

DEPARTMENT OF MICROBIOLOGY AND IMMUNOLOGY (GRAD)

The Department of Microbiology and Immunology, an administrative division of the School of Medicine, is a unit of The Graduate School. It offers instruction leading to the doctor of philosophy degree. A terminal master of science degree is granted only under special conditions. The department is highly regarded in many scientific disciplines, including immunology, microbial pathogenesis, virology, infectious diseases, host/pathogen interactions, molecular genetics, prokaryotic and eukaryotic molecular and cellular biology, and cancer biology. Research in the department is supported by funds from the University, the National Institutes of Health, the National Science Foundation, the American Cancer Society, and other private foundations and granting agencies.

Research Environment

The Department of Microbiology and Immunology consists of approximately 75 faculty members with active research laboratories, 60 graduate students, 90 postdoctoral scientists, 20 research staff, and 10 administrative staff, who together form a highly interactive, friendly, and collaborative community.

The department occupies the entire sixth floor (~25,000 net square feet) of the new Marsico Hall, as well as the recently renovated ninth floor of the Burnett-Womack Building. A significant number of faculty members who hold primary appointments in the department have laboratories in the nearby Lineberger Comprehensive Cancer Center as well as other departments within the School of Medicine and Gillings School of Global Public Health.

A variety of modern equipment is available in individual laboratories or shared by multiple users throughout the department. Well-equipped research laboratories are supplemented by specialized rooms dedicated to tissue culture, controlled temperature environments, BSL3 physical containment for research on microbial select agents, supervised animal care, etc. In addition, the University operates an extensive network of core facilities with major equipment and expert support staff, including flow cytometry, genomics, proteomics, oligonucleotide synthesis, DNA sequencing, X-ray crystallography, NMR, animal models (transgenic mouse and embryonic stem cell services), animal histopathology, bioinformatics, gene chips, confocal microscopy, electron microscopy, and mass spectrometry.

The department is fully supplied with high-speed Internet connections (both wired and wireless). University libraries provide electronic access to thousands of professional journals.

Admission

Students seeking admission to the Department of Microbiology and Immunology apply to BBSP, a common portal by which students interested in any of the 14 participating graduate programs begin their studies at UNC-Chapel Hill. To apply, prospective students should visit the BBSP (<http://bbsp.unc.edu/admissions/>) and graduate admissions (<http://gradschool.unc.edu/admissions/>) websites, fill out the online application, and select Microbiology and Immunology as their first choice of interest.

Financial Assistance

All Ph.D. students making satisfactory degree progress receive a stipend plus in-state tuition, fees, and health insurance. Funds are available from individual research grants, training grants, the department, and the University. Students are encouraged to apply for a predoctoral fellowship from the National Institute of Health, the National Science Foundation, or other organizations.

As is the case for all graduate students in the basic science departments of the UNC School of Medicine, education during the first year is under the guidance of the interdisciplinary Biological and Biomedical Sciences Program (BBSP). Students rotate through three different research laboratories of their choosing in year one. For students interested in microbiology and immunology, recommended classroom courses include Immunobiology (MCRO 614), Virology (MCRO 630), Microbial Pathogenesis I (MCRO 635), and Microbial Pathogenesis II (MCRO 640).

Upon choosing a dissertation laboratory and joining the Department of Microbiology and Immunology, students are provided with an outstanding learning environment, an opportunity to conduct cutting-edge research, and most importantly, thorough preparation for a successful career in science. The microbiology and immunology Ph.D. program is designed to provide a foundation of fundamental knowledge in modern microbiology and immunology, foster critical scientific thinking, develop written and oral communication skills, allow students to gain teaching experience, and offer opportunities to travel and present posters or talks at national meetings. Specific components of the microbiology and immunology Ph.D. training program include:

- Completion of six relevant courses, including two courses based directly on discussion of the primary literature (e.g., MCRO 710, MCRO 711, MCRO 712), and MCRO 795 are required. Students typically finish four of the six classes while in BBSP and the remainder during year two. There is no language requirement.
- The written preliminary exam (also known as the doctoral written examination) consists of an original non-thesis research proposal, written in a format similar to an NIH pre- or postdoctoral fellowship proposal. The proposal is written whenever the student likes over the course of the spring semester of year two.
- The oral preliminary exam (also known as the doctoral oral examination) centers on the topic of the thesis project and provides an opportunity for the student to demonstrate his or her ability to discuss the fields of science related to the thesis proposal, as well as the ability to analyze problems and design experiments. The exam serves a dual purpose as the initial meeting of the thesis committee. Therefore, a separate decision to approve or disapprove the thesis project will occur in the same meeting.

