

DEPARTMENT OF MICROBIOLOGY AND MOLECULAR GENETICS

<http://www.uvm.edu/microbiology/>

The College of Agriculture and Life Sciences shares this department with the Larner College of Medicine (LCOM). Undergraduate studies are in CALS while graduate studies are in the LCOM. The department offers a B.S. in Biochemistry, a B.S. in Microbiology, or a B.S. in Molecular Genetics.

CALS BIOCHEMISTRY MAJOR

Biochemistry is the basic science that explores the chemical and physical properties of living organisms and the chemical changes that occur in these organisms. It is integral to the study of multiple disciplines within the life and biomedical sciences, including biology, chemistry, microbiology, genetics, anatomy, physiology, pharmacology, nutrition and food sciences, animal sciences, plant biology, and plant sciences. The Bachelor of Science in Biochemistry draws upon a broad set of university resources from CALS, CAS, and COM to provide students with a modern science-based education designed to emphasize fundamental knowledge of chemistry and biology along with advanced courses specializing in biochemistry and related life and biomedical sciences. The biochemistry curriculum offers students with a strong academic ability in the sciences an opportunity to explore upper-level courses in areas of modern biochemistry and is designed to meet the needs of students wishing to compete in the job market at the B.S. degree level as well as students planning to continue with advanced studies in a graduate or professional degree program.

CALS MICROBIOLOGY AND MOLECULAR GENETICS MAJOR

Undergraduates who undertake studies in the Department of Microbiology and Molecular Genetics receive instruction in the classroom and in state-of-the-art teaching and research laboratories. If you are interested in attending medical school or graduate school, then majoring in Microbiology (MICR) or Molecular Genetics (MGEN) may be appropriate. Fascinating recent developments in medicine and biomedical sciences, such as stem cell research, emerging microbial infectious diseases, genetic engineering, and cancer therapeutics, have emerged from a detailed understanding of the molecular events that underlie the routine functions of cells and organisms. Microbiology majors study in detail the microbes involved in infectious disease, human health, industrial manufacturing, ecology, and basic science research. Molecular genetics majors investigate the chemical, biological, and genetic principles that underlie all living processes at the molecular level.

Small classes, hands-on/intensive classroom laboratory experiences, and a strong commitment to undergraduate advising give students many opportunities to interact with the faculty, including a First-year Colloquium in which students meet directly with the faculty to discuss on-going research projects and contemporary issues

in microbiology and molecular genetics. Undergraduates are encouraged to get involved in cutting-edge research projects in the department and the College of Medicine in such areas as DNA repair, infectious diseases, bioinformatics, structural biology, developmental genetics, and other fields. Internship opportunities outside of UVM with the local hospital, The University of Vermont Medical Center, the Department of Health, and the Office of the Chief Medical Examiner are also available to pre-med students. Approximately 75 percent of MICR and MGEN majors take advantage of either research or internship opportunities.

The program is flexible enough to allow students to minor in another scientific discipline such as animal sciences, biochemistry, biological sciences, chemistry, computer science, mathematics, medical technology, nutrition, and pharmacology -- or in a field that is altogether different. Students have graduated with minors in French, business administration, psychology, and statistics, allowing them to put together a career plan that spans a wide range of opportunities. The program is also flexible enough to allow students to experience a study abroad semester.

MAJORS

MICROBIOLOGY AND MOLECULAR GENETICS MAJORS

Biochemistry B.S.

Microbiology B.S.

Molecular Genetics B.S.

MINORS

MICROBIOLOGY AND MOLECULAR GENETICS MINORS

Biochemistry

Bioinformatics

Microbiology

Molecular Genetics

GRADUATE

Cellular, Molecular, and Biomedical Sciences M.S.

Cellular, Molecular, and Biomedical Sciences Ph.D.

Microbiology and Molecular Genetics M.S.

See the online Graduate Catalogue for more information

Biochemistry Courses

BIOC 1010. Biochem: Modern Perspect I. 1 Credit.

This is Part I of a sequence to help students develop an understanding of what the field of biochemistry is, its core principles, and what biochemists do. Prerequisites: Biochemistry major, First-year standing.

