

Master of Science in Biochemistry and Molecular Biology

The purpose of the Master of Science in Biochemistry and Molecular Biology (MS BMB) is to offer students specific graduate level training in biochemistry, molecular biology, and biotechnology. The program is designed with theoretical and practical training that students can then tailor to their particular areas of interest, and thus includes three concentration options in a) Biochemistry and Molecular Biology, b) Biotechnology and c) Environmental Science Technology. The MS BMB provides students with the foundational problem-solving and analytical skills they need to help our society understand and solve the complex biomedical and biotechnology problems it faces. Students will be trained in the methods and approaches of cell, molecular and biochemical sciences, and, in the process, learn key analytical, methodological, and evaluative techniques that will equip them to work in a host of areas to address challenging problems in the life sciences. Through a program of rigorous course work, students will gain a sophisticated understanding of the theoretical and practical biomedical knowledge needed to tackle scientific and technological problems in the public or private sectors. The skill sets developed through the program would be of notable value for persons seeking work in state and local entities, including pharmaceutical science, government, and other non-profit sectors, as well as those pursuing doctorate or professional training post-graduation. This program is projected to attract current AUM students, as well as others across the region and state looking to upgrade their skills and/or transition into new career pathways.

The **Biochemistry and Molecular Biology concentration** will train students as “generalists” in molecular/cell biology and/or biochemistry and will be prepared to work in research labs in the public sector (universities, state health departments, federal testing labs, etc.) or the private sector (biotechnology, pharmaceutical, hospital labs, etc.). Alternatively, some are likely to use this program as a stepping stone to professional (medical, veterinary, law, etc.) or graduate schools.

The **Biotechnology concentration** will target students interested in targeting roles in the biotechnology or pharmaceutical sectors, focusing in particular on jobs that may have duties that involve the use of bioinformatics, genomics or other computational methodologies in addition to biomanufacturing.

The **Environmental Science Technology concentration** will target students interested in roles in government agencies such as the environmental protection agency or the national oceanic and atmospheric administration where they will be involved in advanced methodologies associated with topics related to water or soil contamination, the impact of climate change on living organisms, or molecular strategies to identify invasive species.

Master of Science in Biochemistry and Molecular Biology Curriculum

The program includes **Thesis** and **Non-Thesis** options with the following credit hour requirements:

	Thesis	Non-Thesis
Credit hours required in core courses	14	14
Credit hours required in concentration	9	9
Credit hours required in support courses or electives	NA	6
Credit hours for thesis writing and/or research	7	1
Total credit hours required for completion	30	30

Core Courses (14 credit hours)

Course Name	Semester Hours
CHEM 6300 Advanced Biochemistry	3
BIOL 6600 Advanced Molecular Genetics	3
BCMB 6100 Research Methodologies	3

BIOL 6080 Reading the Scientific Literature	3
BCMB 6950 Graduate Seminar Course (Take twice)	1+1

Elective Courses (at least 16 credit hours)*

In addition to the core classes, the following electives will be available to fulfill the required 30 credit hour requirement and to support defined tracks within the program:

Course Name	Semester Hours
BCMB 6200 Introduction to Biotechnology	3
BCMB 6300 Applied Bioinformatics	3
PSYC 6290 Research Statistics or STAT 5670 Mathematical Statistics I	3
BIOL 6060 Environmental Microbiology	3
BIOL 6050 Industrial Microbiology	3
BIOL 6350 Advanced Cell Biology	3
BIOL 6932 or CHEM 6992 Research Credits	1-3

***Other electives are listed. Elective courses beyond those listed need approval by the Program Director or a Graduate Affairs Committee member.**

Students pursuing the thesis option of the **General Biochemistry and Molecular Biology concentration** will choose from any three of the above elective courses plus 7-hours of BIOL 6932 (or CHEM 6932) "Research Credits." Those in the non-thesis option will take five of the above elective courses plus no more than 1-hour of BIOL 6932 (or CHEM 6932) "Research Credits."

Students pursuing the thesis option of the **Biotechnology concentration** will be required to take BCMB 6200, BCMB 6300 and PSYC 6290 or STAT 5670 plus 7-hours of BIOL 6932 (or CHEM 6932) "Research Credits." Those in the non-thesis option will take these same three courses along with two additional elective courses plus no more than 1-hour of BIOL 6932 (or CHEM 6932) "Research Credits."

Students pursuing the thesis option of the **Environmental Science Technology concentration** will be required to take BCMB 6200, BIOL 6050 and PSYC 6290 or STAT 5670, plus 7-hours of BIOL 6932 (or CHEM 6932) "Research Credits." Those in the non-thesis option will take these same three courses along with two additional elective courses plus no more than 1-hour of BIOL 6932 (or CHEM 6932) "Research Credits."

Master of Science in Biochemistry and Molecular Biology Course Descriptions:

CHEM 6300 Advanced Biochemistry. An in-depth overview of the current information about the flow and regulation of genetic information from DNA to RNA in a variety of biological systems. Topics include mechanisms of gene regulation, transcription, histone modifications, protein translation and transport, and RNA structure, function, processing, and transport.

BIOL 6600 Advanced Molecular Genetics. Fundamentals of DNA structure, replication, mutation and repair, gene expression; recombinant DNA techniques; and applications of biotechnology in medicine, agriculture and industry.