Students must regularly attend weekly student and departmental seminars (MCRO 701) beginning in year two and present their research annually in the student seminar series beginning in year three.

Students act as teaching assistants for two semesters in department-approved courses, typically in years two and three.

Students form a dissertation committee in the start of year three, obtain approval of their dissertation project, and meet annually with their committee to discuss research progress. Completion of sufficient original research for at least two first-author papers in high-quality peer reviewed journals is expected. As a minimum standard, to earn the Ph.D. degree we require that

- A student must make meaningful contributions to and be an author on at least two manuscripts intended for publication in respected, high-quality professional journals or books,
- At least one of the two manuscripts must be a first (or co-first) author primary research manuscript,
- At least one of the two manuscripts must be accepted for publication, and
- If the second manuscript is not accepted for publication, then peer reviews must be returned prior to the private Ph.D defense.

Following the faculty member's name is a section number that students should use when registering for independent studies, reading, research, and thesis and dissertation courses with that particular professor.

Professors

Kristy Ainslie (120), Formulation of Vaccines and Drug Delivery Treatments for Immune Modulation to Treat and Prevent Infectious and Other Diseases¹

Ralph Baric (76), Molecular Mechanisms of Virus Cross-Species Transmissibility and Systems Genetics and Pathogenesis¹

Robert Bourret (64), Signal Transduction in Bacteria

Wesley Burks (102), Allergic Diseases, Mechanisms and Immunotherapy¹

Bruce Cairns (93), Immune Response to Injury, Cellular Immunology, Transplantation¹

Craig E. Cameron (125), Respiratory Enteroviruses, Biochemistry and Cell Biology of Genome Replication, Host Response, Antiviral Therapy, Single-Cell Analysis, Between-Individual Variation in Host Response, Personalized Medicine

Myron S. Cohen (55), Biology and Epidemiology of Transmission of STD Pathogens (Including HIV)¹

Peggy Cotter (97), Microbial Pathogenesis, Molecular Genetics, Protein Secretion

Blossom Damania (79), Kaposi's Sarcoma-Associated Herpesvirus (KSHV/HHV-8), Rhesus Monkey Rhadinovirus (RRV)

Jeff Dangl (87), Plant Genetics, Plant Microbiome, Plant Disease Resistance and Cell Death Control, Bacterial Type III Secretion Systems¹

Toni Darville (117), Chlamydia Trachomatis Pathogenesis and Immune Protective Mechanisms¹

Kristina De Paris (98), Neonatal/Pediatric Immunology; Pathogenesis of Infectious Diseases; HIV and Co-Infections

Aravinda de Silva (73), Arthropod Vector-Borne Infectious Diseases and Microbial Pathogenesis

Dirk Dittmer (88), West Nile Virus (WNV) and Kaposi's Sarcoma-Associated Herpesvirus (KSHV/HHV-8)

Gianpietro Dotti (112), Cancer Immunotherapy, Genetic Engineering; T-Cell Therapies, Tumor Microenvironment

Peter H. Gilligan (51), Bacterial Toxins, Clinical Microbiology¹

Jack Griffith (35), Chromosome Structure: Viruses and Their Host Cells

Mark Heise (83), Molecular Genetics of Viral Pathogenesis¹

Ilona Jaspers (106), Respiratory Viruses, Host Innate Defense in the Respiratory Mucosa, Virus-Host Cell Interaction, Epithelial-Immune Cell Interaction, Environmental Effects¹

Tal Kafri, Development of HIV-Based Vector for Gene Therapy, Epigenetics of HIV and HIV-1 Vectors, Basic Biology of Nonintegrating HIV-1 and HIV-1 Vectors

Sam Lai (105), Mucosal Immunity, Antibody Engineering, Antibody Response to Nanomaterials, Targeted Drug Delivery, Bacteriophage Engineering, Vaccines¹