BIOC 1011. Biochem: Modern Perspect II. 1 Credit.

This is Part 2 of a sequence to help students develop an understanding of what the field of biochemistry is, its core principles, and what biochemists do. Prerequisites: Biochemistry major, First-year standing.

BIOC 1990. Special Topics. 1-18 Credits.

See Schedule of Courses for specific titles.

BIOC 1991. Internship. 1-3 Credits.

On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

BIOC 1993. Independent Study. 1-18 Credits.

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

BIOC 2990. Special Topics. 1-18 Credits.

See Schedule of Courses for specific titles.

BIOC 2991. Internship. 1-18 Credits.

On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

BIOC 2993. Independent Study. 1-18 Credits.

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

BIOC 2994. Teaching Assistantship. 1-3 Credits.

Undergraduate student service as a teaching assistant, usually in an introductory-level course in the discipline, for which credit is awarded. Offered at department discretion.

BIOC 2995. Undergraduate Research. 1-18 Credits.

Undergraduate student work on individual or small team research projects under the supervision of a faculty member, for which credit is awarded. Written report due at end of each semester. Prerequisite: Instructor permission.

BIOC 3001. Fundamentals of Biochemistry. 3 Credits.

Provides a broad introduction to the field of biochemistry. Students will explore the molecular basis and chemical principles of biochemistry pertinent to living systems. This course is taught by LCOM faculty and emphasizes the relevance of biochemistry to health, disease, physiology and medicine. Prerequisites: CHEM 1150, CHEM 1580, CHEM 1550, CHEM 2585, or equivalent; BIOL 1450, BCOR 1450, BCOR 2500, or equivalent.

BIOC 3003. Fundamentals of Biochem Lab. 1 Credit.

A companion laboratory course for BIOC 3001 Fundamentals of Biochemistry. Designed to provide students with hands-on biochemical experience that will be useful for a future career in science; focuses on some of the most commonly used techniques in today's biomedical research laboratories. Pre/Co-requisite: BIOC 3001.

BIOC 3005. Biochemistry I. 3 Credits.

Introduction to chemistry and structure of biological macromolecules; examination of mechanisms of chemical processes in biological systems including enzyme catalysis, biosynthesis, regulation, and information transfer. Prerequisite: CHEM 1550 or CHEM 2585. Cross-listed with: MMG 3050.

BIOC 3006. Biochemistry II. 3 Credits.

Continuation of Biochemistry I. Biochemistry of nucleic acids; nucleic acid based processes, such as replication and transcription; cellular information transfer, genomics, and proteomics. Prerequisite: BIOC 3005 or MMG 3050. Cross-listed with: MMG 3060.

BIOC 3007. Biochemistry Lab. 3 Credits.

Introduction to biochemical tools, including spectrometry, chromatography, and electrophoresis; natural and recombinant enzyme isolation; assays of DNA-modifying enzymes; computer-based structure/function exercises. Prerequisite: BIOC 3005 or MMG 3050. Cross-listed with: MMG 3070.

BIOC 3030. Adv Biochem Lab: Protein CURE. 4 Credits.

Course-based undergraduate research experience (CURE) designed to develop students' critical thinking and use of the scientific method. Students will read the literature to identify a biological question linked to a specific protein, develop a hypothesis, and test it at the bench. Findings will be presented to their classmates. Prerequisites: BIOC 3005, BIOC 3006, BIOC 3007. Pre/Co-requisites: BIOC 3005, BIOC 3006, BIOC 3007.

BIOC 3063. Nutritional Biochemistry. 3 Credits.

Comprehensive study of the metabolism of the macro-nutrients by humans with emphasis on hormonal control of biochemical pathways, nutritional and metabolic interrelationships and dietary disorders. The biochemistry of the micronutrients and vitamins will also be studied. Prerequisite: BIOC 3001, BIOC 3005, or NFS 2183.

BIOC 3075. Adv Biochem of Human Disease. 3 Credits.

The course takes a deep dive into five distinct areas of biochemistry related to a disease or group of diseases primarily through group learning. Key biochemical principles are reviewed and extended. Additionally students will read and discuss a primary literature article with each area. Prerequisites: NFS 2183, BIOC 3001, or BIOC 3005.

