

Microbiology and Immunology

Courses offered by the Department of Microbiology and Immunology are listed under the subject code MI on the (<http://explorecourses.stanford.edu/CourseSearch/search?view=catalog&catalog=&page=0&q=MI&filter-catalognumber-MI=on>) Stanford Bulletin's (<http://explorecourses.stanford.edu/CourseSearch/search?view=catalog&catalog=&page=0&q=MI&filter-catalognumber-MI=on>) ExploreCourses web site (<http://explorecourses.stanford.edu/CourseSearch/search?view=catalog&catalog=&page=0&q=MI&filter-catalognumber-MI=on>).

Graduate Programs in Microbiology and Immunology

The Department of Microbiology and Immunology offers a program of training leading to the Ph.D. degree, as well as research training, courses, and seminars for medical students and postdoctoral fellows. Research interests focus on two broad areas: host/parasite interactions, and the function of the immune system. Laboratories investigate mechanisms of pathogenesis and the physiology of viruses, bacteria, and protozoan parasites, as well as the lymphocyte function in antigen recognition, immune response, and autoimmunity.

Master of Science

A regular M.S. program is not offered, although this degree is awarded under special circumstances. Candidates for master's degrees are expected to have completed the preliminary requirements for the B.S. degree, or the equivalent. In addition, the candidate is expected to complete 45 quarter units of work related to microbiology; at least 25 of these units should concern research devoted to a thesis. The thesis must be approved by the student's committee.

Doctor of Philosophy in Microbiology and Immunology

University requirements for the Ph.D. are described in the "Graduate Degrees (<http://exploreddegrees.stanford.edu/graduatedegrees>)" section of this bulletin.

Application, Admission, and Financial Aid

Prospective Ph.D. candidates should have completed a bachelor's degree in a discipline of biology or chemistry, including course work in biochemistry, chemistry, genetics, immunology, microbiology, and molecular biology.

Applicants must file a report of scores on the general subject tests of the Graduate Record Examination (GRE). It is strongly recommended that the GRE be taken before October so that scores are available when applications are evaluated.

In the absence of independent fellowship support, entering predoctoral students are fully supported with a stipend and tuition award. Highly qualified applicants may be honored by a nomination for a Stanford Graduate Fellowship. Successful applicants have been competitive for predoctoral fellowships such as those from the National Science Foundation.

Program for Graduate Study

The Ph.D. degree requires course work and independent research demonstrating an individual's creative, scholastic, and intellectual abilities. On entering the department, students meet an advisory faculty member; together they design a timetable for completion of the degree requirements. Typically, this consists of first identifying gaps in the student's undergraduate education and determining courses that should be taken. Then, a tentative plan is made for two to four lab rotations (one rotation per quarter). During the first year of graduate study in the department, each student also takes six or seven upper-level (200-series) courses.

Course requirements:

		Units
BIOS 200	Foundations in Experimental Biology	6
BIO 214	Advanced Cell Biology	4
MED 255	The Responsible Conduct of Research	1
MI 204	Innate Immunology	3
MI 210	Advanced Pathogenesis of Bacteria, Viruses, and Eukaryotic Parasites	4
MI 215	Principles of Biological Technologies	3
MI 250	Frontiers in Microbiology and Immunology (Taken once in the first year and once in the second year for a total of 2 units.)	1

Recommended courses:

		Units
BIO 230	Molecular and Cellular Immunology	4

One Elective from the following:

		Units
DBIO 210	Developmental Biology	4
CSB 210	Cell Signaling	4
CSB 220	Chemistry of Biological Processes	3
MCP 202	Advanced Immunology II	3
MI 211	Advanced Immunology I	3
MI 245	Computational Modeling of Microbial Communities	4
SBIO 241	Biological Macromolecules	3-5
GENE 205	Advanced Genetics	3
MCP 256	How Cells Work: Energetics, Compartments, and Coupling in Cell Biology	4

Prior approval from the student's adviser and department Graduate Program Director is required for courses not from the elective list.

In Autumn Quarter of the second year, each student defends orally a formal research proposal on a topic outside the intended thesis project. This qualifying examination proposal is due to the graduate program steering committee by September 1. Based on successful performance on this proposal, the student is admitted to candidacy. In Spring Quarter of the second year, a research proposal based on the student's own thesis topic is defended to the thesis committee. The written thesis proposal is due May 1 and the oral defense will be presented and completed by the end of the Spring quarter. Teaching experience and training are also part of the graduate curriculum. Graduate students are required to act as teaching assistants for two courses. In addition, first- and second-year graduate students are required to participate in a bi-weekly journal club. Full program requirements can be found at <http://microimmuno.stanford.edu/education/>.