Stanley M. Lemon (59), Molecular Virology, Innate Immunity, Viral Carcinogenesis¹

Zhi Liu (91), Biochemistry, Cell Biology, and Immunology of Hemidesmosome and Basement Membrane¹

David M. Margolis (90), Regulation of Gene Expression, Molecular Biology of Retroviruses, HIV Pathogenesis¹

Virginia L. Miller (96), Molecular and Genetic Analysis of Microbial Pathogenesis, Virulence Gene Regulation, Host-Pathogen Interactions¹

Robert A. Nicholas (94), Antibiotic Resistance Mechanisms, Bacterial Genetics, *Neisseria gonorrhoeae*¹

Joseph S. Pagano (14), Epstein-Barr Virus and Ubiquitin-Proteasomal Systems, Interferon Regulatory Factors, Invasion and Metastasis and Antiviral Drugs¹

David Peden, Translational and Clinical Research in Environmental Lung Disease¹

Matthew Redinbo, Structural and Chemical Biology of Host-Pathogen Contacts¹

Howard M. Reisner (32), Immunogenetics of Human Plasma Proteins (Particularly IgG and Coagulant Factors VII and IX)¹

R. Balfour Sartor (77), Etiology and Pathogenesis of Inflammatory Bowel Disease (especially Crohn's Disease and Associated Extraintestinal Manifestations)¹

Barbara Savoldo (121), Cancer Immunotherapy, T Cell Viral Immunity, T Cells Based Therapies¹

Jonathan Serody (82), Transplantation and Tumor Immunology¹

Ronald Swanstrom (74), Molecular Biology and Pathogenesis of HIV¹

Rita Tamayo (100), Microbial Pathogenesis, Bacterial Genetics, Bacterial Gene Regulation

Jenny P. Ting (50), Molecular Immunology, Transcription, Signal Transduction, Apoptosis, Neuroimmunology, Transplantation¹

Roland Tisch (70), Immune Tolerance, T-Cell Antigen Recognition, T-Cell Mediated Autoimmunity, Tumor Antigen-Specific Genetic Vaccines, Type 1 Diabetes

David van Duin, Translational/Clinical Research, Antimicrobial Resistance, Infections in Immunocompromised Hosts¹

Barbara J. Vilen (78), Molecular Immunology, Signal Transduction, and B Cell Tolerance

Yisong Wan (103), Regulatory T-Cell and TGF-Beta Signaling Controlled T-Cell Function Under Normal and Pathological Conditions

Jason Whitmire (124), Viral Immunology, Memory T-Cell Differentiation, Vaccines, Inflammation, Microbial Immunology¹

William J. Yount (25), Genetic Control of Antibody Response and Gamma Globulin Synthesis in Humans¹

Associate Professors

Brian Conlon (115), Antibiotic Resistance, Bacteriology

Misty Good, Neonatology, Developmental Biology, Intestinal Immunity, Mucosal Immunology, Epithelial Biology, Necrotizing Enterocolitis¹

Nilu Goonetilleke (116), T-Cell Immunology, HIV-1 Immunobiology

Jonathan Hansen (110), Inflammatory Bowel Disease, Host-Microbe Interactions, Microbial Adaptation/Evolution, Experimental Colitis¹

Matthew Hirsch, AAV Gene Therapy, Gene Editing, Cellular Response to Foreign DNA¹

Helen Lazear (114), Innate Immune Mechanisms that Control Flavivirus Pathogenesis

Jessica Lin, Molecular epidemiology, Malaria transmission, Parasite genotyping, Infectious disease¹

Nancie MacIver, Nutritional Immunology and Immunometabolism¹

Cary Moody (103), Pathogenesis of Human Papillomaviruses

Nathaniel Moorman (104), Molecular Virology, Host Pathogen Interactions, HCMV Pathogenesis

Timothy Moran, Immune mechanisms of allergy and asthma¹

Raymond Pickles (86), Respiratory Viruses, Host Innate Defense in the Airway, Virus-Host Cell Interactions, Gene Therapy for Cystic Fibrosis and Other Lung Diseases

Yuliya Pylayeva-Gupta (126), Tumor Immunology, B Cell Biology, Immunosuppression and Immunotherapy in Cancer¹

