

IMMUNOLOGY AND MICROBIOLOGY (MS)

Aurora, CO 80045

International students must meet ALL of the requirements above and those required by International Admissions.

Overview

The Master of Science Degree in Immunology and Microbiology will provide students with a focused education in immunology and microbiology as well as laboratory skills. The program goals are to enhance career advancement in education or industry or prepare a student for a career in research, including further training in graduate and professional programs. Importantly, this program will provide extensive hands-on research experience, where students will be trained in research laboratories located within the department of Immunology and Microbiology at the University of Colorado School of Medicine. Students will complete 38 units that include core course work, electives and participation in cutting-edge research, as well as write and defend a thesis.

Admissions Requirements

- A bachelor's degree with a minimum GPA of 3.0
- Official General GRE or MCAT (both optional)
- Complete transcripts of undergraduate work and any previous graduate work
- A completed application to Graduate Studies
- Three academic letters of recommendation
- Letter of intent
- Strong background in biological sciences. BA/BA in molecular biology, cell biology, genetics, immunology, microbiology or equivalent specialty

To apply for admission applicants must submit the following:

- Online Graduate School application
 - Personal Statement: A one-page personal statement describing the applicant's career goals and purpose for studying biomedical sciences and biotechnology
 - Resume: The applicant's current resume or curriculum vitae, including professional work/practice since graduating with a bachelor's degree (or equivalent).
 - Personal statement.
 - Three recommendation letters from people who know your professional, academic and/or personal achievements or qualities well.
- Application Fee: A nonrefundable application fee of \$75.00 (U.S. dollars). Checks or money orders should be made payable to the University of Colorado.
- Transcripts: Official transcripts from all post-secondary colleges and/or universities should be sent directly to:
 - Electronic Transcripts should be sent to: graduate.school@cuanschutz.edu (preferred)
 - If sending a physical transcript, please mail to:

University of Colorado Anschutz Medical Campus
Graduate School
Mail Stop C296
Fitzsimons Building, C5000
13001 E. 17th Place

Program Requirements

1. Students must complete a total of 38 credit hours.
2. Students must maintain an overall GPA of at least 3.0 ("B"). Courses with a grade lower than 2.7 ("B-") cannot be counted towards the degree requirements.
3. Students must complete 2-3, 5-week, research rotations (MIMS 6070) in their first year. These rotations are arranged with faculty members in the Department of Immunology and Microbiology with the goal of finding a mentor for their thesis project. A rotation with a faculty mentor outside of the department requires prior approval from the Program Director.
4. Students must write and defend a master's thesis based on an Immunology or Microbiology research project. Upon completion of the research rotations, with the consent and support of the relevant faculty mentor, the student will select a lab to join for conducting the master's thesis laboratory research project (MIMS 6950). A minimum of 8 and a maximum of 15 credits of MIMS 6950 may be taken.

Curriculum

Code	Title	Hours
Biological Foundations		
BSBT 6072	Foundations in Biochemistry	1.5
BSBT 6073	Foundations in Molecular Biology	1.5
BSBT 6074	Foundations in Cell Biology	1.5
BSBT 6075	Foundations in Genetics	1.5
Immunology and Microbiology		
BMSC 7810	Core Topics in Biomedical Science (Section 002 Microbiology in Biomedical Research)	2
IMMU 7530	Introduction to Immunology	2
<i>Choose either the Immunology or Microbiology track:</i>		5-6
Immunology		
IMMU 6210	Intensive Advanced Immunology	
BMSC 7810	Core Topics in Biomedical Science (Section 004 Inflammation)	
Microbiology		
MICB 7701	Molecular Virology and Pathogenesis	
MICB 7703	Molecular Mechanisms of Bacterial Disease	
Professional Development		
MIMS 6062	Introduction to Science Communication	1
MIMS 6063	Scientific Literature Analysis	1
BSBT 6064	Scientific Writing	1
BSBT 6067	Statistics for Biomedical Sciences	2
MIMS 6071	Introduction to R Programming for Immunologists and Microbiologists	1
IMMU 7607	Science as a Profession	1
Laboratory Research		
MIMS 6070	Mini-Research Rotations ¹	2-3
MIMS 6950	Laboratory Thesis Research ²	8
Electives		4-5

Can be any combination of the following:

MIMS 6950	Laboratory Thesis Research (credits taken in addition to the 8 required) ²
IMMU 6110	Introduction to Bioinformatics ³
Any didactic BSBT course not previously taken.	
Total Hours	36-39

¹ Research rotations arranged by the student with faculty members in the Department of Immunology and Microbiology. Taken for 2-3 credits with each 5-week rotation worth 1 credit.

