The Department of Molecular Microbiology and Immunology (MMI), in partnership with the faculty from the Department of Veterinary Pathobiology (VPB), offers a comprehensive graduate program, Molecular Pathogenesis and Therapeutics Graduate Program (MPT), leading to the Doctor of Philosophy (Ph.D.) degree. Strong scientific interactions among faculty from these and other academic units across campus illustrate the importance of scientific collaborations not only in meeting the research challenges in microbiology and immunology, but also in providing a strong academic environment for the training of the next generation of scientists and educators in these disciplines. The faculty in this training program have achieved international recognition for their scientific contributions and expertise, with their research efforts published in top tier research journals and funded through stringent peer-reviewed federal grants. Many of these investigators serve on scientific review committees for these funding agencies.

This program provides individualized training that is strongly oriented toward basic research in molecular and cellular biology, microbiology, virology, pathogenesis, immunology and host-parasite interactions. MMI offers under the program name of Molecular Pathogenesis and Therapeutics Graduate Program (MPT):

- PhD in Microbiology (Medicine)
- Cooperative Degrees: MD/PhD in Microbiology (Medicine)

**Faculty**

**Molecular Microbiology and Immunology**

**Professor** D.H. Burke, D. Duan, M.C. Johnson, M.A. McIntosh, D.J. Pintel, X. Wan, H. Zaghouani

**Associate Professor** M. R. Baldwin, J.F. Cannon, M.A. Daniels, A.G. Schrum, E. Teixeiro-Pernas

**Assistant Professor** H. Guo, M.J. Lange

**Professor Emerita/Emeritus** K.L. Bennett, H. Braley-Mullen, R.A. Finkelstein, D.R. Lee, M.L. Misfeldt, K.S. Wise

**Research Associate Professor** K. Singh, Y. Lai
**Research Assistant Professor** D. Chance
**Associate Teaching Professor** J.L. Furrer
**Adjunct Professor** S. Sarafianos

**Veterinary Pathobiology**

**Associate Professor** J. Amos-Landgraf, A. Franz, J. Skyberg
**Adjunct Professor** G.C. Stewart

**Jointly appointed to Molecular Microbiology and Immunology**

**Professor** C.R. Brown, M.J. Calcutt, D. Cornelison, C. L. Franklin, C.L. Lorson, W. Ma, H. Shirwan, E. Shirwan Yolcu
**Associate Professor** P.B. Brown, D. Gil Pagés, B. Hahn, S.C. McKarns
**Assistant Professor** G. Li

- Graduate Faculty Member - membership is required to teach graduate-level courses, chair master's thesis committees, and serve on doctoral examination and dissertation committees.
- Doctoral Faculty Member - membership is required to chair doctoral examination or dissertation committees. Graduate faculty membership is a prerequisite for Doctoral faculty membership.

**Undergraduate**

For information on the undergraduate degree in Microbiology offered through the university’s College of Veterinary Medicine, refer to the BS in Microbiology (http://catalog.missouri.edu/undergraduategraduate/collegeofveterinarymedicine/microbiology/bs-microbiology/).

**Graduate**

- MS in Microbiology (http://catalog.missouri.edu/undergraduategraduate/interdisciplinaryacademicprograms/molecularmicrobiologyandimmunology/ms-microbiology/)
- PhD in Microbiology (http://catalog.missouri.edu/undergraduategraduate/interdisciplinaryacademicprograms/molecularmicrobiologyandimmunology/phd-microbiology-med/)

School of Medicine
M616 Medical Sciences Building
(573) 882-8152
https://medicine.missouri.edu/departments/molecular-microbiology-immunology/graduate-program/
opportunities in the laboratories of established scientists with diverse research interests.

**Faculty Research**

The program is equipped to support a wide range of research activities at the cutting edge of our diverse science. Faculty research activities focus on key problems in pathogenic microbiology, immunology, molecular biology, genetics, therapeutic, and virology.

**Research Facilities and Resources**

The research environment at MU with Colleges of Medicine, Veterinary Medicine, Agriculture, Engineering, and Arts and Sciences on one comprehensive campus fosters the development of interdisciplinary scientific interactions that enhance both research and training opportunities for faculty and students alike. The Bond Life Sciences Center represents such an interdisciplinary research enterprise and houses investigators from multiple colleges and departments, including MMI and VPB. Critical to the Molecular Pathogenesis and Therapeutics Graduate Program interests in infectious diseases, pathogenesis, therapeutics, and immunity research, the recent construction of an NIH-funded Laboratory for Infectious Disease Research provides modern BSL3/ABSL3 containment research space and animal holding facilities for the investigation of highly infectious organisms and human select agents. This resource, and the Molecular Pathogenesis and Therapeutics Graduate Program's partnership with the Midwest Regional Center for Excellence in Biodfense and Emerging Infectious Disease Research, centered at Washington University in St. Louis, position MU in the national network of infectious disease research and training efforts. Please visit the MMI Web site (https://medicine.missouri.edu/departments/molecular-microbiology-immunology/graduate-program/) for additional information on MMI's access to state of the art facilities.

