Department of Chemistry and Biochemistry

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The Department of Chemistry and Biochemistry offers research-oriented programs culminating in the Doctor of Philosophy degree. The Department also offers a Master of Science degree with a research focus (Option A) or a coursework focus (Option B). The faculty in the department have expertise in a broad range of specialty areas including synthesis, structure, spectroscopy, and mechanism. In each of these fields, the strength of MSU Chemistry and Biochemistry Department has been recognized at the international level. MSU is a growing and dynamic university of 17,000 students. MSU is rapidly increasing in research prominence and is now ranked among the nation's 100 leading research universities by the Carnegie Foundation. The Department of Chemistry and Biochemistry has the largest and best-funded doctoral program on campus. Our doctoral students receive world-class mentoring in a spectacular northern Rocky Mountain setting and graduate to superb career opportunities.

Graduate programs in chemistry and biochemistry are designed to provide students with a solid and broad foundation on which to base their careers. An appropriate combination of coursework and independent investigation is planned with individual faculty advisors. In consultation with their graduate advisor, graduate students can tailor their program to their own needs and interests. We believe that at the conclusion of their graduate education at Montana State University, students should have a professional command of the fundamentals of their disciplines. We cultivate the ability to think independently and to critically analyze scientific problems that span disciplinary boundaries.

Admissions

An entering graduate student is expected to have had a solid chemistry background including general, analytical, organic, and physical chemistry courses; mathematics through calculus and college level physics are also expected. A student less well prepared may be provisionally admitted provided he or she can attain an acceptable background proficiency within one year.

Applicants must be formally admitted to The Graduate School. See the Admission Policies and Application Requirements sections for additional information at https://www.montana.edu/gradschool/admissions/getting_started.html

PhD Program Requirements

For the Doctor of Philosophy in Chemistry or Biochemistry, students must satisfy a qualifying exam requirement, complete a core program of coursework, advance to candidacy by passing the comprehensive examination*, conduct independent research and analysis in their discipline, present that research in a public seminar during the 4th year of the graduate program and write and defend a dissertation based on the student's research.

PhD Course Requirements

To earn a Ph.D. in chemistry or biochemistry, a student must successfully complete at least six, three-credit courses maintaining a "B" average or better. Four of these must be Department of Chemistry and Biochemistry courses and at least three must be in the student's area of specialization.

The Graduate Program and Admissions Committee will advise entering students on course selection. The listed courses can provide guidance in planning the first year's courses.

Biochemistry

BCH 524	Mass Spectrometry	3
BCH 526	Adv Protein NMR Spectroscopy	3
BCH 543	Proteins	3
BCH 544	Molecular Biology	3
BCH 545	Advanced Physical Biochemistry	3
BCH 547	Bioinorganic Chemistry	3
BCH 550	X-ray Crystallography	3
BCH 575	Professional Paper	1-6

Inorganic

CHMY 515	Structure and Bonding in Inorganic Chemistry	3
CHMY 516	Mechanisms and Dynamics in Inorganic Chemistry	3
CHMY 525	Chemical Reactions	3

Organic

CHMY 523	Organic Reaction Mechanisms	3
CHMY 533	Physical Organic Chemistry	3
CHMY 535	Reagent Chemistry	3
CHMY 540	Organic Synthesis	3
CHMY 554	Organometallic Chemistry	3

Physical/Analytical

CHMY 557	Quantum Mechanics	3
CHMY 558	Classical & Stat Thermodynamic	3
CHMY 559	Kinetics & Dynamics	3
CHMY 564	Adv Quantum Chemistry	3

* Students can take a 400 level course provided that it is outside of their specific area of interest. (For example, students may be served well by Advanced Instrument Analysis (CHMY 421) or one of the 400-level organic classes).

