Graduate Division of Biological and Biomedical Sciences

Microbiology and Molecular Genetics

Our faculty members have a wide range of expertise and interests, and our program offers a comprehensive education in the biology of microbes and the molecular biology of viruses and bacterial pathogens: bacterial genetics and physiology, microbial development, mechanisms of bacterial and viral pathogenesis, molecular biology of gene regulation, antibiotic resistance, and antiviral and vaccine development.

Goals of the MMG Program
The central goal of the MMG program is to provide students with the essential training experiences needed to be a successful independent investigator in microbiology research. Using bacterial and viral systems, we teach our students the basic principles of microbiology, biochemistry, molecular biology and molecular genetics. Second, we instruct our students in how to read the original literature and interpret it critically. Our goal is to enable our students to construct hypotheses and to design experiments using contemporary technologies to test these hypotheses. Third, we emphasize training in effective communication, both oral and written.

The program is designed both for students interested in academic careers in teaching and research and for those interested in careers in related aspects of medicine and industry.

Research Areas
Opportunities for dissertation research are grouped into two broad areas:

Gene Expression and Physiology of Bacteria and Viruses
This area studies the transcription of genes involved in antibiotic resistance, virulence, motility and the differentiation of microbes, as well as viral multiplication and host genes influenced by infection. Microbes are used to study fundamental physiological processes including sporulation, antibiotic synthesis and resistance, transport, biofilm formation, bacterial communication
systems and metabolism. Research in virology focuses on viruses that are associated with disease in humans, as well as animal models to better understand the host immune response to viral infection.

**Microbial Pathogenesis:**
In this field, important areas of research include the study of genes required for bacterial and viral pathogenesis and the response of the host to infection.

MMG faculty with interests in bacteriology conduct basic research that addresses important, contemporary problems in the areas of microbial physiology (including sporulation, biofilm formation, mechanisms of antibiotic resistance and production and cellular communication systems), microbial genetics (mechanisms of control of gene expression, transposition, and recombination), bacterial virulence factors (including those produced by the Group A streptococci, Streptococcus pneumoniae, Neisseria gonorrhoeae, Neisseria meningitidis, enteropathogenic bacteria, Proteus spp, Staphylococcus aureus, and Mycobacterium tuberculosis), use of microbial genomics to understand mechanisms of virulence and antibiotic resistance and how bacteria evade host defenses.

MMG faculty with interests in virology conduct basic research that address important, contemporary problems in the areas of antiviral development, mechanisms of antiviral resistance, viral replication, roles of viruses in oncology, HIV/AIDS, influenza, mechanisms of viral pathogenesis, mechanisms of viral fusion with host cells, use of Cryo-electron microscopy to study viral assembly and trafficking, escape from immune systems and vaccine development.

**Resources and Opportunities**
The MMG program draws together resources from a number of institutions, providing students with unparalleled opportunities.

- Faculty members are drawn from departments within the Emory School of Medicine (Biochemistry, Microbiology and Immunology, Medicine, Pathology and Pediatrics), the Rollins School of Public Health, science departments in the Emory College, the Centers for Disease Control and Prevention (located adjacent to the Emory campus) and the Atlanta VA Medical Center.

- The MMG program is the home of a training grant from the National Institutes of Health, “Molecular Mechanisms of Microbial Pathogenesis,” first awarded in 1994 and renewed in 2006 with Professor Sam Speck as the Director.

- The faculty members are well-funded with extramural grant support from federal agencies such as the NIH, National Science Foundation and the Veterans Administration.

- Two research centers directed by MMG faculty members sponsor collaborative and interdisciplinary research in areas central to the study of microbes: the Emory Vaccine Center, directed by Professor Rafi Ahmed, and the Center of Excellence for Influenza Research and Surveillance, directed by Professor Richard Compans and the Children's Healthcare of Atlanta Center for Immunology and Vaccines.

All of the necessary equipment and core facilities to conduct cutting-edge research are available to our students.

**Curriculum**
The MMG curriculum is flexible and allows students to enroll in elective classes that will best meet their educational needs. Each student is assigned a pre-research advisor for consultation in design of his/her individual curriculum. The MMG program is small and therefore can be tailored to the needs of each individual student. Most students complete their degree in approximately 5 to 6 years.

**Coursework**
In the first year, all students take three required courses. In subsequent semesters, students work with their advisor to select a set of elective courses to prepare for the student’s research and to fulfill the requirements for the Ph.D. Most students take 3 to 4 full courses in the first year and 2 to 3 in year two.

In addition to these courses, in the first and second year students participate in Colloquium in Microbiology, which involves student-led informal presentations and discussions of current papers and research.

Incoming students also attend an Introduction to Research series, in which all faculty members in the program present and discuss their laboratories and current research projects. This often provides a useful guide for organization of laboratory rotations.

**Lab Rotations**
Following the Introduction to Research series, the students begin the first of three research rotations, designed to provide exposure to different areas and to varied techniques, and to enable the student to choose a laboratory for their thesis research. These rotations of approximately 8 weeks each, are generally completed at the end of Spring semester. Incoming first year students can also start their graduate career early by organizing a summer rotation prior to the beginning of Fall semester classes. This popular option allows students to settle into the area, get used to the Emory environment, and start doing laboratory research prior to the commitments of the full Fall semester schedule.