Emeriti: (Professors) Stanley Falkow, Hugh O. McDevitt, Edward S. Mocarski

Chair: Peter Sarnow

Associate Chair: David Schneider

Professors: Ann Arvin, Helen Blau, Matthew Bogyo, John C. Boothroyd, Yueh-Hsiu Chien, Christopher Contag, Mark M. Davis, Stephen J. Galli, Harry B. Greenberg, Peter Jackson, Karla Kirkegaard, A. C. Matin, Garry Nolan, Peter Parham, Phillip Pizzo, Charles Prober, David Relman, Peter Sarnow, Gary K. Schoolnik, Julie Theriot, Lucy S. Tompkins

Professor (Teaching): Robert D. Siegel

Associate Professors: Manuel Amieva, Jeffrey Glenn, K.C. Huang, Denise Monack, David Schneider, Upinder Singh, Justin Sonnenburg

Assistant Professors: Jan Carette, Shirin Einar, Juliana Idoyaga, Ellen Yeh

Institute for Immunity, Transplantation and Infection

Director, Human Immune Monitoring Center and Associate Professor (Research): Holden Maecker

Courses

MI 18SC. The Coming Influenza Pandemic. 2 Units.

Examines the H1N1 influenza virus from molecular, clinical, societal, historical, demographic, economic, and political perspectives. Examines the unique genetic, epidemiological, virologic, and pathogenic features of the influenza virus that allow it to continue to reinvent itself and re-emerge on an annual basis. Discusses past successes and failures, the current status of influenza, and the critical factors to consider to avert the coming influenza pandemic. Explores whether or not the lessons learned from influenza can be applied to other diseases. Includes guest lectures, field trips, student presentations.

MI 19SC. Measles and Sneezles and Things That Go Mumps in the Night. 2 Units.

A study of measles (until recently one of the leading causes of death in the world and the most contagious disease agent ever studied) and its relatives in the paramyxovirus family, including mumps, respiratory syncytial virus, hendra, and nipah, as well as a number of important animal pathogens. Investigates the nature of viruses using the paramyxoviruses as a paradigm. Topics include: the history of this devastating group of pathogens; basic aspects of paramyxovirus taxonomy and molecular virology; viral epidemiology, emergence, and eradication, including the pioneering studies of Peter Panum; the use, misuse, and abuse of science; the interactions between pathogen and host and how this interplay leads to disease, including the appearance of a bizarre brain complication with 100% mortality; the politics and economics of infection; how a putative link between the measles vaccine and autism entered the public eye, and how it refuses to disappear despite overwhelming evidence to the contrary. Field trips, guest speakers, student presentations. No science background necessary.

MI 70Q. Photographing Nature. 3 Units.

Utilizes the idiom of photography to learn about nature, enhance observation, and explore scientific concepts. Builds upon the pioneering photographic work of Eadweard J. Muybridge on human and animal locomotion. A secondary goal is to learn the grammar, syntax, composition, and style of nature photography to enhance the use of this medium as a form of scientific communication and also to explore the themes of change across time and space. Scientific themes to be explored include: taxonomy, habitat preservation, climate change; species diversity; survival and reproductive strategies; ecological niches and coevolution, carrying capacity and sustainability, population densities, predation, and predator-prey relationships, open-space management, the physics of photography. Extensive use of field trips and class critique.

MI 104. Innate Immunology. 3 Units.

Innate immune mechanisms as the only defenses used by the majority of multicellular organisms. Topics include Toll signaling, NK cells, complement, antimicrobial peptides, phagocytes, neuroimmunity, community responses to infection, and the role of native flora in immunity. How microbes induce and defeat innate immune reactions, including examples from vertebrates, invertebrates, and plants. Same as: IMMUNOL 204, MI 204

MI 115B. The Vaccine Revolution. 6 Units.

Advanced seminar. Human aspects of viral disease, focusing on recent discoveries in vaccine development and emerging infections. Journal club format: students choose articles from primary scientific literature, write formal summaries, and synthesize them into a literature review. Emphasis is on analysis, experimental design, and interpretation of data. Oral presentations. Enrollment limited to 8. Prerequisite: prior enrollment in HumBio 155H Humans and Viruses or MI 116, The Human Virosphere. Same as: HUMBIO 155B

MI 115C. Human Virology Inquiry Project I. 1-3 Unit.

Advanced topics in human virology focuses on current issues in the field. Topics will include: clinical features of infection, epidemiology, molecular virology, drug development and policy, vaccinology, pathogenesis, host modulation, and media representations of viral infection. Student presentations and discussion in a small group setting.

MI 116. The Human Virosphere. 5 Units.

Focus on interaction of humans and viruses from a number of perspectives: historical, cultural, political, and demographic. Organismal, molecular biological, biochemical, human and viral interactions; clinical aspects of viral disease, epidemiology and risk factors, public and international health, aspects of virology including emerging viruses and biological weapons. Case studies involving particular viruses: human herpes viruses, retroviruses, oncogenic viruses; vaccination and disease eradication, evolution of viruses as tools for research and therapy. Emphasis on general principles of biology and matters of decision making policy. Prerequisite: Biology core, Human Biology core, or consent of instructor. Same as: MI 216

MI 120. Bacteria in Health and Disease. 3 Units.

