Graduate Division of Biological and Biomedical Sciences

Microbiology and Molecular Genetics

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The program in Microbiology and Molecular Genetics (MMG) provides training in the study of microorganisms and the use of microbial models to investigate basic problems in 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: bacterial genetics and physiology, microbial development, molecular biology of viruses and bacterial pathogens, mechanisms of bacterial and viral pathogenesis, molecular biology of gene regulation, antibiotic resistance, 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 development and 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.

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) 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, escape from immune systems and vaccine development.

Resources and Opportunities

The MMG program draws together resources from a number of institutions, providing students with an unparalleled range of 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 is 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.

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 5 or 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 3-4 full courses in the first year and 2-3 in year two.

In addition to these courses, in the first and second year students also participate in Colloquium in Microbiology and Introduction to Research.

Lab Rotations

The graduate experience in MMG begins with an introduction to the faculty, current students, and their research through a series of short talks, discussions and a poster session. The students then choose 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 thesis research. These rotations, which often begin in the summer prior to enrolling in the program, are usually completed in the second semester of the first year.

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 presents a research proposal of up to 5 pages to a faculty Advisory Committee whose members they select. This may be related to the thesis topic chosen by the student and 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 a Student Research Symposium, which is held twice a year. This is one of the 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 34 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, 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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MMG Faculty Profile

Richard W. Compans, Ph.D., Principal Investigator and Director of the NIH-funded Emory/UGA Influenza Pathogenesis and Immunology Research Center (IPIRC).

The goals of the Center are to determine the molecular, ecologic and/or environmental factors that influence the evolution, emergence, transmission and pathogenicity of influenza viruses, including studies on animal influenza viruses with pandemic potential, and to characterize the immune response to influenza vaccination to improve understanding of the immune correlates of protection and cross-protection.

The center includes four research projects, two pilot research projects, and two training positions. Investigators from both Emory University and the University of Georgia will direct these projects.

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.

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

- Biochemistry, Cell and Developmental 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 stipend ($24,500 for the 2009 – 2010 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 work with GDBBS faculty outside their program. Students typically perform three rotations before affiliating with a faculty member for their dissertation research.

The application deadline is January 3rd for the following fall semester.

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Requests for Additional Information:

RECRUITMENT AND ADMISSIONS

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