

# 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-microbe interactions, and the function of the immune system. Laboratories investigate mechanisms of pathogenesis and commensalism 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

Students seeking admissions to the Microbiology and Immunology Ph.D. program typically have an undergraduate major in biological sciences, but majors from other areas are acceptable if the applicant has sufficient coursework or interest in the field. Information for prospective students can be found on the Stanford Biosciences (<https://biosciences.stanford.edu/prospective-students/>) website. Applications should be submitted at the Office of Graduate Admissions (<http://gradadmissions.stanford.edu/>) website. The GRE is not required to apply for the Ph.D. degree in Microbiology and Immunology.

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 are oriented to the curriculum and the timetable for completion of the degree requirements by the Director of Graduate Studies. Typically, students plan three laboratory rotations (one rotation per quarter). During the first year of

graduate study in the department, each student also takes seven upper-level (200-series) courses.

### Course requirements:

		Units
BIOS 200	Foundations in Experimental Biology	5
BIO 214	Advanced Cell Biology	4
MED 255	The Responsible Conduct of Research	1
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 course:

		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
GENE 205	Advanced Genetics	3
IMMUNOL 202	Advanced Immunology II	3
MCP 256	How Cells Work: Energetics, Compartments, and Coupling in Cell Biology	4
MI 221	Gut Microbiota in Health and Disease	3
S BIO 241	Biological Macromolecules	3-5
STATS 141	Biostatistics	5

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. 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 is presented and completed by the end of the Spring Quarter. Based on successful performance on these proposals, the student is admitted to candidacy. Teaching experience and training are also part of the graduate curriculum. Graduate students are required to act as teaching assistants for one course. In addition, first- and second-year graduate students are required to participate in a bi-weekly journal club. Additional information on program requirements can be found on the Microbiology and Immunology (<http://med.stanford.edu/microimmuno.html>) web site.

## COVID-19 Policies

On July 30, the Academic Senate adopted grading policies effective for all undergraduate and graduate programs, excepting the professional Graduate School of Business, School of Law, and the School of Medicine M.D. Program. For a complete list of those and other academic policies relating to the pandemic, see the "COVID-19 and Academic Continuity (<http://exploreddegrees.stanford.edu/covid-19-policy-changes/#tempdeptemplatetabtext>)" section of this bulletin.

The Senate decided that all undergraduate and graduate courses offered for a letter grade must also offer students the option of taking the course for a "credit" or "no credit" grade and recommended that deans,

departments, and programs consider adopting local policies to count courses taken for a "credit" or "satisfactory" grade toward the fulfillment of degree-program requirements and/or alter program requirements as appropriate.

## Graduate Degree Requirements

### Grading

The Microbiology and Immunology Program counts all courses taken in academic year 2020-21 with a grade of 'CR' (credit) or 'S' (satisfactory) towards satisfaction of graduate degree requirements that otherwise require a letter grade provided that the instructor affirms that the work was done at a 'B' or better level.

## Graduate Advising Expectations

The Department of Microbiology and Immunology is committed to providing academic advising in support of graduate student scholarly and professional development. When most effective, this advising relationship entails collaborative and sustained engagement by both the adviser and the advisee. As a best practice, advising expectations should be periodically discussed and reviewed to ensure mutual understanding. Both the adviser and the advisee are expected to maintain professionalism and integrity.

Faculty advisers guide students in key areas such as selecting courses, designing and conducting research, development of teaching and mentoring skills, navigating policies and degree requirements, and exploring academic opportunities and professional pathways.

Graduate students are active contributors to the advising relationship, proactively seeking academic and professional guidance and taking responsibility for informing themselves of policies and degree requirements for their graduate program.

Additional information about the department's policy on graduate advising can be found on the Microbiology and Immunology (<http://med.stanford.edu/microimmuno.html>) web site. For a statement of University policy on graduate advising, see the "Graduate Advising (<http://exploreddegrees.stanford.edu/graduatedegrees/#advisingandcredentialstext>)" section of this bulletin.

