

PROMOTION RECOMMENDATION
UNIVERSITY OF MICHIGAN
MEDICAL SCHOOL
DEPARTMENT OF MICROBIOLOGY AND IMMUNOLOGY
COLLEGE OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Patrick D. Schloss, Ph.D. assistant professor of microbiology and immunology, Department of Microbiology and Immunology, Medical School, and assistant professor of civil and environmental engineering, Department of Civil and Environmental Engineering, College of Engineering, is recommended for promotion to associate professor of microbiology and immunology, with tenure, Department of Microbiology and Immunology, Medical School, and associate professor of civil and environmental engineering, without tenure, Department of Civil and Environmental Engineering, College of Engineering.

Academic Degrees:

Ph.D.	2002	Cornell University
B.S.	1997	Cornell University

Professional Record:

2012-present	Assistant Professor of Civil and Environmental Engineering, University of Michigan
2009-present	Assistant Professor of Microbiology and Immunology, University of Michigan
2006-2009	Assistant Professor of Microbiology, University of Massachusetts

Summary of Evaluation:

Teaching: Since arriving at the University of Michigan in 2009, Dr. Schloss has contributed greatly to educational advancements in the basic sciences in impressive and innovative ways. In Winter term of 2011, he developed a new course for the department, MICRBIOL 430: Microbial Symbiosis. This initial offering had 12 students, the course for Winter 2012 has nearly 30 students. Developing this course *de novo* required a significant effort as all educators appreciate. Dr. Schloss has taught this course twice now and the student evaluations were all outstanding and above the course average. The students enjoyed the topic and the material and felt Dr. Schloss was an outstanding teacher. The course topic filled a void in the curriculum and demonstrated further our commitment to the undergraduate microbiology major at Michigan. To fill another void, Dr. Schloss has developed and is teaching yet another new course, MICROBIOL 612, Microbial Informatics. This course is designed to train graduate students to handle the avalanche of data currently being generated with high throughput sequencing technology and other techniques that produce high volumes of data. This course is on the cutting edge for the graduate program. Building on his expertise in the field of computational microbial ecology, Dr. Schloss has developed a 3-day workshop, which he uses to teach others how to implement the latest methods in 16S rRNA gene sequence analysis. Since joining the University of Michigan, Dr. Schloss has taught 50 university researchers ranging from undergraduates to faculty through two offerings (Spring 2010 and Winter 2012). In addition, he has taught this workshop by request numerous times around the world, further emphasizing his reputation. The workshop combines an interactive lecture-based approach with a hands-on tutorial

where the participants interact with each other and with him to learn the material. His evaluations were outstanding, stating the workshop and labs were very helpful and provided useful information. This course was open to faculty, students and staff all over our campus and has been well attended at each offering. In addition to classroom teaching, Dr. Schloss has a cohesive and energetic research group in which he is training students at all stages of their careers. In 2011, his lab consisted of two Microbiology and Immunology graduate students, two research assistants, and three rotation students. He also served on dissertation committees for three students and on one post-doctoral advisory committee.

Research: Dr. Schloss is the epitome of an interdisciplinary scientist, bridging areas of computer science, microbiology, statistics and bioinformatics. This broad approach to science is a major component of President Coleman's vision in setting up the Junior Faculty Initiative that brought Dr. Schloss to Michigan. His research is in a fascinating area of interdisciplinary science, currently recognized as of great importance to human health. Dr. Schloss' research group is interested in understanding how the stability of microbial communities relates to their function. Intrigued by this question as a graduate student at Cornell University, he sought to investigate the relationship using compost reactors to study waste processing. As a post-doc at the University of Wisconsin, Dr. Schloss realized that to fully capture the genetic diversity of microbial communities, he would have to use his engineering background to develop computational tools to describe these microbial communities based on vast DNA sequence data being generated by next generation sequencing platforms. The development of these tools has made Dr. Schloss a highly cited leader in the field of computational microbial ecology. It should be stressed that Dr. Schloss is heavily involved in the development of these computation tools because they are necessary to address the important biological questions being posed in his lab. Since joining the faculty of the University of Michigan, Dr. Schloss has continued to develop these tools and has applied them to study the communities that reside in the murine and human gut. His group is unique in the great breadth they apply to their research questions: they cherish their interdisciplinary focus and the diverse training that is required to achieve it. They are connecting the disparate fields of microbiology, genetics, immunology, cell biology, ecology, systems biology, and bioinformatics, to make novel discoveries regarding the role of the microbiome in protecting against pathogen colonization and increased inflammatory states that can exacerbate tumorigenesis in the colon. There are two main areas to which he focuses his groups' efforts.

Dr. Schloss' research group is studying the mechanisms by which *Clostridium difficile* and *Bacteroides fragilis* colonize the gut community following disturbances induced by antibiotics and how the microbiome resists their colonization. Early indications suggest that the pathogens are only able to colonize when organisms from the same niche are depleted from the community. Such results are intriguing because they suggest that other pathogens that can colonize without an antibiotic disturbance are filling a niche that is not being filled by a member of the normal microbiome. These studies in mice are complemented by studies using clinical samples from the University of Michigan Hospital where they are able to link a patient's antibiotic history with colonization. Both the murine and human studies of *C. difficile* involve a large team of investigators with expertise in infectious diseases, microbiology, epidemiology and immunology. Dr. Schloss is part of the executive committee that meets every two weeks to oversee this interdisciplinary center.

