicago
Northwestern University
Tulane University
University of Washington
University of Wisconsin
Vanderbilt University

Brajcich, B.C., Iarocci, A.L., Johnstone, L.A.G., Morgan, R.K., Lonjers, Z.T., Hotchko, M.J., Muhs, J.D., Kieffer, A., Reynolds, B.J., Mandel, S.M., Marbois, B.N., Clarke, C.F., Shepherd, J.N. (2010). "Evidence that Ubiquinone is a required intermediate for Rhodoquinone biosynthesis in Rhodospirillum rubrum." Journal of Bacteriology. 192:436-445.

Gidofalvi, G., Shepard, R. (2010). "Exploiting sparsity in the graphically contracted function configuration interaction method." Molecular Physics. 108:2717.

Murphy, K., Kubin, Z.J., Shepherd, J.N., Ettinger, R.H. (2010). "Valeriana officinalis root extracts have potent anxiolytic effects in laboratory rats." Phytomedicine. 17:674-678.

Shepard, R., Gidofalvi, G., Hovland, P.D. (2010). "An efficient recursive algorithm to compute wave function optimization gradients for the graphically contracted function method." International Journal of Quantum Chemistry. 110:2938.

Smieja, J. A, D'Ambruoso, G. D., Richman, R. M. (2010). "Art and chemistry: Designing a study-abroad course." Journal of Chemical Education. 87:1085-1088.

D'Ambruoso, G. D., Ross, E. E., McGrath, D. V. (2009). "Site-isolated, intermolecularly photocrosslinkable, and patternable dendritic quinacridones." Chemical Communications. 22:3222-3224.

Miller, C. S., Ploetz, E. A., Cremeens, M. E., Corcelli, S. A. (2009). "Carbon-deuterium vibrational probes of peptide conformation: Alanine dipeptide and glycine dipeptide." Journal of Chemical Physics. 130:125103.

Zimmermann, J., Gundogdu, K., Cremeens, M. E., Bandaria, J., Hwang, G. T., Thielges, M., Cheatum, C. M., Romesberg, F. E. (2009). "Efforts toward developing probes of protein dynamics: Vibrational dephasing and relaxation of carbon–deuterium stretching modes in deuterated leucine." Journal of Physical Chemistry. 113:7991-7994.

Employers
Avista Laboratories
Bend Research
Brooks
Gilead Sciences
Jubilant HollisterStier
Merck
Metrical
Publicity Providers Inc.
Spokane School District #81
Teach for America

FACULTY CONTACT & SPECIALTIES

Kylie D. Allen
Ph.D., Washington State University
Assistant Professor
biochemistry
allen@gonzaga.edu

David A. Cleary
Ph.D., University of Michigan
Professor
physical and materials chemistry
cleary@gonzaga.edu

Matthew E. Cremeens
Ph.D., Cornell University
Associate Professor
organic and biophysical chemistry
cremeens@gonzaga.edu

Jeff D. Cronk
Ph.D., University of California, Berkeley
Dept. Chair
Associate Professor
biochemistry and structural enzymology
cronk@gonzaga.edu

Gemma D'Ambruoso
Ph.D., University of Arizona
Lecturer
organic chemistry
dambruoso@gonzaga.edu

Osasere Evbuomwan
Ph.D., University of Texas, Dallas
Assistant Professor
bioinorganic chemistry, biomedical imaging agents
evbuomwan@gonzaga.edu

Gergely Gidofalvi
Ph.D., University of Chicago
Associate Professor
computational chemistry and electronic structure
gidofalvi@gonzaga.edu

Masomi Matsumoto
Ph.D., University of Oklahoma
Assistant Professor
organic chemistry
matsumoto@gonzaga.edu

Eric Ross
Ph.D., University of Arizona
Associate Professor
analytical development and application of nanoporous materials
rosse@gonzaga.edu

Jennifer N. Shepherd
Ph.D., University of California, Los Angeles
Professor
organic synthesis with applications in quinone biosynthesis, anaerobic energy metabolism and drug design
shepherd@gonzaga.edu

Sarah Siegel
Ph.D., The Scripps Research Institute
Lecturer
biophysical chemistry
siegel@gonzaga.edu

Joanne Smieja
Ph.D., University of Minnesota
Professor
environmental applications of inorganic chemistry
smieja@gonzaga.edu

Stephen Warren
Ph.D., State University of New York at Buffalo
Assistant Professor
medicinal, bioorganic, and organic chemistry
warren@gonzaga.edu

Jeff Watson
Ph.D., Purdue University
Associate Professor
Director, Institute for Undergraduate Research and Creative Inquiry
biochemistry with emphasis on enzyme structure-function relationships and protein dynamics
watsonj@gonzaga.edu

EMERITUS FACULTY

Dennis Kelsh
Ph.D., Iowa State University
Professor Emeritus
kelsh@barney.gonzaga.edu

Dennis McMinn
Ph.D., University of Minnesota
Professor Emeritus
mcminn@gonzaga.edu

Kay Nakamaye
Ph.D., University of California, Berkeley
Professor Emeritus
nakamaye@gonzaga.edu

GONZAGA UNIVERSITY