Department of Molecular Microbiology

The Department of Molecular Microbiology teaches introductory courses in microbiology and pathogenic microorganisms for first-year medical students and graduate students. In conjunction with the Division of Biology & Biomedical Sciences (DBBS) (http://www.dbbs.wustl.edu/Pages) program in Molecular Microbiology and Microbial Pathogenesis (http://www.dbbs.wustl.edu/divprograms/micro/Pages/default.aspx), the department also offers a number of advanced courses, primarily designed for graduate students, but open to medical students. Advanced elective research activities are offered by faculty in the department.

Website: http://www.microbiology.wustl.edu

Degrees & Requirements

More information about Department of Molecular Microbiology degrees (http://bulletin.wustl.edu/grad/gsas/dbbs) and requirements can be found in the Graduate School Bulletin.

Research

M30 MolMB 900
Cross-listed with L41 Biol 590

Stephen M. Beverley, PhD
McDonnell Pediatric Research Building, 9th Floor
Phone: 314-747-2630
Molecular genetics of protozoan parasites and tropical diseases; biosynthesis of the parasite surface, genomics, virulence and drug action or resistance.

Michael Caparon, PhD
McDonnell Pediatric Research Building, 10th Floor
Phone: 314-362-1485
Molecular genetics and pathogenicity of the streptococci and other pathogenic gram positive bacteria.

Tamara L. Doering, MD, PhD
McDonnell Pediatric Research Building, 10th Floor
Phone: 314-747-5597
The Doering lab studies the opportunistic fungal pathogen, Cryptococcus neoformans, with the dual motivations of elucidating basic biology and identifying potential drug targets. Projects include studies of the synthesis and regulation of the main cryptococcal virulence factor, its polysaccharide capsule, and investigation of host fungal interactions. Current approaches include those of biochemistry, cell and molecular biology, and genetics; studies also include high-throughput analysis of host-pathogen interactions and computational approaches to reconstructing the capsule regulatory network.

Daniel Goldberg, MD, PhD
McDonnell Pediatric Research Building, 9th Floor
Phone: 314-362-1514
Biochemistry of malaria.

Henry Huang, PhD
McDonnell Pediatric Research Building, 8th Floor
Phone: 314-362-2755

Scott J. Hultgren, PhD
McDonnell Pediatric Research Building, 10th Floor
Phone: 314-362-6772
Pathogenic mechanisms and disease outcomes in the urinary tract. Work in the Hultgren lab blends multiple scientific disciplines to elucidate bacterial and host mechanisms that determine the onset, course and outcome of interactions between a host mucosal surface and bacterial pathogens. Using genetics, genomics, biochemistry, structural biology, high-resolution imaging, animal models, clinical studies and combinatorial chemistry, we have illuminated new ways in which intracellular lifestyles and community behavior play critical roles in the pathogenesis of urinary tract infection. We have uncovered new principles of adhesive pili biogenesis in Gram Negative bacteria by the chaperone/usher pathway; delineating the fine molecular details of a donor strand complementation and exchange mechanism by which the energy of final subunit folding is used to complete assembly and extrusion of pili across the outer membrane. We revealed how UPEC use type 1 pili to invade and establish biofilm-like intracellular bacterial communities within bladder cells as part of a mechanism that subverts host defenses and how quiescent intracellular reservoirs can seed recurrent infections. We have uncovered complex networks that govern mucosal epithelial response to infection, which we have shown determines disease outcome. Further, we have made seminal contributions to our understanding of the pathogenesis and response to other uropathogens, polymicrobial infections and catheter-associated UTIs and to the mechanisms by which bacteria form a directed amyloid fiber, curli, which is important in biofilm formation. Together, this work is changing the way UTIs are evaluated, reshaping models of bacterial infections in general and spawning new technologies to design novel vaccines and anti-microbial therapeutics to diagnose, treat and/or prevent UTIs and their sequelae.