Benjamin Vincent (123), How Immunogenomics Features Including T-Cell Receptor and B-Cell Receptor Repertoire Characteristics Predict Survival and Response to Immunotherapy in Breast Cancer, Bladder Cancer, and Acute Myeloid Leukemia¹

Matthew C. Wolfgang (89), Microbial Pathogenesis, Bacterial Gene Regulation, Host-Pathogen Interactions

David Zaharoff (119), Vaccine and Immunotherapy Delivery Platforms¹

Assistant Professors

Janelle Arthur (113), Microbiota, Inflammation and Innate Immunity, Colorectal Cancer

Luther Bartelt, Microbial Pathogenesis, Host-Pathogen Interactions, Microbiota-Pathogen Interactions, Metabolomics, Immunity¹

Camille Ehre, Respiratory Virus and Host Interactions, Muco-Obstructive Lung Diseases, Cellular Response to Infection, Innate Defense Mechanisms¹

Lisa Gralinski (48), Viral Pathogenesis, Respiratory Disease, Coronavirus, Virus-Host Interactions¹

Indriati Hood-Pischany, Microbial Ecology of the Vaginal Microbiome, Microbiome-Focused Therapeutic Development¹

Sarah Joseph (49), HIV-1 Evolution and Establishment of Reservoirs, HIV-1 Neuropathogenesis

Brian Miller, Mechanisms of Tumor Response and Resistance to Immunotherapy; Myeloid Cells¹

Justin Milner, Cancer Immunotherapy, T Cell Biology, Immune Responses to Viral Infections, Vaccination

Jason Mock, Immunology, Acute Lung Injury, Mechanism Underlying Lung Repair and Resolution¹

Adam Rosenthal (53), Microbial Ecology, Phenotypic Heterogeneity in Bacteria, Microbial-Host Interactions

Tim Sheahan (54), Coronavirus Pathogenesis, Host-Pathogen Interactions, Antiviral Development¹

Celia Shiau, Neuroimmunology, Innate Immune Response, Tissue Macrophages, Microglia, CRISPR Engineering, Developmental Immunology, Genetics and Genomics, In Vivo Microscopy¹

Lance Thurlow (130), Host-Pathogen Interactions, Microbial Physiology and Immune Metabolism¹

Ageliki Tsangaratou, Epigenetics, T Cell Differentiation and Function, Cancer¹

Matthew Vogt (58), Viral Immunology, Antibodies, Acute Flaccid Myelitis, Enterovirus D68, Respiratory Viruses, Pathogenesis

Teaching Assistant Professors

Lorraine Cramer

Gina Donato

Research Associate Professors

Jamie Arnold, Mechanisms of RNA Virus Genome Replication and Antiviral Strategies Targeting Viral Enzymes

W. June Brickey, Host Immune Responses, Radiation Injury, Expression Profiling

Premkumar Lakshmanane, Structural Biology, Protein Engineering, Diagnostics Development, Drug Design, Antibacterial Discovery

Alessandra Livraghi-Butrico, Airway Mucosal Immunology¹

Julie A. E. Nelson, Molecular Virology, HIV Evolution and Pathogenesis, HCV Co-Infection, HIV Assay Development and HIV Clinical Trial Virology

Sarah Rowe-Conlon, Antibiotic Mechanism of Action, Chronic Relapsing Bacterial Infections, Antibiotic Tolerance

Kimberly Walker, Microbial Pathogenesis, Bacterial Gene Regulation

Research Assistant Professors

Ed Browne (128), Virology, Immunology, HIV-1, Systems Biology, Single Cell Analysis¹

Karen McKinnon, Dendritic Cell Induction of Tumor Specific CD4 and CD8 T Lymphocytes

Shaomin Tian, Nanoparticle-Mediated Drug Delivery, Nano-Vaccine Formulation for Infectious Diseases and Cancer Immunotherapy

Shuntai Zhou¹

Professors Emeriti

Steven L. Bachenheimer

Janne G. Cannon

Susan A. Fiscus

Nancy C. Fisher

Jeffrey A. Frelinger

William Goldman

Jean Handy

Clyde A. Hutchison III

Robert E. Johnston

David G. Klapper

John E. Newbold

Nancy Raab-Traub

P. Frederick Sparling¹

Associate Professor Emeritus

Glenn Matsushima

¹ *joint faculty members*

MCRO

Advanced Undergraduate and Graduate-level Courses

MCRO 449. Introduction to Immunology. 3 Credits.

