

PROMOTION RECOMMENDATION  
THE UNIVERSITY OF MICHIGAN  
MEDICAL SCHOOL  
DEPARTMENT OF MICROBIOLOGY AND IMMUNOLOGY

Eric C. Martens, Ph.D., assistant professor of microbiology and immunology, Medical School, is recommended for promotion to associate professor of microbiology and immunology, with tenure, Department of Microbiology and Immunology, Medical School.

Academic Degrees:

Ph.D.	2005	University of Wisconsin, Madison
B.A.	1997	Washington University, St. Louis

Professional Record

2009-present	Assistant Professor of Microbiology and Immunology, University of Michigan
2009-2009	Instructor, Department of Pathology, Washington University School of Medicine

Summary of Evaluation:

Teaching: Dr. Martens is an energetic and effective teacher and mentor at the undergraduate, graduate, and post-graduate levels. He developed and continues to teach Microbiology 430, a course that examines microbial symbiosis, particularly with reference to human physiology and disease. Dr. Martens has directed and co-taught this course for five years, and it is well-received by the students. His teaching evaluations are routinely positive, and many written comments are enthusiastic (e.g., “great prof!,” “course is great and I don’t think he can improve it”). In his laboratory, Dr. Martens has mentored eight trainees, including one undergraduate, one master’s student, three Ph.D. students, and three post-doctoral researchers. Three students including one Ph.D. student have completed their training in the Martens laboratory and moved on to further training in Ph.D. or M.D. programs or at a post-doctoral research position. Two post-doctoral fellows whom Dr. Martens trained are now in tenure-track faculty positions. Dr. Martens is greatly appreciated by his trainees. In addition to dissertation committees for his own Ph.D. students, he has served on seven dissertation committees since 2009. Since taking on the role of chair of graduate studies for the Microbiology and Immunology Program in 2015, Dr. Martens has been heavily involved in advising graduate students, especially on the qualifying exam process. From 2010 to the present, Dr. Martens has organized the Bacterial Pathogenesis Journal Club, which meets every other week during the academic year and is presented by a different department trainee each week. Altogether, it is clear that Dr. Martens’ commitment to the educational mission of the Medical School is exemplary.

Research: Dr. Martens’ research record is exceptional. As a post-doctoral fellow (and then instructor) at Washington University, Dr. Martens conducted systematic functional genomic and genetic analyses of the genes used by *Bacteroidetes*, a predominant member of gut symbiotic

bacteria, to degrade various complex carbohydrates (glycans or polysaccharides) of host and dietary origins. These studies served as a basis for his independent research program at the University of Michigan. Dr. Martens was recruited to Michigan in 2009 as part of the Biological Sciences Scholars Program, a university-wide program designed to recruit exceptional junior investigators. He has easily surpassed expectations in that regard. Since his appointment as an assistant professor in the Department of Microbiology and Immunology, Dr. Martens' laboratory has published 25 peer-reviewed publications, including three invited reviews since 2009. Dr. Martens is the single corresponding author on five of these and co-corresponding author on seven more. His research has been cited over 2000 times, and his *h*-index is 20. His research program has been well funded from the beginning, and he is currently a PI for one NIH R01 grant and a co-investigator for several NIH and foundation grants. Naturally, Dr. Martens has developed an international reputation for his studies on the roles played by human intestinal symbiotic bacteria in digestion of glycans and their implications in human health and diseases. He has been invited to speak on 24 occasions in the U.S. and other countries, and he has been invited to participate in editorial boards and study sections both here and abroad. He has not only established a highly successful laboratory, but also contributed importantly to the research efforts of many collaborators at the University of Michigan and elsewhere.