Amanda Lewis, PhD
BJC Institute of Health, 10th Floor
Phone: 314-286-0016
Polymicrobial Infection and Women's Health. Our lab is using biochemical, cellular and animal models to study infectious processes of the female urogenital tract that involve multiple bacterial species. For example, bacterial vaginosis (BV) is
a polymicrobial imbalance of the vaginal flora characterized by reductions in beneficial lactobacilli and an overgrowth of mostly Gram negative bacteria. BV is the most common of all vaginal infections and is associated with increased risks of adverse pregnancy outcomes and greater susceptibility to sexually transmitted infections. We are collaborating with clinical investigators to define molecular and biochemical processes of BV and identify patient groups most at risk for adverse events. Another active area of study in the lab involves polymicrobial urinary tract infection (UTI). We have developed a mouse model of polymicrobial UTI and are currently defining novel processes, bacterial factors and the impact of host that contribute to susceptibility.

**Jennifer Lodge, PhD**  
McDonnell Pediatric Research Building, 10210A  
Phone: 314-286-2125  
Antifungal therapy and vaccine development against a fungal pathogen: Cryptococcus neoformans is a significant fungal pathogen, particularly in immunocompromised patients, that causes pulmonary infections and meningoencephalitis. It has been estimated that over 1,000,000 new cases of Cryptococcus occur, with over 650,000 deaths per year, and the majority of these cases are in Africa. Our lab focuses on understanding the structure and the synthesis of the fungal cell wall. We are working on it as a target for antifungal therapies and for vaccine development.

**David Sibley, PhD**  
McDonnell Pediatric Research Building, 9th Floor  
Phone: 314-362-8873  
We study the intracellular survival mechanisms of protozoan parasites, focusing on the model parasite Toxoplasma gondii. Current approaches include high-resolution microscopy, genetic mapping of virulence traits, comparative genomic analyses and development of animal models for studying pathogenesis and resistance.

**Christina L. Stallings, PhD**  
McDonnell Pediatric Research Building, 8th Floor  
Phone: 314-286-0276  
Molecular Pathogenesis of Mycobacteria. Our laboratory integrates in vivo disease modeling, molecular biology and biochemistry to provide answers to the fundamental biological questions regarding molecular pathogenesis and yield therapeutic strategies for treatment of mycobacterial infections.

**Niraj H. Tolia, PhD**  
McDonnell Pediatric Research Building, 8th Floor  
Phone: 314-286-0134  
Structural and Mechanistic Studies of Malaria Pathogenesis. Our lab is interested in the molecular events that occur during erythrocyte invasion by Plasmodium parasites. We use the tools of structural biology, biochemistry and biophysics to examine proteins and protein complexes associated with these events.

**Joseph P. Vogel, PhD**

McDonnell Pediatric Research Building, 10th Floor  
Phone: 314-747-1029  
Legionella pneumophila, the causative agent of Legionnaires’ pneumonia, replicates inside alveolar macrophages by preventing phagosome-lysosome fusion.

**David Wang, PhD**  
McDonnell Pediatric Research Building, 8th Floor  
Phone: 314-286-1123  
Discovery and characterization of novel viruses. We use functional genomic technologies to identify novel viruses from a variety of clinical samples from diseases of unexplained etiology. We then use epidemiologic and molecular/cellular strategies to define the relevance of newly identified viruses to human disease. A range of new viruses, including polyomaviruses, astroviruses and picornaviruses are under investigation.

**Faculty**

**Department Chair**  
Stephen M. Beverley, MD

**Program Director**  
L. David Sibley, PhD

Visit our website for more information about our faculty (http://www.microbiology.wustl.edu/faculty_research_2014.htm) and their appointments.