² Requires prior completion of MIMS 6070 and approval of the faculty mentor. Taken multiple times for credit with a variable amount of credits each semester. Credits are commensurate with time devoted to lab and thesis work.

³ Requires MIMS 6071 and instructor consent.

Learning Objectives

Upon completing the Master's Degree in Immunology and Microbiology student's will have obtained the following:

1. Broad foundational understanding of terms and concepts related to biochemistry, genetics, cellular and molecular biology.
2. Broad foundational understanding of terms and concepts related to microbiology and immunology.
3. Advanced conceptual understanding of either microbiology or immunology.
4. Advanced technical understanding of immunological and microbiological research techniques.
5. Effective communication of concepts, scientific literature and data related to immunology and microbiology.

Courses

MIMS 6062 - Introduction to Science Communication (1 Credit)

This introductory course in science communication is designed to introduce the skills to effectively convey complex scientific concepts to diverse audiences, including the public, policymakers, and fellow scientists from different fields. Through a combination of brief lectures, in-class activities and practical assignments, students will learn key principles of clear and accurate scientific communication, the ethics of public science discourse, and strategies for engaging written, media and digital platforms. Emphasis is placed on adapting messages for different target audiences, crafting compelling narratives, and developing visual aids. By the end of the course, students will be prepared to communicate their research effectively across a range of platforms.

Grading Basis: Letter Grade

Typically Offered: Spring.

MIMS 6063 - Scientific Literature Analysis (1 Credit)

This course for Immunology and Microbiology Masters students will instruct in how to think critically about scientific literature with particular emphasis on how data is presented used to construct scientific arguments. Students will have practice both analyzing existing literature and scientific presentations, as well as presenting their own work.

Grading Basis: Letter Grade

Typically Offered: Fall, Spring, Summer.

MIMS 6070 - Mini-Research Rotations (1-3 Credits)

The course MIMS 6070, Mini-Research Rotations, will allow graduate students to learn in three different laboratories about research in immunology and microbiology.

Grading Basis: Letter Grade with IP

Typically Offered: Fall, Spring, Summer.

MIMS 6071 - Introduction to R Programming for Immunologists and Microbiologists (1 Credit)

Introduction to the R programming language geared towards Immunology and Microbiology students with no prior programming experience. This course will provide instruction in R language syntax, data structures and visualization techniques.

Grading Basis: Letter Grade with IP

Typically Offered: Fall, Spring, Summer.

MIMS 6950 - Laboratory Thesis Research (1-6 Credits)

Laboratory Thesis Research with allow Immunology and Microbiology masters students students to engage in mentored laboratory research training ultimately producing a masters thesis based on their work.

Grading Basis: Letter Grade

Repeatable. Max Credits: 15.

Typically Offered: Fall, Spring, Summer.

BMSC 7810 - Core Topics in Biomedical Science (2 Credits)

Sections focus on different core topics in biomedical science, and will address subject areas such as protein structure and function, neurobiology, embryology, stem cell research, and cancer biology. Students can enroll in multiple Core Topic Courses topics in one semester. Previously offered as IDPT 7810.

Grading Basis: Letter Grade

Repeatable. Max Credits: 20.

AMC-PHD PhD Students only

Typically Offered: Fall.

IMMU 7530 - Introduction to Immunology (2 Credits)

This course is an introductory immunology course designed to provide students with an introduction to the field of immunology. This class is intended to introduce students who already have some background in general biology and cell biology to the study of the immune system.

Grading Basis: Letter Grade

Typically Offered: Fall, Spring.

IMMU 6210 - Intensive Advanced Immunology (3 Credits)

During this intensive-style class, students will attend daily lectures and laboratories in Week 1, then complete a 2-week project with final presentations in Week 3. In Week 1, Students will be fully immersed from 8 am to 6 pm with reading/prep in the evenings. Pre-requisite: AGRAD

Grading Basis: Letter Grade

Typically Offered: Spring.

MICB 7701 - Molecular Virology and Pathogenesis (3 Credits)

Topics in this course include viral structure and genome organization, replication and expression of viral genomes, mechanism of action of tumor viruses, molecular aspects of virus-host cell interactions, animal models of infectious diseases and pathogenesis of human viruses.