This course provides a general overview of the evolution, organization, and function of the immune system. Instruction will be inquiry-based with extensive use of informational and instructional technology tools.

Rules & Requirements

Requisites: Prerequisites, BIOL 205; or BIOL 103, BIOL 104, and BIOL 240; or permission of the instructor for students lacking the prerequisites.

Grading Status: Letter grade.

Same as: BIOL 449.

MCRO 614. Immunobiology. 3 Credits.

A strong background in molecular biology, eukaryotic genetics, and biochemistry is required. Advanced survey course with topics that include molecular recognition, genetic mechanisms of host resistance, development of cells and cell interactions; hypersensitivity, autoimmunity, and resistance to infection. Course material from textbook and primary literature.

Rules & Requirements

Grading Status: Letter grade.

MCRO 630. Virology. 3 Credits.

Required preparation, coursework in molecular biology and cell biology. Current concepts of the chemistry, structure, replication, genetics, and the natural history of animal viruses and their host cells.

Rules & Requirements

Grading Status: Letter grade.

MCRO 631. Advanced Molecular Biology. 4 Credits.

This course explores cutting edge research in molecular biology – the investigation at molecule-scale of the mechanisms behind life. We briefly review core-principles in molecular biology, then investigate more recent research that extends or overturns these core principles.

Rules & Requirements

Requisites: Prerequisites, BIOL 202, or BIOL 220, or CHEM 430, and permission of the course director.

Grading Status: Letter grade.

Same as: GNET 631, BIOC 631, BIOL 631.

MCRO 632. Advanced Molecular Biology II. 3 Credits.

Required preparation for undergraduates, at least one undergraduate course in both biochemistry and genetics. The purpose of this course is to provide historical, basic, and current information about the flow and regulation of genetic information from DNA to RNA in a variety of biological systems. Three lecture hours a week.

Rules & Requirements

Grading Status: Letter grade.

Same as: GNET 632, BIOC 632, BIOL 632.

MCRO 635. Microbial Pathogenesis I. 3 Credits.

Permission of the instructor. Required preparation, coursework in molecular biology and genetics. Topics will include aspects of basic bacteriology as well as bacterial and fungal pathogens and mechanisms of disease.

Rules & Requirements

Grading Status: Letter grade.

MCRO 640. Microbial Pathogenesis II. 3 Credits.

Permission of the instructor or a fundamental understanding of molecular virology and immunology. Molecular pathogenesis, with a primary focus on viral pathogens. Additional topics include vaccines and genetics of host-pathogen interactions.

Rules & Requirements

Grading Status: Letter grade.

MCRO 690. Special Topics in Microbiology or Immunology. 1-15 Credits.

Permission of the department except for department majors. Designed to introduce the student to research methods. Minor investigative problems are conducted with advice and guidance of the staff. Hours and credit to be arranged, any term. May be repeated for credit two or more semesters.

Rules & Requirements

Repeat Rules: May be repeated for credit; may be repeated in the same term for different topics; 15 total credits. 5 total completions.

Grading Status: Letter grade.

Graduate-level Courses**MCRO 701. Seminar in Microbiology and Immunology. 1 Credits.**

Faculty and student seminars on current research in microbiology and immunology.

Rules & Requirements

Repeat Rules: May be repeated for credit.

Grading Status: Letter grade.

MCRO 702. Seminar in Microbiology. 1 Credits.

Seminar on selected topics in microbiology.

Rules & Requirements

Repeat Rules: May be repeated for credit.

Grading Status: Letter grade.

MCRO 705. Data and Molecular Visualization for Biomedical Research. 2 Credits.

This is an introductory course focused on methods to visualize scientific data and molecular structures. The course will include: R to visualize various biomedical data and generate multiple publication-ready figures and tables, phylogenetic analysis using R and other tools, and PyMol to visualize and analyze molecular structures and create images for publication. This course will also include a large codebase on using R and state-of-art packages to summarize and visualize various data types.