BIOL 6080 Reading the Scientific Literature. The ability to locate, read, and interpret journal articles is essential to scientists as well as to individuals working in any field where scientific discovery helps determine policies and procedures. This course introduces students to the tools and techniques that will help them navigate the primary scientific literature. An emphasis will be placed on how to read and understand scientific information in this format.

BCMB 6100 Research Methodologies. Research Methodologies exposes students to an in-depth discussion of a broad range of molecular, genetic, and biochemical techniques used in

research laboratories. The emphasis will be on understanding research methods and application of experimental methods to scientific problems. Examples include chromatography and fractionation, electrophoresis, protein structure/function and molecular cloning.

BCMB 6950 Graduate Seminar. Presentation on research or current literature by graduate students, faculty, or guest speakers. May be taken twice for credit.

BCMB 6300 Principles of Bioinformatics. In this course, students will be familiarized with advanced computational techniques, programs and databases used at the frontiers of biomedical sciences. Advanced applications will be covered in four broad areas: new bioinformatics tools, genomics, proteomics, and RNomics/transcriptomics.

BCMB 6200 Introduction to Biotechnology. This course provides students with a working knowledge of the instrumentation and techniques employed in a biotechnology laboratory. Emphasis will be on molecular and biochemical strategies, including the introduction of foreign DNA into bacterial, yeast and mammalian cells as well as the use and production of nucleic acids (mRNA, DNA) and proteins for therapeutic purposes.

BIOL 6050 Industrial Microbiology. Pr. BIOL 2010 and BIOL 2011 or BIOL 3010 and BIOL3011. Lectures on the principles and practices of industrial processes involving microorganisms with emphasis on microbial biotechnology. Topics include screening and improvement of industrial microorganisms, fermentation media/equipment/systems, healthcare products (antibiotics, anti-tumor agents, alkaloids, steroids, vaccines, etc.), alcoholic beverages, biofuel, single cell protein, probiotics, bio-insecticides, microbial fertilizer, fermented foods, microbial mining, production of amino acids, biocatalysis, waste biotechnology and recombinant DNA technology.

BIOL 6060 Environmental Microbiology. Pr. BIOL 2010 and BIOL 2011 or BIOL 3010 and BIOL 3011. Covers the roles of microorganisms in the environment. Specific study areas include microbial diversity in earth environments, microbial ecology, biofilms and microbial communication, water- and food-borne pathogens and diseases, mycotoxins, water and sewage treatment, biogeochemical cycles, molecular methods, microorganisms and bioterrorism, indoor health microbiology, environmental sample collection and processing.

STAT 5670 Mathematical Statistics I. Pr. Min. grade of C in MATH 1620. Basic probability theory, discrete and continuous distributions, discrete bivariate distributions, distribution functions of random variables, the Central Limit Theorem, basics of statistical inference including point estimation, interval estimation, hypothesis testing, and simple regression.

PSYC 6290 Research Statistics. An advanced lecture and laboratory course using statistical analysis for complex research designs.

BIOL 6350 Advanced Cell Biology. Pr. BIOL 1020 and BIOL 1021, CHEM 1200, CHEM 1201. Cell structure and function. The generalized cell, specialized cell and the cell as an organism are considered from the viewpoint of classical cytology and in terms of current biochemical, optical and ultra-structural studies.

BIOL 6932 Directed Research. Affords the opportunity for graduate students to conduct research under the supervision of biology faculty. Faculty must agree to sponsor the research for 1-4 hours elective credit.

CHEM 6992 Directed Research. Conduct primary research targeted to the fulfillment of a MS thesis under the direction of a faculty member (instructor/laboratory principal investigator - PI).

Example Other Courses Available to Non-thesis Students to Fulfill 30 Credit Hours:
Prior approval is required, and no more than 2 electives from this category.

BIOL 6010 Medical Microbiology. Pr. BIOL2010 and BIOL2011 or BIOL3010 and BIOL 3011. The etiology, epidemiology, vector controls, identification, and pathogenesis of microorganisms of medical importance to man.

BIOL 6030 General Virology. Pr. BIOL 2010 and BIOL 2011 or BIOL 3010 and 3011, and BIOL 3300 or 5300. The molecular biology of bacterial and animal viruses, pathogenesis, diagnosis, and procedures for isolation, cultivation, and purification.

BIOL 6070 Immunobiology. Pr. BIOL 3300, BIOL 3303, or BIOL 5300. Topics include the molecules, cells, and organs involved in the immune response; genetic control of the immune response; normal functions of the immune system; and immunopathology.

BIOL 6230. Environment Pollution and Control (3). Pr. BIOL 1020 and BIOL 1021. Introduction to environmental science, focusing on detention, sources, and treatment methods of water pollution; air pollution; noise pollution; solid waste; and hazardous waste. Legal and regulatory background also presented.

CHEM 6303. Instrumental Biochemistry (4). Pr. CHEM 3100 and CHEM 3101. Emphasis on the principles and applications of instrumental methods to structure determination, chemical behavior, and analysis. Methods include chromatography and spectral analysis.

GEOG 6890. Geographic Information Science and Environmental Management (3). This course provides students with exposure to methods and theory in geographic information systems (GIS) as they apply to the analysis of relationships between humans and their environments whether physical or social. Study focuses on the role GIS plays in environmental management.