BIOC 3990. Special Topics. 1-18 Credits.

See Schedule of Courses for specific titles.

BIOC 3991. Internship. 1-18 Credits.

On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

BIOC 3993. Independent Study. 1-18 Credits.

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

BIOC 3994. Teaching Assistantship. 1-3 Credits.

Undergraduate student service as a teaching assistant, usually in an introductory-level course in the discipline, for which credit is awarded. Offered at department discretion.

BIOC 3995. Undergraduate Research. 1-18 Credits.

Undergraduate student work on individual or small team research projects under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

BIOC 4084. Biochemistry Senior Seminar. 1 Credit.

Oral and written presentation of a subject of current biochemical interest. Prerequisite: Senior standing.

BIOC 4996. Honors. 1-6 Credits.

College honors thesis or other department/program honors, under the supervision of a faculty member. Offered at department discretion.

Microbiology Molecular Genetics Courses**MMG 1010. First Year Colloquium. 1 Credit.**

Colloquium is designed to enhance faculty-student interactions in Microbiology and Molecular Genetics and to inform first-year majors about the educational and research opportunities in MMG. Instructor's permission for non- majors.

MMG 1020. Unseen Wrlds:Microbes & You. 3 Credits.

Examination of current topics in Microbiology, such as antibiotic resistance, vaccinations, sexually transmitted diseases, and the human microbiome, focusing on the impact of microbes on human and animal health, the environment, agriculture, and modern culture around the world. Catamount Core: GC1, SU.

MMG 1030. Methods in Microbial Ecology. 2 Credits.

A research methods laboratory course framed around identifying novel antibiotic-producing bacterial strains from local soil. Covers fundamental lab skills and practice reading and evaluating the work of other scientists. Students will create a research poster to present their findings.

MMG 1650. Microbiology & Pathogenesis. 0 or 4 Credits.

Overview of microbiology, emphasizing the relationships between the structure, metabolism, and genetics of microorganisms and their roles in nature and in pathogenesis. Prerequisite: One semester chemistry. Not intended for students who have completed BIOL 1400 and BIOL 1450 or equivalent.

MMG 1990. Special Topics. 1-18 Credits.

An approved area of study or project under the guidance of an MMG faculty member and the Academic advisor.

MMG 1991. Internship. 1-3 Credits.

On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

MMG 1993. Independent Study. 1-18 Credits.

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

MMG 1995. Undergraduate Research. 1-18 Credits.

Undergraduate student work on individual or small team research projects under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

MMG 2010. Microbiol & Infectious Disease. 0 or 4 Credits.

An introduction to basic microbiology and microbes that cause infectious diseases, with a focus on microbial structure, function, metabolism, ecology, and pathogenesis. Prerequisites: BCOR 1400, BIOL 1400, BCOR 1425, or BHSC 1340; CHEM 1400. Pre/co-requisites: One semester of Biology and Chemistry.

MMG 2040. Intro Molecular Genetics. 0 or 4 Credits.

Designed to present the science of molecular genetics combined with the laboratory practices of recombinant DNA technology (genetic engineering), gene editing, and bioinformatics. Prerequisite: MMG 2010; Microbiology & Molecular Genetics major or minor. Pre/Co-requisites: BCOR 1400 or BCOR 1425; Microbiology & Molecular Genetics major or minor.

MMG 2060. Intr Biomedical Research Meth. 3 Credits.

Introduces life science majors/minors to the scientific processes involved in biomedical research and to current research techniques and approaches, also introduces reading and interpreting primary literature articles, as well as discussing current topics regarding the ethical concerns of biomedical research. Prerequisite: MMG 2010.

MMG 2114. Vaccines: Science and Ethics. 3 Credits.

Explores the history of vaccines, the science supporting current vaccination programs and the controversies surrounding them. Explores both historical and current social, economic, and ethical factors related to the development of vaccines and the adoption of immunization programs in different cultural settings. Combines audio lecture, projects, activities and case studies to help students learn, practice and apply course materials. Prerequisites: BIOL 1100, BCOR 1400, BCOR 1425, or Instructor permission.