**Research**
After completing their rotations, students select their laboratory for dissertation research and begin to develop a research project of their own. Towards the end of the second year, each student prepares an NIH-style research proposal of approximately 10 pages, which relates to their thesis project. This is submitted to the faculty thesis committee chosen by the student, and along with the oral discussion of this proposal and relevant background material, serves as the Ph.D. qualifying exam.

In years 3 and above, students present a 25-minute oral progress report to the faculty and students as part of the regular MMG seminar series that takes place on Monday afternoons. Each student generally presents at least two times prior to graduation, providing additional opportunities for students to become effective at scientific communication.

In all years of study, students are required to attend MMG-sponsored seminars and are encouraged to attend other seminars offered on campus that enhance their knowledge.
Training in Teaching

Scientists are often also teachers, whether in formal education or in the process of presenting to lay persons. At Emory, all doctoral students receive training in pedagogy and other elements of teaching, through the Teaching Assistant Training and Teaching Opportunity Program (TATTO) administered by the Graduate School.

After a brief summer workshop (usually before the second year), students are assigned by the Graduate Division of Biological and Biomedical Sciences to assist a faculty member as a lecturer, laboratory instructor or discussion leader for one semester. The Graduate Division offers additional TATTO courses, as well as additional teaching opportunities.

Faculty

The 41 members of the MMG faculty are diverse in their research interests in the disciplines of bacteriology and virology, with special interests in the molecular biology and genetics of bacteria and viruses, mechanisms of microbial pathogenesis, basic principles of microbial physiology, and viral replication.

Most of the MMG faculty have dual appointments and actively participate in other GDBBS graduate programs, including Genetics and Molecular Biology, Immunology and Molecular Pathogenesis, Biochemistry, Cell and Developmental Biology and Population Biology, Ecology and Evolution. Such dual appointments enhance the opportunity for collaborations and increase the exposure of students to different aspects of contemporary issues in microbiology, biology and medicine.

Certain MMG faculty are also members of the Emory Vaccine Center, the Center for AIDS Research, the Southeastern Research Center of Excellence in Biodefense and Emerging Infectious Diseases, or the Center of Excellence for Influenza Research Center and Surveillance.

A complete list of faculty members, with descriptions of research interests and links to publications is on our website: www.biomed.emory.edu/program_sites/mmg.

Students

The career opportunities that are now available for Ph.D.s in microbiology are substantial and the goal of the MMG faculty is to guide the students in establishing a scientific foundation so that the students can be successful life-long learners. Graduates of the MMG program pursue many different career pathways and post-graduate training opportunities or employment.

- Some students continue their basic science training by conducting postdoctoral research at universities or in government laboratories. Recent MMG graduates have undertaken postdoctoral research at Princeton University, Harvard University, Yale University, the University of Washington, Oxford University, the Centers for Disease Control and Prevention (CDC), the NIH and FDA.
- Other students continue their formal education by attending medical, law or public health schools.
- Others take up professional positions ranging from university professorships to private sector scientific work. MMG graduates are presently faculty members in Microbiology and Immunology departments at universities, staff scientists at the CDC and NIH, scientists employed by biotechnology firms and large pharmaceutical companies, practicing physicians or lawyers, or involved in scientific journalism enterprises.

Contact Information:

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About the GDBBS

Emory University is one of the major biological research and medical referral centers in the Southeast and is among the fastest growing Medical Centers in the United States. Emory is consistently ranked in the top 20 institutions nationally for NIH research support. Emory was recently named one of the 25 “New Ivies” by Newsweek, a testament to its quality and dedication to education. Emory was also ranked as having the sixth most beautiful campus in the nation by The Best Colleges.

The Graduate Division of Biological and Biomedical Sciences (gdbbs) has over 460 graduate students in nine interdisciplinary Ph.D. programs:

- Biochemistry, Cell and Developmental Biology
- Cancer Biology
- Genetics and Molecular Biology
- Immunology and Molecular Pathogenesis
- Microbiology and Molecular Genetics
- Molecular and Systems Pharmacology
- Neuroscience
- Nutrition and Health Sciences
- Population Biology, Ecology and Evolution

Over 330 world-renowned researchers mentor students admitted to these programs, giving them a unique opportunity to train with faculty at:

- the American Cancer Society
- the U.S. Centers for Disease Control and Prevention
- Emory College
- the Robert W. Woodruff Health Sciences Center
- the Rollins School of Public Health
- The Carter Center
- the Winship Cancer Institute
- the Yerkes National Primate Research Center

Financial support includes a tuition scholarship, health insurance and a competitive stipend ($26,500 for the 2011-2012 academic year). Funding is guaranteed as long as the student is making satisfactory progress toward their degree. The average time to degree is about 5.5 years. Training is interdisciplinary and students have the flexibility to perform their thesis work with GDBBS faculty outside their chosen program. Students typically perform three rotations before affiliating with a faculty member for their dissertation research.

The application deadline is December 1st for the following fall semester.