**Career Opportunities**

Graduates completing this training are prepared to pursue challenging and rewarding professional careers that involve research and teaching at supervisory levels in both the academic and private sectors.

**Research and Teaching Assistantships**

Students in the doctoral program are awarded research assistantships. Research assistants work with faculty members to obtain practical experience in carrying out a research project through the collection of research data and writing research reports. All students in the graduate program are required to participate as teaching assistants for two semesters during their studies.

If you are interested in a the Molecular Pathogenesis Graduate Program, please see the 'Degrees, Majors (Degree Programs), Emphasis Areas, Minors and Certificate (http://catalog.missouri.edu/degreesanddegreeprograms/)’ page for the Ph.D. in Microbiology.

**MICROB 2800: Microbiology for Nursing and Health Professions**

This course will provide basic principles for understanding microbial growth, function, and control. This includes a survey of microbial cellular structure/functions, immunology concepts, epidemiology, specimen handling, and causes of microbial disease (bacterial, viral, and parasitic). Material is presented in lecture and corresponding laboratory exercises that will allow students to explore the microbial world around them.

**Prerequisites:**

- The overall content is 'restricted to Freshman and sophomore Nursing and Health Related Professional students only'.
- Other inquires contact department

**MICROB 3200: Medical Microbiology and Immunology**

Focus on medically important viruses, bacteria, fungi and parasites with emphasis on their disease causing potential and mechanisms. Introduction to cells and molecules of the immune system with emphasis on their role in fighting infectious diseases. Discussion of treatment and prevention strategies. Lecture material will be reinforced with laboratory demonstrations and hands-on exercises. The course is intended for preprofessional students.

**Credit Hours:** 4

**MICROB 3800: Case-Based Microbiology: Assembling Systemic Health Connections**

Detailed infectious diseases across organ systems. The biological characteristics and pathologic mechanisms of infectious diseases caused by bacteria, viruses, fungi and parasites are explored in a case-based learning. Student-driven learning objectives for each case (to include microbiology, anatomy, physiology, pharmacology, technology and clinical LO's each case) help groups connect scientific information across disciplines.

**Credit Hours:** 3

**Prerequisites:** Instructor's consent

**Recommended:** MICROB 2800 or MICROB 3200, MPP 3202, and PTH_AS 2201

**MICROB 4300: Bacterial Pathogenesis**

(cross-leveled with MICROB 7404). This team taught course covers the biology and virulence mechanisms of bacterial pathogens, with emphasis on those causing human and zoonotic diseases. Topics covered include bacterial structure, genetics, physiology, and metabolism; antibiotic resistance; host-pathogen interactions; microbiomes and emerging pathogens.

**Credit Hours:** 2

**Prerequisites:** MICROB 3200 or equivalent. Consent from Course Director is required to insure academic readiness

**MICROB 4303: Fundamental Virology**

(cross-leveled with MICROB 7303). Classification of viruses, life cycles, genome organization and expression, host-virus interactions, oncogenes and cellular transformation, viral pathogenesis, viral gene therapy approaches, strategies for anti viral therapy.

**Credit Hours:** 2

**Prerequisites:** undergraduates require instructor's consent. This course will include evaluation of current literature and require paper presentations

**MICROB 4304: Immunology**

(cross-leveled with MICROB 7304). This is a comprehensive team-taught, basic immunology course covering cells and organs of the immune system, lymphocyte development, innate immunity, antibody production, antibody-antigen presentation, CD4+ and CD8+ T lymphocyte responses, cytokines, autoimmunity and immunodeficiency among other
immunologically relevant topics. Completion of a biochemistry, genetics, or molecular biology course would be helpful. Graded on A-F basis only.

**Credit Hours:** 3
**Recommended:** MICROB 3200 or BIOCHM 4270

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**MICROB 7101: Structure and Synthesis of Macro Molecules**

This multiple-instructor course is designed to provide students with a detailed understanding of the structure, function, and biophysical properties of bio-molecules. Principles and techniques of molecular biology related to the study of recombinant DNA and genetic analysis, protein structure, function and basic immunological principles will be covered. Admission is dependent on approval by course director.

**Credit Hours:** 2
**Prerequisites:** consent required

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**MICROB 7303: Fundamental Virology**

(cross-leveled with MICROB 4303). Classification of viruses, life cycles, genome organization and expression, host-virus interactions, oncogenes and cellular transformation, viral pathogenesis, viral gene therapy approaches, strategies for anti viral therapy.