Dr. Schloss' research group is also dissecting the complex network of genetics, inflammation, and cell biology that leads to the formation of colon cancer. Their hypothesis is that the microbiome is the mediator of all of these processes and plays a role in stalling or accelerating tumorigenesis. Using mouse models they see clear shifts in the microbial community that are synchronized with the

development of tumors. Furthermore, they can colonize germ free mice with the tumorigenic microbiome and see increased tumor loads compared to those colonized with a healthy microbiome. In parallel to the mouse studies, they are also characterizing the differences between healthy patients and those diagnosed with colorectal cancer. To his credit, Dr. Schloss has more than 35 publications, exemplifying the spirit of team science that is highly recognized today, particularly at the National Institutes of Health. His work is of high impact with his publications being cited over 3600 times (*h*-index = 22). Indeed, his work is cited globally more than twice every day. In addition, he is currently the principal investigator (or co-investigator) on seven grant awards, yielding a percent effort total of >90%, happily approaching the maximum percent effort allowable. This further indicates the trajectory of his program.

Recent and Significant Publications:

Schloss PD, Westcott SL, Ryabin T, Hall JR, Hartman M, Hollister EB, Lesniewski RA, Oakley BB, Parks DH, Robinson CJ, Sahl JW, Stres B, Thallinger GG, Van Horn DJ, and Weber CF: Introducing mothur: Open source, platform-independent, community-supported software for describing and comparing microbial communities. *Appl Environ Microbiol* 75:7537-7541, 2009.

Schloss PD & Westcott SL: Assessing and improving methods used in OTU-based approaches for 16S rRNA gene sequence analysis. *Appl Environ Microbiol* 77:3219-3226, 2011.

Schloss PD, Gevers D, Westcott SL: Reducing the effects of PCR amplification and sequencing artifacts on 16S rRNA-based studies. *PLoS ONE*. 6:e27310, 2011.

The Human Microbiome Project Consortium: Structure, function and diversity of the healthy human microbiome. *Nature* 486:207-213,2012.

Schloss PD, Schubert AM, Zackular JP, Iverson KD, Young VB, and Petrosino JF: Stabilization of the murine gut microbiome following weaning. *Gut Microbe* 3:383-393, 2012.

Service: Dr. Schloss has contributed an admirable level of service as a young investigator. At the international level, he has served on the editorial boards of one journal, *Applied & Environmental Microbiology*, and serves as an *ad hoc* reviewer for more than 25 other journals. He is a member of two scientific societies – the American Society for Microbiology and the International Society for Microbial Ecology. Locally, at the University, he is currently a member of the search committee seeking to hire at least six new faculty members for the Department of Computational Medicine and Bioinformatics within the Medical School. In the Department of Microbiology and Immunology, he is serving on the Graduate Studies Committee and as director of our newly-developed Master's program.

External Reviewer:

Reviewer A: "...Pat Schloss is a leading bioinformatician in the field of microbial ecology with special application to the human microbiome. His development of freely available (open-access) software is transforming his field."

Reviewer B: "...Pat has been a leader in developing and vetting methods for sequence analysis in the Human Microbiome Project....He is highly respected by his peers and all of us acknowledge the rigor, creativity and thoughtfulness of his science."

Reviewer C: "In recent years Patrick has moved much more towards large community projects in microbial ecology – of many habitats including the human microbiome. He has become a highly sought after collaborator and key player on these various projects and the results of which are clearly reflected in his impressive publication record."


Reviewer D: "He has achieved international stature in the field of microbial ecology as demonstrated by his many invited lectures at high profile scientific conferences, his activities as reviewer for numerous scientific journals, and his service on review panels for NIH, NSF, and USDA."

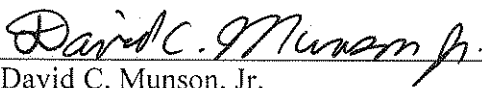
Reviewer E: "Next-generation DNA sequencing technologies have revolutionized the study of complex bacterial communities by enabling the study of species directly, without the need for cultivation. This breakthrough has lead [sic] to an international effort to study the human microbiota in health and disease, and Dr. Schloss has been one of the pioneers in moving this field of research forward. It is no exaggeration to state that his methods for comparative analysis of complex bacterial ecosystems have been game-changing."

Reviewer F: "He has clearly made the transition to an independent scientific career, publishing as senior author of important manuscripts, independent grant support and recognition by peers..."

Summary of Recommendation:

Dr. Schloss is an outstanding and internationally recognized investigator in microbial ecology microbiome research. He has demonstrated excellence in computational biology with his work currently being cited at a high rate, in teaching with the development of two new courses, and mentoring as well as in service in the Department, the University, and the research community. We strongly recommend Patrick D. Schloss, Ph.D. for promotion to associate professor of microbiology and immunology, with tenure, Department of Microbiology and Immunology, Medical School, and associate professor of civil and environmental engineering, without tenure, Department of Civil and Environmental Engineering, College of Engineering.


James D. Woolliscroft, M.D.
Dean
Lyle C. Roll Professor of Medicine


David C. Munson, Jr.
Robert J. Vlasic Dean of Engineering
College of Engineering

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