Prereq: MICB 7706, MICB 7705 are desirable but not required. Restriction: Permission of Instructor.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Spring.

MICB 7703 - Molecular Mechanisms of Bacterial Disease (3 Credits)

The course focuses on molecular processes that bacteria utilize to cause disease in humans. The course content will use specific examples from pathogenic bacteria to illustrate common virulence mechanisms utilized to initiate, maintain and survive interactions with host cells. Prereq: Recommended Fundamentals of Microbiology Restrictions: Permission of the instructor.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Spring.

IMMU 7607 - Science as a Profession (1 Credit)

This course discusses ethical issues, conflicts of interest, and regulations for working with humans or animals. It also includes instruction on writing papers and grants, giving effective presentations and advice on finding jobs in academia and industry.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Fall.

IMMU 6110 - Introduction to Bioinformatics (3 Credits)

An intensive course aimed to introduce basic theory and concepts of commonly used bioinformatics workflows encountered in immunology and microbiology NGS data sets. This course is also designed as a workshop; all workflows will be directly applied to pre-existing datasets.

Pre-requisite: At least one semester of any R programming.

Grading Basis: Letter Grade

Restricted to IMMU, MICB, MICR, BSBT students

Typically Offered: Spring.

BSBT 6060 - Special Topics in Biomedical Science & Biotech (1-3 Credits)

Special topics of interest to graduate students in the biomedical sciences and biotechnology fields.

Grading Basis: Letter Grade

Repeatable. Max Credits: 9.

Typically Offered: Fall, Spring, Summer.

BSBT 6061 - Project Management (2 Credits)

Provides training in initiating, executing & closing a project, including the management of scope, time, cost, human resources, communication, risk and more. Highly interactive intensive course prepares students for Certified Project Management exam (internationally recognized certification). Taught by Project Management Professional.

Grading Basis: Letter Grade

Typically Offered: Fall, Spring, Summer.

BSBT 6064 - Scientific Writing (1 Credit)

Taught by a biomedical researcher and a professional writing instructor, this 15-hour (3-week) course focuses on developing a framework for successful scientific writing practices, including how to effectively structure arguments, how to write grant proposals and more.

Grading Basis: Letter Grade

Typically Offered: Fall, Spring, Summer.

BSBT 6065 - Case Studies in Responsible Conduct of Research (1 Credit)

Anyone conducting research using federal funding must study RCR. You'll learn expectations and regulations that permeate science. You'll understand consequences of violations to individuals and society. We'll explore misconduct through interactive video, written and video case studies, and other engaging activities.

Grading Basis: Letter Grade

Typically Offered: Fall, Spring, Summer.

BSBT 6067 - Statistics for Biomedical Sciences (2 Credits)

Learn how and when to apply statistical procedures to answer scientific questions relevant to biomedicine, and how to critically assess statistical data for validity.

Grading Basis: Letter Grade

Typically Offered: Fall, Spring, Summer.

BSBT 6068 - Laboratory Research in Structural Biology (1-6 Credits)

The Course BSBT 6068, Laboratory Research, with allow graduate students to engage in laboratory research training in the biomedical sciences with focus on structural biology.

Grading Basis: Letter Grade

Repeatable. Max Credits: 15.

Typically Offered: Fall, Spring, Summer.

BSBT 6069 - Laboratory Research in Immunology and Microbiology (1-6 Credits)

The Course BSBT 6069, Laboratory Research, with allow graduate students to engage in laboratory research training in the biomedical sciences with focus on immunology and microbiology.

Grading Basis: Letter Grade

Repeatable. Max Credits: 6.

Typically Offered: Fall, Spring, Summer.

BSBT 6070 - Mini-Research Rotations (1-3 Credits)

The Course BSBT 6070, Mini-Research Rotations, with allow graduate students to learn in three different laboratories about research in immunology and microbiology.

Grading Basis: Letter Grade with IP

Typically Offered: Fall, Spring.

BSBT 6071 - Introduction to R Programming (1 Credit)

Introduction to the statistical programming language R geared primarily to biomedical science students with little to no previous programming experience. Basic features of R as a programming language and as scientific computing platform. Basics of data cleaning, visualization, and analysis.

Grading Basis: Letter Grade

Typically Offered: Spring.

