BIOGRAPHICAL SKETCH

NAME: **Roberto Kolter**

POSITION TITLE: **Professor of Microbiology, Emeritus**

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Carnegie-Mellon University, Pittsburgh, PA	B.S.	06/1975	Biology
University of California, San Diego, CA	Ph.D.	08/1979	Biology
University of California, San Diego, CA	(post-doc)	08/1980	Biology
Stanford University, Stanford, CA	(post-doc)	05/1983	Biology

A. Personal Statement

From 1983, when I joined Harvard Medical School as an Assistant Professor until 2018, when I retired and closed the lab, I was deeply involved in research and education. More than 130 individuals trained in my laboratory during those 35 years and most of those trainees followed careers in science in both academic and industry settings. Research in the Kolter Lab always gravitated around the study of microbes. We explored a large number of different subjects ranging from basic bacterial physiology to bioactive compound discovery.

Now, as Professor Emeritus I continue my involvement in science through teaching, writing and blogging (at Small Things Considered) and communicating microbial sciences to the public, including through exhibitions in museums of natural history and invited lectures. Our photographic exhibition *World in a Drop*, produced jointly with Scott Chimileski and first shown at the Harvard Museum of Natural History in 2017, continues to travel to numerous locations around the world. Our exhibition *Microbial Life* is the major special exhibition at the Harvard Museum of Natural History for two years, open from February 2018 to March 2020. Our book *Life at the Edge of Sight* (co-authored with Scott Chimileski) was released by Harvard University Press September 2017.

B. Partial List of Positions and Honors

1983-1989	Assistant Professor of Microbiology, Harvard Medical School
1989-1993	Associate Professor of Microbiology, Harvard Medical School
1994-2017	Professor of Microbiology, Harvard Medical School
2018-	Professor of Microbiology, Emeritus, Harvard Medical School
2003-2017	Co-Director, Microbial Sciences Initiative, Harvard University
2016-	Co-Blogger, Small Things Considered
2017-2018	Director, Microbial Sciences Initiative, Harvard University
1980-1982	Helen Hay Whitney Postdoctoral Fellowship
1983-1985	Charles King Trust Fellowship
1989-1994	American Cancer Society Faculty Research Award
2000-	Fellow, American Academy of Microbiology
2000	ASM International Professorship Award
2002-2006	Ellison Medical Foundation Senior Scholar in Global Infectious Diseases
2005	Chair, Gordon Conference on Microbial Adhesion and Signaling
2009-2010	President, American Society for Microbiology (ASM)
2010-2013	Chair, ASM Public and Scientific Affairs Board
2011	Fellow, American Association for the Advancement of Science

2012-2014 Member of Board of Reviewing Editors, Science Magazine (AAAS)
2012-2015 Editor, mBio
2012-2015 Member of Board of Reviewing Editors, eLife

C. Publications

Full list of publications in PubMed: http://www.ncbi.nlm.nih.gov/pubmed/?term=Kolter+R

Google Scholar Profile: https://scholar.google.com/citations?user=yW9RJEQAAAAJ&hl=en&oi=ao

D. Major Contributions to Science

1. Regulation of DNA Replication

As a graduate student (1975-1979) I studied the control of plasmid DNA replication. The results of my work provided some of the earliest direct physical evidence for the "replicon hypothesis" that had been put forth in 1962 by Jacob, Brenner and Cuzin. In my work, I was able to separate (and thus define) an origin of DNA replication from a gene encoding a initiator protein that bound and activated the origin. Aside from the basic knowledge provided, this separated replicon served as the foundation for many of the "suicide cloning vectors" still in wide use today.

Kolter R, Helinski DR. Construction of plasmid R6K derivatives in vitro: characterization of the R6K replication region. Plasmid. 1978 Sep;1(4):571-80.PubMed PMID: 372982.

Kolter R, Inuzuka M, Helinski DR. Trans-complementation-dependent replication of a low molecular weight origin fragment from plasmid R6K. Cell. 1978 Dec;15(4):1199-208. PubMed PMID: 728998.

Kolter R, Helinski DR. Regulation of initiation of DNA replication. Annu Rev Genet. 1979;13:355-91. Review. PubMed PMID: 395895.

Kolter R, Helinski DR. Plasmid R6K DNA replication. II. Direct nucleotide sequence repeats are required for an active gamma-origin. J Mol Biol. 1982 Oct 15;161(1):45-56. PubMed PMID: 6296394.

2. Peptide Antibiotic Biosynthesis

When I started my laboratory at HMS in 1983, the genetic bases for antibiotic biosynthesis and export was virtually unexplored. I developed a program to identify and characterize the genes involved in the production of small peptide antibiotics produced by *Escherichia coli.* The power of the genetic tools available in this organism and the application of the nascent technologies of rapid cloning and sequencing allowed us to lead the field in the area of peptide antibiotic biosynthesis. We discovered several novel post-translational modifications and were among the first to characterize the so-called "ABC Exporters", now known to be among the most widespread membrane proteins involved in both import and export processes.

Gilson L, Mahanty HK, Kolter R. Genetic analysis of an MDR-like export system: the secretion of colicin V. EMBO J. 1990 Dec;9(12):3875-84. PubMed PMID: 2249654; PubMed Central PMCID: PMC552155.

Yorgey P, Davagnino J, Kolter R. The maturation pathway of microcin B17, a peptide inhibitor of DNA gyrase. Mol Microbiol. 1993 Aug;9(4):897-905. PubMed PMID: 8231817.

Fath MJ, Kolter R. ABC transporters: bacterial exporters. Microbiol Rev. 1993 Dec;57(4):995-1017. Review. PubMed PMID: 8302219; PubMed Central PMCID:PMC372944.