Enrollment limited to junior and senior undergraduates, graduate students and medical students. Introduces students to the bacteria that live in and on humans and, in some cases, can cause disease and sometimes death. Topics include the biology of the interaction of the simple microbe with complex human biology and the factors that determine whether or not we coexist relatively peacefully, suffer from overt disease, or succumb to the bacterial onslaught. Same as: BIO 120

MI 155H. Humans and Viruses I. 6 Units.

Introduction to human virology integrating epidemiology, molecular biology, clinical sciences, social sciences, history, and the arts. Emphasis is on host pathogen interactions and policy issues. Topics: polio and vaccination, smallpox and eradication, yellow fever and history, influenza and genomic diversity, rubella and childhood infections, adenovirus and viral morphology, ebola and emerging infection, lassa fever and immune response. Same as: HUMBIO 155H

MI 155V. Humans and Viruses II. 6 Units.

Introduction to human virology integrating epidemiology, molecular biology, clinical sciences, social sciences, history, and the arts. Emphasis on host pathogen interactions and policy issues. Topics: measles and viral epidemiology, rotavirus and world health, rabies and infections of the brain, HPV and cancer-causing viruses, herpes simplex and viral latency, CMV and viral teratogenesis, retrovirology and endogenous viral sequences, HIV and viral treatment, viral hepatitis and chronic infections, prions and diseases of life style. Prerequisite: MI155H.

MI 185. Topics in Microbiology. 3 Units.

For advanced undergraduates and graduate students. 1/3rd of the course consists of lectures by the instructor/colleagues. These cover, at an advanced level, with emphasis on bacteria, topics not covered elsewhere, e.g., phylogeny, molecular regulation, and bioenergetics. The remainder of the course involves interactive discussion of a topic of current interest in microbiology, chosen with student participation, and includes student presentations. (The topic last year was: Gene therapy.) Satisfies Central Menu Area 3 for BIO majors. Prerequisites: CHEM 31X, Biology core. Same as: MI 285

MI 198. Directed Reading in Microbiology and Immunology. 1-15 Unit.

Fields of study are decided in consultation with sponsoring professor. Prerequisite: consent of instructor.

MI 199. Undergraduate Research. 1-18 Unit.

Investigations sponsored by individual faculty members. Possible fields: microbial molecular biology and physiology, microbial pathogenicity, immunology, virology, and molecular parasitology. Prerequisite: consent of instructor.

MI 204. Innate Immunology. 3 Units.

Innate immune mechanisms as the only defenses used by the majority of multicellular organisms. Topics include Toll signaling, NK cells, complement, antimicrobial peptides, phagocytes, neuroimmunity, community responses to infection, and the role of native flora in immunity. How microbes induce and defeat innate immune reactions, including examples from vertebrates, invertebrates, and plants. Same as: IMMUNOL 204, MI 104

MI 209. Advanced Pathogenesis of Bacteria, Viruses, and Eukaryotic Parasites: Part I. 4 Units.

For graduate students and advanced undergraduates; required of first-year graduate students in Microbiology and Immunology. Emphasis is on mechanisms to establish infection in the host and responses of the host to infection. Current literature. Prerequisite: background in biochemistry and molecular biology.

MI 210. Advanced Pathogenesis of Bacteria, Viruses, and Eukaryotic Parasites. 4 Units.

For graduate and medical students, and advanced undergraduates; required of first-year graduate students in Microbiology and Immunology. The molecular mechanisms by which microorganisms invade animal and human hosts, express their genomes, interact with macromolecular pathways in the infected host, and induce disease. Current literature. Undergraduate students interested in taking this class must meet with the instructor to obtain approval before enrolling.

MI 211. Advanced Immunology I. 3 Units.

For graduate students, medical students and advanced undergraduates. Topics include the innate and adaptive immune systems; genetics, structure, and function of immune molecules; lymphocyte activation and regulation of immune responses. Prerequisites: undergraduate course in Immunology and familiarity with experimental approaches in biochemistry, molecular biology, and cell biology. Same as: IMMUNOL 201

MI 215. Principles of Biological Technologies. 3 Units.

The principles underlying novel as well as commonly utilized techniques to answer biological questions. Lectures and primary literature critiques on topics such as fluorescence microscopy, including applications such as FRET and single-cell analysis; human and murine genetic analysis; FACS; proteomics and analysis of noncoding RNAs. Class participation is emphasized. Prerequisite: biochemistry. Required of first-year graduate students in Microbiology and Immunology and the Immunology program. Same as: IMMUNOL 215

MI 216. The Human Virosphere. 5 Units.