BSBT 6072 - Foundations in Biochemistry (1.5 Credits)

This short course provides a condensed and fast-paced overview of the fundamentals in biochemistry including research strategies and techniques. The course aims to enhance the students' ability to engage in critical scientific reasoning and problem-solving and to prepare students for the scientific analyses and discussions.

Grading Basis: Letter Grade

Typically Offered: Fall.

BSBT 6073 - Foundations in Molecular Biology (1.5 Credits)

This short course provides a condensed and fast-paced overview of the fundamentals in molecular biology including research strategies and techniques. The course aims to enhance the students' ability to engage in critical scientific reasoning and problem-solving and to prepare students for the scientific analyses and discussions.

Grading Basis: Letter Grade

Typically Offered: Fall.

BSBT 6074 - Foundations in Cell Biology (1.5 Credits)

This short course provides a condensed and fast-paced overview of the fundamentals in cell biology including research strategies and techniques. The course aims to enhance the students' ability to engage in critical scientific reasoning and problem-solving and to prepare students for the scientific analyses and discussions.

Grading Basis: Letter Grade

Typically Offered: Fall.

BSBT 6075 - Foundations in Genetics (1.5 Credits)

This short course provides a condensed and fast-paced overview of the fundamentals in genetics including research strategies and techniques. The course aims to enhance the students' ability to engage in critical scientific reasoning and problem-solving and to prepare students for the scientific analyses and discussions.

Grading Basis: Letter Grade

Typically Offered: Fall.

BSBT 6076 - Research Explorations (1 Credit)

This course allows for exploration of SBB research labs in a "mini-rotation" format, through meeting faculty, reading literature and participating in lab group meetings and research in order to choose a research lab and prepare a short research proposal.

Grading Basis: Letter Grade

Typically Offered: Fall, Spring.

BSBT 6078 - Seminar in Immunology and Microbiology (1 Credit)

This course provides students in the Bioinformatics in Immunology/ Microbiology program an integration of didactic knowledge with research approaches to outstanding questions in the field. Students will attend department weekly seminar followed by structured discussion.

Prerequisites - IDPT 7810 & IMMU 7630

Grading Basis: Letter Grade

Typically Offered: Fall, Spring.

BSBT 6079 - Leadership in a Global Environment (3 Credits)

The Leadership in a Global Environment course seeks to offer students a foundation for understanding the intricate and complex relationship between language, culture, communicative practices, and the role we play as individuals in the globalized work environment of today. In particular, this course is geared to emerging and developing global leaders. Today's leaders must be incredibly versatile. In fact, the entire management team needs to be able to link their industry science with value in the marketplace and tell a compelling story about what makes not just the innovation but also the company itself, special. Sometimes investors are very focused on the science of the products, and sometimes on the finance, so company leaders have to be prepared to talk about either or both. Today's leaders must be transversal: highly strategic and operational while able to understand and connect clinical, market access, commercial, finance, and strategy. The Leadership in a Global Environment course seeks to offer students a foundation for understanding the intricate and complex relationship between language, culture, communicative practices, and the role we play as individuals in the globalized work environment of today. In particular, this course is geared to emerging and developing global leaders. Today's leaders must be incredibly versatile. In fact, the entire management team needs to be able to link their industry science with value in the marketplace and tell a compelling story about what makes not just the innovation but also the company itself, special. Sometimes investors are very focused on the science of the products, and sometimes on the finance, so company leaders have to be prepared to talk about either or both. Today's leaders must be transversal: highly strategic and operational while able to understand and connect clinical, market access, commercial, finance, and strategy.

Grading Basis: Letter Grade

Typically Offered: Fall, Spring, Summer.

BSBT 6110 - Introduction to Biocomputing (3 Credits)

This course provides students with hands on experience in basic computation, database, and programming skills set as a pre-requisite for a higher level data analysis course. The students will use example in the context of biomedical and genomic data set. Prerequisite: Undergraduate degree in science, technology, business, engineering or math.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Fall.

BSBT 6111 - Introduction to Biomedical Data Practices (2 Credits)

This course provides students with advance knowledge and topics in every aspects of data science.

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Fall, Spring, Summer.

BSBT 6112 - Introduction to Biocomputing (2 Credits)

This course provides students with hands on experience in basic computation, database, and programming skills set as a pre-requisite for a higher level data analysis course. The students will use example in the context of biomedical and genomic dataset. Requisite: Must be simultaneously enrolled in BSBT 6113.

Grading Basis: Letter Grade

Typically Offered: Fall.