**Credit Hours:** 2
**Prerequisites:** Undergraduates require instructor's consent. This course will include evaluation of current literature and require paper presentations

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**MICROB 7304: Immunology**

(cross-leveled with MICROB 4304). Covers innate immunity, antibodies, antigens, MHC, antigen presentation, lymphocyte development, antigen specific receptors, lymphocyte activation and differentiation, immune effector mechanisms, hypersensitivities, tolerance, autoimmunity, immunodeiciencies. Graded on A-F basis only.

**Credit Hours:** 3
**Recommended:** MICROB 3200 or BIOCHM 4270 or BIOCHM 4272 or instructor's consent

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**MICROB 7404: Foundations in Bacteriology and Pathogenesis**

(cross-leveled with MICROB 4300). This team taught course covers the biology and virulence mechanisms of bacterial pathogens, with emphasis on those causing human and zoonotic disease. Topics covered include bacterial structure, genetics, physiology, and metabolism; antibiotic resistance; host-pathogen interactions; microbiomes and emerging pathogens.

**Credit Hours:** 3

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**MICROB 8050: Graduate Student Survival Skills**

This course is an introduction to inform new graduate students about the Microbiology program and provide them with the knowledge to access resources and information needed for a successful transition into their course work and research. The course will also focus on guidelines in selecting mentors and their relationships, time management, good notebook practices, presentation and posters, comprehensive exams, and computer skills needed. Graded on A-F basis only.

**Credit Hour:** 1

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**MICROB 9001: Topics in Microbiology**

Current topics, highly specialized topics taught infrequently, or courses taught by visiting professors.

**Credit Hour:** 1-99
**Prerequisites:** instructor's consent

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**MICROB 9005: Problems in Microbiology**

Students assigned individual problems in microbiology for library or lab investigation. Graded on A-F basis only.

**Credit Hour:** 1-99
**Prerequisites:** instructor's consent

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**MICROB 9087: Seminar in Microbiology**

Presentation and critical discussion of student and faculty research, current literature, and guest lectures on subjects in various areas of microbiology. Graded on A-F basis only.

**Credit Hour:** 1

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**MICROB 9090: Research in Microbiology**

Original investigations in various areas of microbiology related to bacteria, fungi, rickettsia, viruses, and animal parasites, or immunology relating to antigens and antibodies of infectious and noninfectious nature designed for graduate thesis research. Graded on a S/U basis only.

**Credit Hour:** 1-99
**Prerequisites:** instructor's consent

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**MICROB 9403: Advanced Medical Microbiology**

Similar to MICROB 4300 but treats medical microbiology and immunology in a more advanced manner. Methods of preparation and instruction stressed. Graded on A-F basis only.

**Credit Hours:** 2
**Prerequisites:** instructor's consent

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**MICROB 9404: Advanced Bacterial Pathogenesis**

Literature based lectures and discussions covering current issues in bacterial pathogenesis. Focus is on understanding host-pathogen interactions that lead to disease. Topics include bacterial toxins and secreted virulence factors, intracellular bacterial growth and survival, host cell death and inflammatory pathways. Course will focus on a few model pathogens and discuss the molecular mechanisms of the pathogen and host that contribute to virulence. Graded on A-F basis only.

**Credit Hours:** 4
**Prerequisites:** MICROB 7404
**Recommended:** MICROB 4304 or MICROB 7304

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**MICROB 9407: Advanced Immunology**

Literature based lectures and discussions covering current issues in molecular and cellular immunology. Topics include innate immunity; lymphocyte development; inflammation; tolerance, infection, and autoimmunity; mucosal immunity; asthma and allergy and tumor immunology.

**Credit Hours:** 4
**Prerequisites:** MICROB 4304 or MICROB 7304, or instructor's consent

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MICROB 9432: Molecular Biology II
(same as BIOCHM 9432 and BIO_SC 9432). Detailed experimental analysis of eukaryotic cellular and molecular biology relevant to cellular and viral gene expression, post-transcriptional and post-translational modifications and genome replication. Models for developmental genetic analysis and genetic determinants controlling developmental processes utilizing the current literature will be examined.

Credit Hours: 4
Prerequisites: MICROB 9430

MICROB 9449: Infection and Immunity
Writing, discussion, literature driven course, covering topics that focus on the interface between infectious diseases, cancer and the immune system. May be repeated for credit. Graded A-F basis only.

Credit Hours: 4
Prerequisites: 2nd year Graduate student with bacteriology, virology, microbial pathogenesis and immunology background only. 1st year graduate students require instructor approval