Yorgey P, Lee J, Kördel J, Vivas E, Warner P, Jebaratnam D, Kolter R. Posttranslational modifications in microcin B17 define an additional class of DNA gyrase inhibitor. Proc Natl Acad Sci U S A. 1994 May 10;91(10):4519-23. PubMed PMID: 8183941; PubMed Central PMCID: PMC43817.

3. Physiology and Evolution During Stationary Phase

Prior to the mid-1980s, the vast majority of studies of bacterial physiology were done on cultures growing in exponential phase or in chemostats. Realizing that in their natural settings bacteria seldom encounter such conditions, we began to study bacteria in stationary phase. This way we discovered regulatory systems that operated only in non-growing cells whose net effect was to render the cells more resistant to diverse stresses. These results had such an impact that a new Gordon Conference was formed to discuss "Microbial Stress Responses". The conference recently celebrated its 20th year and I was invited to present the opening Neidhardt lecture there. Perhaps the most surprising finding we made was the discovery that stationary phase cultures were remarkably dynamic, with fitter mutants taking over in a matter of a few days. This work was one of the early examples of experimental evolution.

Almirón M, Link AJ, Furlong D, Kolter R. A novel DNA-binding protein with regulatory and protective roles in starved Escherichia coli. Genes Dev. 1992 Dec;6(12B):2646-54. PubMed PMID: 1340475.

Zambrano MM, Siegele DA, Almirón M, Tormo A, Kolter R. Microbial competition: Escherichia coli mutants that take over stationary phase cultures. Science. 1993 Mar 19;259(5102):1757-60. PubMed PMID: 7681219.

Kolter R, Siegele DA, Tormo A. The stationary phase of the bacterial life cycle. Annu Rev Microbiol. 1993;47:855-74. Review. PubMed PMID: 8257118.

Zambrano MM, Kolter R. GASPing for life in stationary phase. Cell. 1996 Jul 26;86(2):181-4. Review. PubMed PMID: 8706122.

4. Bacterial Biofilms

By the mid-1990s my laboratory opened another field of study in bacterial physiology by applying genetic approaches to understand bacterial biofilms. Prior to our work, very few bacterial geneticists and molecular biologists were studying these surface-associated microbial communities. The vast majority of the studies involving biofilms were carried out by engineers interested in flow dynamics and how these were influenced by fouling. Our recognition that most microbes in natural settings are indeed surface-associated led us to begin to characterize the process of biofilm formation by performing mutant screens in many species, looking for biofilm-defective mutants. We published two seminal papers in 1998 and an influential review in 2000. Each of these has been cited more than 1000 times and, importantly, continue to be cited more than 100 times a year. Since then we have published dozens more papers in the area of biofilms and we are still considered one of the key laboratories at the forefront of biofilm research.

O'Toole GA, Kolter R. Initiation of biofilm formation in Pseudomonas fluorescens WCS365 proceeds via multiple, convergent signalling pathways: a genetic analysis. Mol Microbiol. 1998 May;28(3):449-61. PubMed PMID: 9632250.

O'Toole GA, Kolter R. Flagellar and twitching motility are necessary for Pseudomonas aeruginosa biofilm development. Mol Microbiol. 1998 Oct;30(2):295-304. PubMed PMID: 9791175.

O'Toole G, Kaplan HB, Kolter R. Biofilm formation as microbial development. Annu Rev Microbiol. 2000;54:49-79. Review. PubMed PMID: 11018124.

Branda SS, González-Pastor JE, Ben-Yehuda S, Losick R, Kolter R. Fruiting body formation by Bacillus subtilis. Proc Natl Acad Sci U S A. 2001 Sep 25;98(20):11621-6. PubMed PMID: 11572999; PubMed Central PMCID: PMC58779.

5. Microbial Interspecies Interactions

Since the early days of microbiology the discipline has been greatly influenced by the studies of pure cultures. Yet, it has always been recognized that microbes seldom exist as pure cultures in natural settings. At the turn of the century we began pioneering the use of co-cultures to understand how microbes alter their physiologies as a consequence of the presence of other species. The study of the emerging properties of multi-species communities now occupies the attention of many members of my lab and our results are greatly influencing how others characterized microbial interactions.

Hogan DA, Kolter R. Pseudomonas-Candida interactions: an ecological role for virulence factors. Science. 2002 Jun 21;296(5576):2229-32. PubMed PMID: 12077418.

Traxler MF, Watrous JD, Alexandrov T, Dorrestein PC, Kolter R. Interspecies interactions stimulate diversification of the Streptomyces coelicolor secreted metabolome. mBio. 2013 Aug 20;4(4). pii: e00459-13. doi: 10.1128/mBio.00459-13. PubMed PMID: 23963177; PubMed Central PMCID: PMC3747584.

Segev E, Wyche TP, Kim KH, Petersen J, Ellebrandt C, Vlamakis H, Barteneva N, Paulson JN, Chai L, Clardy J, Kolter R. Dynamic metabolic exchange governs a marine algal-bacterial interaction. eLife. 2016 Nov 18;5. pii: e17473. doi:10.7554/eLife.17473. PubMed PMID: 27855786 [Epub ahead of print]

Pishchany G, Mevers E, Ndousse-Fetter S, Horvath DJ Jr, Paludo CR, Silva-Junior EA, Koren S, Skaar EP, Clardy J, Kolter R. Amycomicin is a potent and specific antibiotic discovered with a targeted interaction screen. Proc Natl Acad Sci U S A. 2018 Oct 2;115(40):10124-10129. doi: 10.1073/pnas.1807613115. Epub 2018 Sep 18. PubMed PMID: 30228116; PubMed Central PMCID: PMC6176635.