BSBT 6113 - Data Science with R (1 Credit)

In this 4 weeks semi-independent study course, you will learn how to use the "tidyverse" programming paradigm to perform data science operation using the programming language R. At the end of the course, you will learn the basic understanding of the fundamental elements of data science, including; wrangling, exploration, visualization and modeling.

Grading Basis: Letter Grade

Typically Offered: Fall.

BSBT 6310 - Practical Clinical Research Informatics (3 Credits)

This course provides students with hands on experience in clinical research informatics involving secondary use of electronic health record (EHR) data, clinical informatics databases, and basic clinical data science as preparation for more advanced informatics or data science coursework. Requisite: 008754 A-GRAD

Grading Basis: Letter Grade

Typically Offered: Spring.

BSBT 6801 - Biomedical Entrepreneurship (3 Credits)

The course addresses the essential elements of bioscience and health innovation and entrepreneurship. Prerequisites: An undergraduate degree in science, technology, business, engineering or math. Cross-listed with ENTP 6801

Grading Basis: Letter Grade

A-GRAD Restricted to graduate students only.

Typically Offered: Spring.

BSBT 6804 - Bioinnovation Regulations (3 Credits)

This course is designed to familiarize biomedical scientists and those interested in the business of science with the fundamentals of U.S. and international regulatory affairs regarding drug discovery and medical devices. Focus is the development of products, such as drugs, devices, diagnostic tests, and health information software, to receive U.S. and international regulatory clearance or approval for commercialization.

Grading Basis: Letter Grade

Typically Offered: Fall.

BSBT 6805 - Bioinformatics (4 Credits)

This course will simultaneously introduce students to coding principles (using R) applied to common problems in bioinformatics and data analysis. To this end, students will learn how to import high-throughput data into R, pre-process that data to account for technical anomalies resulting from the acquisition modality (e.g., RNA-Seq, ChIP-Seq), and perform a sequence of statistical analysis (e.g., ANOVA) and data visualization (e.g., heatmaps). At the completion of this course, students will be equipped with coding templates in R that they can apply to data analysis for their own research purposes. Students will also be exposed to more advanced principles of data analysis, such as training machine learning algorithms. These include unsupervised and supervised algorithms, which are commonly used for general data exploration and training diagnostic/prognostic models, respectively.

Prereq: • Mathematical Foundations: Students are expected to have a solid understanding of calculus and matrix algebra. These mathematical principles are essential for comprehending common data analysis techniques used in bioinformatics. • Programming Skills: Coding experience in any programming language is preferred but not required. The course will teach bioinformatics and coding concepts simultaneously, primarily using R as the programming language.

Grading Basis: Letter Grade

Typically Offered: Spring.

BSBT 6806 - Communication Skills (3 Credits)

Position yourself for success biomedical research and industry careers where effective communication is essential. Learn and practice the fundamentals of effective public speaking, presenting, interviewing, and personal branding. This is a graduate level course designed for individuals in research and industry fields who are looking to refine their communication skills.

Grading Basis: Letter Grade

Typically Offered: Spring.

BSBT 6939 - Internship - Technology and Innovation (3-6 Credits)

The internship provides hands-on learning opportunities for graduate students in institutions related to technology/biotechnology, computer science, engineering, innovation and entrepreneurship. Requisite: Enrollment with permission only. Instructor consent required.

Grading Basis: Letter Grade with IP

Repeatable. Max Credits: 6.

A-GRAD Restricted to graduate students only.

Additional Information: Report as Full Time.

Typically Offered: Fall, Spring, Summer.

BSBT 6950 - Laboratory Thesis Research (1-6 Credits)

Laboratory Thesis Research with allow graduate students to engage in laboratory research training in the biomedical science.

Grading Basis: Letter Grade

Repeatable. Max Credits: 6.

Typically Offered: Fall, Spring, Summer.

BSBT 7646 - Tissue Biology and Disease Mechanism (1 Credit)

This course provides an overview of organ systems and through 1) a survey of the major systems, including the cellular and molecular mechanisms underlying their function and repair, integrated with 2) common diseases, current therapies, and their mechanistic basis. Prereq: IDPT 7811, 7812, 7813, 7814, 7815 (BIOM Sci Core Courses).

Grading Basis: Letter Grade

Typically Offered: Fall.

Policies

Please refer to the Graduate School Policies page (<http://catalog.ucdenver.edu/cu-anschutz/schools-colleges-programs/graduate-school/#policiestext>).

Contact Us

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