MMG 2990. Special Topics. 1-18 Credits.

An approved area of study or project under the guidance of an MMG faculty member and the Academic advisor. Prerequisite: Instructor permission. Credits negotiable.

MMG 2991. Internship. 1-18 Credits.

On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

MMG 2993. Independent Study. 1-18 Credits.

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

MMG 2994. Teaching Assistantship. 1-3 Credits.

Undergraduate student service as a teaching assistant, usually in an introductory level course in the discipline, for which credit is awarded. Offered at department discretion.

MMG 2995. Undergraduate Research. 1-18 Credits.

Undergraduate student work on individual or small team research projects under the supervision of a faculty member, for which credit is awarded. Undergraduate Program Director approval. Offered at department discretion.

MMG 3010. Applied Cell & Mol Bio Lab. 4 Credits.

A course based undergraduate research experience (CURE), covering the basic principles and techniques of mammalian cell culture and molecular biology tools to perform a student-designed CRISPRi experiment. The research culminates with working group presentations and the writing of individual research manuscripts. Lab work outside of class time is routinely necessary. Prerequisites: MMG 2040 or BIOC 3007 or Instructor permission.

MMG 3050. Biochemistry I. 3 Credits.

Introduction to chemistry and structure of biological macromolecules; examination of mechanisms of chemical processes in biological systems, including enzyme catalysis, biosynthesis, regulation, and information transfer. Prerequisite: CHEM 1550 or CHEM 2585. Cross-listed with: BIOC 3005.

MMG 3060. Biochemistry II. 3 Credits.

Continuation of Biochemistry I. Biochemistry of nucleic acids; nucleic acid based processes, such as replication and transcription; cellular information transfer, genomics, and proteomics. Prerequisite: MMG 3050. Cross-listed with: BIOC 3006.

MMG 3070. Biochemistry Lab. 3 Credits.

Introduction to biochemical tools, including spectrometry, chromatography, and electrophoresis; natural and recombinant enzyme isolation; assays of DNA-modifying enzymes; computer-based structure/function exercises. Prerequisite: BIOC 3005 or MMG 3050. Cross-listed with: BIOC 3007.

MMG 3110. Bacterial Genetics. 3 Credits.

Bacterial genetics and the biology of bacteria at an intermediate to advanced level. Specific topics include regulation of replication, transcription, translation, post-translation, mRNA stability, secretion, signaling, and motility. Credit not awarded for both MMG 3110 and MMG 5110. Prerequisites: MMG 2010, MMG 2040, BCOR 2300.

MMG 3200. Environmental Microbiology. 3 Credits.

The activities of microorganisms, primarily bacteria, in air, soil, and water. Prerequisites: CHEM 2580 or equivalent with Instructor permission.

MMG 3210. Advanced Medical Microbiology. 3 Credits.

Addresses the clinical importance of infectious diseases with emphasis on the appropriate collection, handling and identification of clinically relevant bacteria. Disease states, modes of transmission, prevention and antibiotic susceptibility testing will also be discussed. Credit not awarded for both MMG 3210 and MMG 5210. Prerequisites: MMG 2010 or equivalent or Instructor permission.

MMG 3220. Adv Medical Microbiology w/lab. 0 or 4 Credits.

Comprehensive study of human pathogenic bacteria and their disease states in humans. Laboratory sessions provide practical experience in handling and identifying these pathogens. Credit not awarded for both MMG 3220 and MMG 5220. Prerequisites: MMG 2010; or Instructor permission.

MMG 3230. Immunology. 3 Credits.

Analysis of the immune response with respect to structure and function of immunoglobulins and the T-cell receptor, tolerance, innate and adaptive immunity, the Major Histocompatibility Complex, hypersensitivity states, transplantation, cancer, and AIDS. Credit not awarded for both MMG 3230 and MMG 5230. Prerequisite: MMG 2010, BCOR 2500, or MMG 2990.

MMG 3250. Eukaryotic Virology. 3 Credits.

An in-depth analysis of eukaryotic virus-mammalian cell interactions emphasizing mechanisms by which viruses modulate gene expression in infected cells. Prerequisites: MMG 2010 and BCOR 2500 or equivalents.