The intestinal microbes that inhabit the normal human intestine (the microbiota) are considered to play critical roles in many aspects of human physiology, health and diseases, and understanding of these roles is the goal of national (NIH) and local (UM Medical School FastForward Initiative) efforts. The overall goal of Dr. Martens' research program has been to understand how the hundreds of species of symbiotic bacteria in our gut influence our health by metabolizing complex glycans and other nutrients, and to use this information to promote health or treat disease. To this end, Dr. Martens' research has determined the molecular mechanisms whereby a predominant human gut bacterial phylum, the Bacteroidetes, metabolize complex glycans. These bacteria have permuted and diversified a series of multi-protein cell envelope systems that allow them to specifically bind and degrade nearly all of the complex glycan classes found in plant and animal cells. These symbionts degrade complex carbohydrates that cannot otherwise be utilized by human cells into simple sugars that can be metabolized by humans. Thus, these systems represent a way in which the human gut microbiota makes contributions to our health. The Martens laboratory has been at the forefront of studies on the substrate range, regulation and specificity of select glycan-degrading systems that target complex carbohydrates of either nutritional or industrial value. For example, Dr. Martens' group identified multiple starch binding modules in a glycan-degrading system, determined the structures of the modules, and elucidated novel functions for individual components of the system in either initial nutrient sensing or subsequent digestion. These findings have broken the ground for systematic analyses of how metabolism mediated by these bacterial mechanisms is regulated in response to a wide variety of food-derived carbohydrates.

Dr. Martens is a superb example of an interdisciplinary scientist. His research is not limited to biochemistry and genetics of glycan-binding systems. Via comparative genomic approaches, the Martens laboratory has made major contributions to understanding of how the bacterial glycan-degrading systems have evolved. Furthermore, using metagenomic analysis and gnotobiotic mice, Dr. Martens' group, along with his international collaborators, revealed that the metabolism of even highly abundant components of dietary fiber such as those from fruits and

vegetables may be mediated by niche species of Bacteroidetes. In another international collaboration, Dr. Martens' group discovered that a cohort of highly successful members of the microbiota has evolved to consume difficult-to-breakdown carbohydrates derived from cell walls of yeasts, which have been in the human diet for >7000 years, thereby revealing the impact on the structure of the human microbiota made by the historical domestication of yeast and other dietary fungi. These discoveries have immediate fundamental and practical implications for gut symbiont population ecology in the context of human diet, nutrition and health.

Finally, using his knowledge of how several prominent gut bacteria degrade the chemically diverse sulfated glycans in the colonic mucosa, Dr. Martens recently discovered a mechanism by which a specific commensal bacterium can predispose mice to ulcerative colitis. This finding has opened new doors to screen candidate drugs to block this pathway and possibly to treat disease in humans. In an ongoing collaboration with groups at Washington University (different from the lab in which he had his post-doctoral training), Dr. Martens' group is revealing the details of the mechanism by which some gut bacteria, while commensal, induce diseases in genetically susceptible human hosts. The strength of Dr. Martens' research program is evidenced by the quantity and quality of his publications, the external funding support it has received, and the many investigators who seek his expertise in collaborations.

#### Recent and Significant Publications:

Cameron EA, Maynard MA, Smith CJ, Smith TJ, Koropatkin NM, Martens EC: Multidomain Carbohydrate-binding Proteins Involved in *Bacteroides thetaiotaomicron* Starch Metabolism. *Journal of Biological Chemistry* 287:34614–34625, 2012.

Cameron EA, Kwiatkowski KJ, Lee B-H, Hamaker BR, Koropatkin NM, Martens EC: Multifunctional nutrient-binding proteins adapt human symbiotic bacteria for glycan competition in the gut by separately promoting enhanced sensing and catalysis. *MBio* 5:e01441–14, 2014.

Rogers TE, Pudlo NA, Koropatkin NM, Bell JS, Moya Balasch M, Jasker K, Martens EC\*: Dynamic responses of *Bacteroides thetaiotaomicron* during growth on glycan mixtures. *Mol Microbiol* 88:876-890, 2013.

Larsbrink J, Rogers TE, Hemsworth GR, McKee LS, Tauzin AS, Spadiut O, Klintner S, Pudlo NA, Urs K, Koropatkin NM, Creagh AL, Haynes CA, Kelly AG, Cederholm SN, Davies GJ, Martens EC#, Brumer H: A discrete genetic locus confers xyloglucan metabolism in select human gut Bacteroidetes. *Nature* 506:498-502, 2014.