Research Facilities

The Department of Chemistry and Biochemistry at Montana State University provides students, faculty, and staff with access to the state-of-the-art instrumentation that is required to stay at the forefront of research. We have the region's best mass spectrometers for proteomics, metabolomics, chemical composition, and imaging. Current MS techniques that are ideal for many projects in chemical biology include ultra high pressure LCMS, ion traps with CID and ECD, chip and standard nanoflow ESI, MALDI-TOF-TOF, and ultra-high resolution Q-TOF MS/MS. Chemists and biochemists benefit from excellent NMR Instrumentation, which includes 600, 500, and 300 MHz NMR spectrometers. These instruments are used in routine analysis of small molecules and also protein structural determination. Our instrumentation for dynamic light scattering, zeta potential, isothermal titration microcalorimetry, cryogenic electron microscopy, and stopped flow spectrophotometry is also state of the art. Two protein crystallographers have all the necessary equipment

for macromolecular crystal structure determination. Protein-protein interactions can be studied using surface plasmon resonance (Biacore), quartz crystal microbalance with dissipation (Q-Sense), and a fluorescence lifetime microplate reader.

The department has some of the nation's most advanced facilities for time-resolved laser spectroscopy on time scales from femtoseconds to seconds. Multiple Ti:sapphire-based ultrafast laser systems provide tunable laser pulses from UV to mid-IR wavelengths, enabling a rich array of transient absorption and emission spectroscopies. Investigations of high-energy gas-phase and gas-surface molecular interaction are conducted using a molecular beam apparatus that was originally designed by Nobel Laureate, Y. T. Lee, for crossed-beam studies of elementary reaction dynamics. Other advanced instrumentation includes CW and pulsed multifrequency EPR, Raman, FTIR, circular dichroism and fluorescence spectrometers.

In addition to the equipment housed in our department, campus microscopy capabilities include transmission electron microscopy (TEM), scanning electron microscopy with cryogenics (SEM), atomic force microscopy (AFM), confocal imaging, and laser micro dissection and capture.

The National NSF Center for Biofilm Engineering is located at Montana State University. Several faculty and students have collaborative research projects with staff associated with this Center and those listed below.

MSU Optical Technology Center (OpTeC)

OpTeC is an interdisciplinary center with research groups from three university departments: Physics, Chemistry & Biochemistry, and Electrical & Computer Engineering. Each of the ten research groups is led by a faculty principal investigator and specializes in a different area of optical research. Collaborating teams profit from a multidisciplinary approach to problems. The primary goals of OpTeC are to foster collaboration with local industry and economic growth of the state. OpTeC promotes research on optical materials, lasers and optoelectronic devices, sensors, micro-optical systems, holography, and coherent optics. For more information, visit www.optec.montana.edu (http://www.optec.montana.edu).

Molecular Biosciences Program

The Molecular Biosciences Program offers numerous graduate research and training opportunities in Basic and Applied Life Sciences. Internationally recognized interdisciplinary research programs and Research Centers of Excellence provide students excellent career development opportunities.

The MB Program provides students with the opportunity to view faculty involved in life science research divided into research areas. The new approach should be easier for the prospective student to find a faculty conducting the research of most interest to them. For more Information visit www.mbprogram.montana.edu/index.asp (http://www.mbprogram.montana.edu/)

Financial Assistance

Graduate students in the program are supported continuously throughout their studies by stipends that average $26,000 per year, tuition waivers for students appointed as graduate teaching assistants and tuition and fee support for graduate students appointed as graduate research assistants. First-year students are supported as graduate teaching assistants, while most students in their second and later years are appointed to grant-funded projects as graduate research assistants. Funding per investigator in the Department of Chemistry and Biochemistry is at a very high level found at only a small number of departments nationwide.

Degrees Offered

- M.S. in Chemistry (http://catalog.montana.edu/graduate/letters-science/chemistry-biochemistry/ms-chemistry/)
- M.S. in Biochemistry (http://catalog.montana.edu/graduate/letters-science/chemistry-biochemistry/ms-biochemistry/)
- Ph.D. in Chemistry (http://catalog.montana.edu/graduate/letters-science/chemistry-biochemistry/phd-chemistry/)
- Ph.D. in Biochemistry (http://catalog.montana.edu/graduate/letters-science/chemistry-biochemistry/phd-biochemistry/)

Interdisciplinary Degrees Offered

- M.S in Optics and Photonics Plan A (http://catalog.montana.edu/graduate/engineering/electrical-computer-engineering/ms-optics-plan-a/)
- M.S in Optics and Photonics Plan B (http://catalog.montana.edu/graduate/engineering/electrical-computer-engineering/ms-optics-plan-b/)