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 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. A high level of creativity and originality in research is expected of candidates for the Ph.D.

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 are strongly encouraged to take the GRE subject test appropriate to their area.

Applicants must be formally admitted to The Graduate School. See the Admission Policies and Application Requirements sections for additional information at www.montana.edu/wwwdg/ (http://www.montana.edu/wwwdg/).

Program Requirements
All entering graduate students are required to demonstrate proficiency in three of the six chemistry areas (analytical, biochemical, inorganic, organic, physical, and structural and molecular biology) within the first year. The exams are offered during August, January, and May of the academic year.

During the second semester, each student selects a major adviser who assists the student in selecting other faculty members for the student’s graduate committee. This committee will offer the major guidance and direction to the student’s degree program and bears the prime responsibility for decisions that affect that program.

For the Doctor of Philosophy in Chemistry or Biochemistry, students must satisfy the proficiency requirement, complete a core program of coursework, advance to candidacy by passing the comprehensive examination, conduct independent research and analysis in their discipline and write and defend a dissertation based on the student’s research.

The comprehensive examination consists of written and oral parts. Most students satisfy the written examination by writing an original proposal describing the candidate’s planned dissertation research. The second part of the comprehensive examination is an oral defense of the proposal. The student is admitted to Ph.D. candidacy upon successful completion of the written and oral portions.

For the Master of Science Plan A in chemistry or biochemistry, the minimum requirements are twenty (20) credit hours of appropriate courses, ten (10) credit hours of Master’s Thesis BCH 590 or CHMY 590 and an acceptable thesis based on the student’s research and a satisfactory oral defense of the thesis. Plan A candidates must present a seminar in addition to the final thesis defense, which constitutes the comprehensive examination. For the Master of Science Plan B in chemistry or biochemistry, the requirements are thirty (30) credit hours of appropriate courses, a seminar, and satisfactory performance in an oral comprehensive examination during the last term of residency for the degree.

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

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BCH 524</td>
<td>Mass Spectrometry</td>
<td>3</td>
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<tr>
<td>BCH 526</td>
<td>Adv Protein NMR Spectroscopy</td>
<td>3</td>
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<tr>
<td>BCH 543</td>
<td>Proteins</td>
<td>3</td>
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<td>BCH 544</td>
<td>Molecular Biology</td>
<td>3</td>
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<td>BCH 545</td>
<td>Advanced Physical Biochemistry</td>
<td>3</td>
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<td>BCH 547</td>
<td>Bioinorganic Chemistry</td>
<td>3</td>
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<td>BCH 550</td>
<td>X-ray Crystallography</td>
<td>3</td>
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<tr>
<td>BCH 575</td>
<td>Professional Paper</td>
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Inorganic

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<td>CHMY 515</td>
<td>Structure and Bonding in Inorganic Chemistry</td>
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<tr>
<td>CHMY 516</td>
<td>Mechanisms and Dynamics in Inorganic Chemistry</td>
<td>3</td>
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<td>CHMY 525</td>
<td>Chemical Reactions</td>
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Organic

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<td>CHMY 523</td>
<td>Organic Reaction Mechanisms</td>
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<td>CHMY 533</td>
<td>Physical Organic Chemistry</td>
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<td>CHMY 535</td>
<td>Reagent Chemistry</td>
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<td>CHMY 540</td>
<td>Organic Synthesis</td>
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<td>CHMY 554</td>
<td>Organometallic Chemistry</td>
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Physical/Analytical

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<tr>
<td>CHMY 557</td>
<td>Quantum Mechanics</td>
<td>3</td>
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<tr>
<td>CHMY 558</td>
<td>Classical &amp; Stat Thermodynamic</td>
<td>3</td>
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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.

Center for Computational Biology (CCB)
The CCB is an interdisciplinary academic unit supporting research, training and technology transfer in the general area of Computational Biology, combining state-of-the-art experimental techniques with state-of-the-art computer-based analysis and modeling capabilities. The research and training environment in the CCB encourage partnerships between experimentalists, theorists and engineers in diverse fields, providing opportunities to establish genuine research partnerships between students and scientists at many different institutions around the world.

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 between $22,000 and $24,000 per year and by tuition waivers. 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/)

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