**A**

**Shabaana Abdul Khader, PHD**  
Associate Professor of Molecular Microbiology (primary appointment)  
Associate Professor of Pathology and Immunology  
PHD Madurai Kamaraj University 2002

**Natalia S Akopyants, MS, PHD, MS1**  
Instructor in Molecular Microbiology (primary appointment)  
MS Moscow State University 1980  
PHD Inst of BioOrg Chem-Rus A of S 1988  
MS1 Moscow State University 1981

**B**

**Wandy L. Beatty, PHD**  
Assistant Professor of Molecular Microbiology (primary appointment)  
BS Montana State University 1989  
PHD Univ of Wisconsin Madison 1994

**Stephen M Beverley, PHD**  
Marvin A Brennecke Professor of Molecular Microbiology (primary appointment)  
Head of the Department of Molecular Microbiology  
PHD University of California 1979  
BS California Institute Technolo 1973

**Tamara L. Brent, PHD, MD**
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Alumni Endowed Professor of Molecular Microbiology
BA Johns Hopkins University 1983
PHD Johns Hopkins University Medici 1991
MD Johns Hopkins University Medici 1991

C
Michael G Caparon Jr, PHD
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PHD University of Iowa 1985
BS Michigan State University 1981

D
Deborah E Dobson, PHD
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PHD University of CA Berkeley 1981
BS University of Illinois 1976
Karen W Dodson, PHD
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Mario Federico Feldman, PHD
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Vice Chancellor for Research
BS Oberlin College 1979
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O
Paul D Olivo, MD, PHD
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BA George Washington University 1972

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BS University of California 1974

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MA Columbia University 2001
MS Columbia University 2002
PHD Columbia University 2005
BS Mary Washington College 1999

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Associate Professor of Molecular Microbiology (primary appointment)
Associate Professor of Biochemistry and Molecular Biophysics
BS Imperial College 1999
PHD Watson Sch of Biological Scien 2004

V
Joseph Paul Vogel, BS2, BS1, PHD
Associate Professor of Molecular Microbiology (primary appointment)
BS2 Minnesota State University 1986
BS Minnesota State University 1986
BS1 Minnesota State University 1986
PHD Princeton University 1993
David Wang, PHD
Associate Professor of Molecular Microbiology (primary appointment)
Associate Professor of Pathology and Immunology
BS Stanford University 1992
PHD Mass Inst of Technology (MIT) 1998

Courses

M30 MolMB 511 Medical Genetics
Topics covered include population and quantitative genetics, clinical cytogenetics, biochemical genetics and metabolic defects. Lectures, clinics and small group discussions.
Prerequisites: Non-medical students must have an introductory genetics course and permission of the instructor. Non-medical students register under cross-listed number L41 Biol 550 (fall only).
Credit 34 units.

M30 MolMB 523 Immunology
The course consists of lectures, laboratory exercises and clinical correlations. It covers all aspects of the immune response — general properties of the immune system; effector molecules; cells and their function; cellular interactions; and immunological diseases. The Immunology course has a heavy component of biochemistry, genetics and cell biology. Some of the basic concepts from these fields should be reviewed during the course. Two laboratory exercises (not required for non-medical students) are based on the POPS (Patient-Oriented Problem-Solving System in Immunology) which consists of workbooks that focus on a specific clinical problem. Students will also meet in small groups (10-15 students) with clinicians to discuss a variety of clinical cases that relate to the course material. The second edition of *Cellular and Molecular Immunology* by Abbas, Lichtman and Pober is used for the lecture part of the course and *Case Studies in Immunology* by Rosen and Geha will be used for the clinically oriented small group discussion. Handouts will be given for selected lectures to either clarify or expand on the information in the textbook. The exam consists of 50 multiple-choice questions on the topics described in the lectures and in the laboratory exercises. Prerequisite: medical student status or graduate student status, some background in biochemistry and genetics helpful. Non-medical students register under cross-listed course L41 Biol 5171 with permission of the course director only (spring only).
Credit 37 units.

M30 MolMB 526 Microbes and Pathogenesis
The course will familiarize the student with the diversity of pathogenic microbes and the different ways they can survive and cause disease. It is a concepts-based course, emphasizing the general principles of microbial pathogenesis. Selected pathogenic microbes are used as models to describe pathogen-host interactions in molecular detail. The laboratory will introduce the student to the principles and the basic techniques of diagnostic bacteriology.
Credit 30 units.

M30 MolMB 900 Research Elective - Molecular Microbiology
Research opportunities may be available. If interested, please contact the Department of Molecular Microbiology.