Cuskin F, Lowe EC, Temple MJ, Zhu Y, Cameron EA, Pudlo NA, Porter NT, Urs K, Thompson AJ, Cartmell A, Rogowski A, Hamilton BS, Chen R, Tolbert TJ, Piens K, Bracke D, Vervecken W, Hakki Z, Speciale G, Muñoz-Munoz JL, Day A, Peña MJ, McLean R, Suits MD, Boraston AB, Atherly T, Ziemer CJ, Williams SJ, Davies GJ, Abbott DW, Martens EC, Gilbert HJ: Human gut Bacteroidetes can utilize yeast mannan through a selfish mechanism. *Nature* 517:165-169, 2015.

Service: Dr. Martens is an enthusiastic participant in administrative and service efforts in support of university, local, national, and international functions. At the international level, he has served on grant review panels in Britain, New Zealand, and Germany, and as guest editor for the *Journal of Molecular Biology* and the *Journal of Biomedicine and Biotechnology*. He has served as a reviewer for 39 journals, including high profile publications such as *Nature*, *Science*, *Cell Host and Microbe*, and the *Proceedings of the National Academy of Sciences*. At the national level, in addition to his journal reviewing service, he is a regular member of the Crohn's and Colitis Foundation Grants Review Committee and has served as an ad hoc member of several NIH and NSF study sections. At the university and department levels, he has served on the departmental academic promotions and awards committee and the graduate studies committee, on which he serves as chair. He has been active in organizing candidacy examinations for microbiology and immunology graduate students. In 2014, he organized the microbiology and immunology annual departmental retreat. In September 2015, he organized Cayman Chemicals and University of Michigan Microbiome Symposium, which featured several internationally renowned outside speakers and attracted approximately 250 participants university-wide as well as from other institutions.

External Reviewers:

Reviewer A: "...the work in Dr. Martens' lab on the Sus-like system is critical to our overall understanding of [the] establishment and dynamics of the human gut microbiome....A scientist [of his cohort] rising to this level of respect by his peers and experts in his area of research is really extraordinary....I look forward to the next chapter of Dr. Eric Martens' career, as he is poised to become one of the most significant scientists in his field."

Reviewer B: "This work establishes the Martens laboratory as the foremost in the world in mechanistic studies of complex carbohydrate utilization in the intestine. The associated publications are extremely high profile. I have never before seen an Assistant Professor go up for tenure with two Nature papers. In short, Dr. Martens has excelled in every aspect of scholarly endeavor."

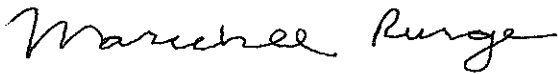
Reviewer C: "Eric's impact on the field of microbiome research is simply transformative....Eric is shaping the field through one publication after another, all of the greatest interest and highest scientific standard."

Reviewer D: "During this relatively short period, he has contributed an enormous amount to his field, conducting research that elegantly blends microbiology and biochemistry....I place Dr. Martens at the top of today's group of independent investigators [of his cohort]."

Reviewer E: "...Dr. Martens is an outstanding research scientist who has had a major impact on his field in a short period of time. Dr. Martens' work is of the highest quality and is at a level of innovation and significance that few achieve. It is a rare opportunity for me to have the opportunity to evaluate a scientist [of his cohort] who is as accomplished as Dr. Martens and whose research program still holds so much promise for new discovery."

Summary of Recommendation:

Dr. Martens is a superb scholar and researcher who, in only a few short years, has become a world leader in his field, respected and sought out by his colleagues and peers. He has made significant contributions to an important and medically relevant field of research while at the same time contributing considerably to the service and teaching missions of the University of Michigan and the many other organizations with which he works. In all areas of his professional life, Dr. Martens has exceeded the expectations of an assistant professor at the University of Michigan, and he shows great promise for continued growth as a scholar and colleague. I am pleased to recommend Eric C. Martens, Ph.D. for promotion to associate professor of microbiology and immunology, with tenure, Department of Microbiology and Immunology, Medical School.



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Marschall S. Runge, M.D., Ph.D.  
Executive Vice President for Medical Affairs  
Dean, Medical School

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