MMG 3270. Cancer Genetics. 3 Credits.

Examination of genetic mechanisms that either protect us from cancer or increase our vulnerability to cancer. Also discusses genetic methods that are being used to discover genes that influence cancer risk or may prove useful in diagnostics or cancer therapy. Credit not awarded for both MMG 3270 and MMG 5270. Prerequisites: BCOR 2300 and BCOR 2500 or the equivalent.

MMG 3300. Emerging Infectious Diseases. 3 Credits.

Presents an interdisciplinary approach to understanding the emergence, and re-emergence, of infectious diseases in a rapidly changing global environment. Historical, cultural, environmental and biological perspectives are incorporated into the analysis of emerging bacterial, viral and protozoal pathogens. Prerequisites: MMG 2010, BCOR 2500. Catamount Core: D2, SU.

MMG 3310. Survey Bioinformatic Databases. 3 Credits.

Provides a broad overview of bioinformatics as applied to biomedical research. Topics include data mining, DNA sequence alignment, genetic variation, study design for high-throughput sequencing (HTS), and transcriptomics. Emphasizes a direct, hands-on experience and interacting with software, as opposed to creating software. Credit not awarded for both MMG 3310 and MMG 5310. Prerequisite: MMG 2040 or BCOR 2300; Instructor permission. Catamount Core: QR.

MMG 3320. Advanced Bioinformatics. 3 Credits.

Provides advanced training in bioinformatics tools and techniques. Particular emphasis is given to programs associated with sequence analysis, comparative genomics, structural biology, and computational biology. Other topics such as data integration, biological data interpretation, R and UNIX-scripting, multi-omics, and systems biology will be covered. Emphasizes a direct, hands-on experience. Credit not awarded for both MMG 3320 and MMG 5320. Prerequisites: MMG 3310. Catamount Core: QR.

MMG 3330. Genetics and Genomics. 3 Credits.

Integrated entry into both genome science and modern genetic analysis. Students will develop skills needed to access, organize and interpret emerging genomic information. Credit not awarded for both MMG 3330 and MMG 5330. Prerequisites: Biological or computational sciences major; minimum Junior standing. Pre/Co-requisites: MMG 2010, BCOR 2500.

MMG 3350. Bioterrorism. 3 Credits.

Covers the microbiological, epidemiological, social and political aspects of bioterrorism. Also examines potential strategies for bioweapon preparedness and response, with a specific focus on ethical and social issues. Prerequisites: MMG 2010.

MMG 3990. Special Topics. 1-18 Credits.

Supervised investigations in microbiology or molecular genetics. Prerequisite: Instructor permission. Credit as arranged.

MMG 3991. Internship. 1-18 Credits.

On-site supervised work experience combined with a structured academic learning plan directed by a faculty member or a faculty-staff team in which a faculty member is the instructor of record, for which academic credit is awarded. Offered at department discretion.

MMG 3993. Independent Study. 1-18 Credits.

A course which is tailored to fit the interests of a specific student, which occurs outside the traditional classroom/laboratory setting under the supervision of a faculty member, for which credit is awarded. Offered at department discretion.

MMG 3994. Teaching Assistantship. 1-3 Credits.

Undergraduate student service as a teaching assistant, usually in an introductory level course in the discipline, for which credit is awarded. Offered at department discretion.

MMG 3995. Undergraduate Research. 1-18 Credits.

Undergraduate student work on individual or small team research projects under the supervision of a faculty member, for which credit is awarded. Undergraduate Program Director approval. Pre/co-requisite: MMG 2995 or Advisor Permission. Offered at department discretion.

MMG 4899. Senior Seminar. 1 Credit.

Required capstone course for Microbiology and Molecular Genetics majors; involves written and oral presentations by Seniors on current topics in microbiology/molecular genetics. Prerequisites: MMG 2010, MMG 2040.

MMG 4990. Special Topics. 1-18 Credits.

An approved area of study or project under the guidance of an MMG faculty member and the Academic advisor. Prerequisite: Instructor permission. Credits negotiable.