Focus on interaction of humans and viruses from a number of perspectives: historical, cultural, political, and demographic. Organismal, molecular biological, biochemical, human and viral interactions; clinical aspects of viral disease, epidemiology and risk factors, public and international health, aspects of virology including emerging viruses and biological weapons. Case studies involving particular viruses: human herpes viruses, retroviruses, oncogenic viruses; vaccination and disease eradication, evolution of viruses as tools for research and therapy. Emphasis on general principles of biology and matters of decision making policy. Prerequisite: Biology core, Human Biology core, or consent of instructor. Same as: MI 116

MI 218. Computational Analysis of Biological Information: Introduction to Python for Biologists. 2 Units.

Computational tools for processing, interpretation, communication, and archiving of biological information. Emphasis is on sequence and digital microscopy/image analysis. Intended for biological and clinical trainees without substantial programming experience. Same as: GENE 218, PATH 218

MI 221. Gut Microbiota in Health and Disease. 2-3 Units.

Preference to graduate students. Focus is on the human gut microbiota. Students enrolling for 3 units receive instruction on computational approaches to analyze microbiome data and must complete a related project.

MI 225. Viral Hemorrhagic Fevers. 4 Units.

Explores four families of human viruses (falvivirus, filovirus, bunyavirus, arenavirus) that share certain clinical and pathological features. These families used to illustrate more general features of human virology ranging from molecular virology, viral replication cycles, transmission, clinical presentation, pathogenesis, diagnosis, treatment, epidemiology, public health responses, public policy, economics. After general introduction, each family will be presented, followed by sessions focused on comparisons and integration. Specific case studies focus on current events. Student assignments include problem sets, model-building, blogging, and comprehensive examinations. In-class sessions will include interactive lectures, guest speakers, student presentations, discussions.

MI 233. The Biology of Small Modulatory RNAs. 2 Units.

Open to graduate and medical students. Explores recent progress and unsolved questions in the field of RNA interference and microRNA biology. Students are required to read assigned primary literature before each class and actively participate in guided discussions on related technical and conceptual issues during class meetings. Assignments include critiques of assigned papers and developing a novel research proposal. Same as: GENE 233, PATH 233

MI 234. Fundamentals of RNA Biology. 2 Units.

For graduate or medical students and (if space allows) to active participants from other segments of the Stanford Community (e.g., TGR students); undergraduates by instructor consent. Fundamental issues of RNA biology, with the goal of setting a foundation for students to explore the expanding world of RNA-based regulation. Each week a topic is covered by a faculty lecture and journal club presentations by students. Same as: GENE 234, PATH 234

MI 245. Computational Modeling of Microbial Communities. 4 Units.

Provides biologists with basic computational tools and knowledge to confront large datasets in a quantitative manner. Students learn basic programming skills focused on Matlab, but also are introduced to Perl and Python. Topics include: image analysis, bioinformatics algorithms, reaction diffusion modeling, Monte Carlo algorithms, and population dynamics. Students apply computational skills to a miniature research project studying the human gut microbiota. Same as: BIOE 115

MI 250. Frontiers in Microbiology and Immunology. 1 Unit.

Required of first- and second-year students in Microbiology and Immunology. How to evaluate biological research. Held in conjunction with the Microbiology and Immunology Friday noon seminar series. Before the seminar, students and faculty discuss one or more papers from the speaker's primary research literature on a related topic. After the seminar, students meet informally with the speaker to discuss their research.

MI 285. Topics in Microbiology. 3 Units.

For advanced undergraduates and graduate students. 1/3rd of the course consists of lectures by the instructor/colleagues. These cover, at an advanced level, with emphasis on bacteria, topics not covered elsewhere, e.g., phylogeny, molecular regulation, and bioenergetics. The remainder of the course involves interactive discussion of a topic of current interest in microbiology, chosen with student participation, and includes student presentations. (The topic last year was: Gene therapy.) Satisfies Central Menu Area 3 for BIO majors. Prerequisites: CHEM 31X, Biology core. Same as: MI 185

MI 299. Directed Reading in Microbiology and Immunology. 1-18 Unit.

Prerequisite: consent of instructor.

MI 370. Medical Scholars Research. 4-18 Units.

Provides an opportunity for student and faculty interaction, as well as academic credit and financial support, to medical students who undertake original research. Enrollment is limited to students with approved projects.

MI 399. Graduate Research. 1-18 Unit.

Students who have completed the necessary foundation courses undertake investigations in general bacteriology, bacterial physiology and ecology, bacterial genetics, microbial pathogenicity, immunology, parasitology, or virology sponsored by individual faculty members. Prerequisite: consent of instructor.

MI 801. TGR Master's Project. 0 Units.

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MI 802. TGR PhD Dissertation. 0 Units.

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