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

*Chair:* David Schneider

*Associate Chair:* Denise Monack

*Director of Graduate Studies:* Justin Sonnenburg

*Professors:* Manuel Amieva, Ann Arvin, Helen Blau, Matthew Bogoy, John C. Boothroyd, Yueh-Hsiu Chien, Wah Chiu, Mark M. Davis, Stephen J. Galli, Jeffrey Glenn, Harry B. Greenberg, K.C. Huang, Peter Jackson, Karla Kirkegaard, A.C. Matin, Denise Monack, Peter Parham, Phillip Pizzo, Charles Prober, Bali Pulendran, David Relman, Peter Sarnow, David Schneider, Upinder Singh, Lucy S. Tompkins.

*Professor (Teaching):* Robert D. Siegel

*Associate Professors:* Paul Bollyky, Jan Carette, Shirin Einav, Michael Fischbach, Justin Sonnenburg, Ellen Yeh

*Assistant Professors:* Dylan Dodd, Elizabeth Egan, Michael Howitt, Juliana Idoyaga, Prasanna Jagannathan, Taia Wang

*Institute for Immunity, Transplantation and Infection*

*Director, Human Immune Monitoring Center and 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 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 MI 116, The Human Virosphere or consent of instructor required.

### MI 115C. Human Virology Inquiry Project. 3 Units.

Selected topics in human virology focusing on current issues in the field. Topics will include: clinical features of infection, epidemiology, molecular virology, drug development and policy, vaccinology, pathogenesis, host modulation, emerging infection, and media representations of viral infection. Student presentations and discussion in a small group setting. Prerequisite: concurrent enrollment in MI 116.

**MI 116. The Human Virophere. 3 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.

Same as: MI 216

**MI 155A. 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.

**MI 155B. 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: MI155A or HUMBIO 155H.

**MI 155N. Viruses in the News. 3 Units.**

Viruses include some of the most devastating and ubiquitous causes of human disease as illustrated by the recent Ebola and Zika epidemics. In books, movies, newspapers, and electronic feeds, viruses continue to make the news on a daily basis. Using contemporary media, talks by content experts, model building, interactive sessions and field trips, we will explore contemporary issues related to the essential nature of viruses, what makes them unique, key molecular processes, breakthroughs in prevention and treatment, current efforts in trying to eradicate viruses and cultural iconography pertaining to viruses. In short, this seminar intended to go viral. Humans and Viruses or consent of instructor required.

**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 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 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.

**MI 216. The Human Virophere. 3 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.

Same as: MI 116

**MI 217. Genome Editing: Redefining Humanity. 4 Units.**

Genome Editing is potentially the most important biological/medical strategy ever developed. Genome Editing has been used to manipulate diverse organisms and viruses including bacteria, plants, insects, nonhuman animals, human remediation, and treatment of genetic and other diseases in animals and humans. The advent of CRISPR-Cas9 and newer techniques has greatly increased the facility and speed with which Genome Editing can be carried out. It has become clear that the main factors limiting the power of Genome Editing are the human imagination and human imposed structures, - not technological limitations.

**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. 3 Units.**

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

Same as: BIOE 221G, GENE 208

**MI 225. Viral Hemorrhagic Fevers. 4 Units.**

Explores four families of human viruses (falvivirus, filovirus, bunyaviruses, arenaviruses) 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, students presentations, discussions.

**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 255. Measles and Sneezles and Things That Go Mumps in the Night. 3 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, parainfluenza viruses, 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. Lectures, discussion, student presentations. No science background necessary.

**MI 260. Creative Visualization Studio. 1-2 Unit.**

In this class, we will teach students to build small, physical explanations of their data for display and use as visual aids in person, at a poster or in a talk. We will use a range of media, including laser cutters, paper cutters, silk screening, CNC routing, 3D printing, jewelry making, embroidery, mold making, stop motion animation, or stained glass cutting. Classes will be split into workshop time for learning techniques and brainstorming and lab time, where students can work on individual projects. Students will be expected to complete 5 small visualization projects over the course of the quarter. Permission numbers are required to enroll. To obtain a permission number please email Professor David Schneider at dschneid@stanford.edu.

**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.****MI 802. TGR PhD Dissertation. 0 Units.**