Rules & Requirements

Requisites: Prerequisites, Knowledge of introductory biochemistry and molecular biology is required; Previous experiences with R and PyMol are NOT necessary for attending this class; Personal computer with 1GB RAM (4GB recommended) and three-button mouse required.

Grading Status: Letter grade.

MCRO 710. Seminar/Tutorial in Bacterial and Eukaryotic Microbes. 1-15 Credits.

One or two faculty and a small number of students will consider current research of importance in depth. Emphasis is on current literature, invited speakers, etc., rather than textbooks.

Rules & Requirements

Repeat Rules: May be repeated for credit. 15 total credits. 15 total completions.

Grading Status: Letter grade.

MCRO 711. Seminar/Tutorial in Animal Virology. 1-15 Credits.

One or two faculty and a small number of students consider current research of importance in depth. Emphasis is on current literature, invited speakers, etc., rather than textbooks.

Rules & Requirements

Repeat Rules: May be repeated for credit. 15 total credits. 99 total completions.

Grading Status: Letter grade.

MCRO 712. Seminar/Tutorial in Immunology. 1-15 Credits.

One or two faculty and a small number of students consider current research of importance in depth. Emphasis is on current literature, invited speakers, etc., rather than textbooks.

Rules & Requirements

Repeat Rules: May be repeated for credit.

Grading Status: Letter grade.

MCRO 721. Refresher Training in the Responsible Conduct of Research. 1 Credits.

MCRO 721 is a modular course that meets the requirements of the National Institutes of Health for refresher training in the Responsible Conduct of Research. The course involves a mixture of assigned readings, formal presentations by department faculty who are active in research, and small group discussions. The course grade is based on attendance and participation.

Rules & Requirements

Grading Status: Letter grade.

MCRO 730. Cancer Immunology. 2 Credits.

The goal of this graduate-level course is to learn about recent advances in the field, acquire specialized knowledge and to develop a foundation of critical thinking skills in cancer immunology. The course format will combine lectures and in-class discussion of assigned readings, with particular emphasis on state-of-the art research methods. Students should be familiar with modern concepts of immunology and should consult with the course director before enrolling. The course meets for half a semester.

Rules & Requirements

Grading Status: Letter grade.

Same as: PATH 730.

MCRO 790. Directed Readings in Prokaryotic Molecular Biology. 1 Credits.

Permission of the instructor or one prior prokaryotic molecular biology course. Directed readings in prokaryotic molecular biology under the direction of a member of the graduate faculty. May be repeated for credit.

Rules & Requirements

Repeat Rules: May be repeated for credit.

Grading Status: Letter grade.

MCRO 791. Directed Readings in Virology. 1 Credits.

Permission of the instructor or one prior virology course. Directed readings in virology under the direction of a member of the graduate faculty. May be repeated for credit.

Rules & Requirements

Repeat Rules: May be repeated for credit.

Grading Status: Letter grade.

MCRO 792. Directed Readings in Immunology. 1 Credits.

Permission of the instructor or one prior immunology course. Directed readings in immunology under the direction of a member of the graduate faculty. May be repeated for credit.

Rules & Requirements

Repeat Rules: May be repeated for credit.

Grading Status: Letter grade.

MCRO 795. Research Concepts. 2 Credits.

Permission of the instructor. This course will provide multiple opportunities for the student to write parts of hypothesis-based proposals, receive substantial feedback, and to rewrite the text. There will be approximately twelve single-page writing assignments.

Rules & Requirements

Grading Status: Letter grade.

MCRO 901. Research in Microbiology or Immunology. 1-15 Credits.

Permission of the department. Designed to introduce the student to research methods and special techniques. Short-term problems are conducted with the advice and guidance of the staff. May be repeated for credit.

Rules & Requirements

Repeat Rules: May be repeated for credit.

Grading Status: Letter grade.

MCRO 993. Master's Research and Thesis. 3 Credits.**Rules & Requirements**

Repeat Rules: May be repeated for credit.

MCRO 994. Doctoral Research and Dissertation. 3 Credits.**Rules & Requirements**

Repeat Rules: May be repeated for credit.

Contact Information

Department of Microbiology and Immunology

Visit Program Website (<http://med.unc.edu/microimm/>)

Chair

Craig E. Cameron