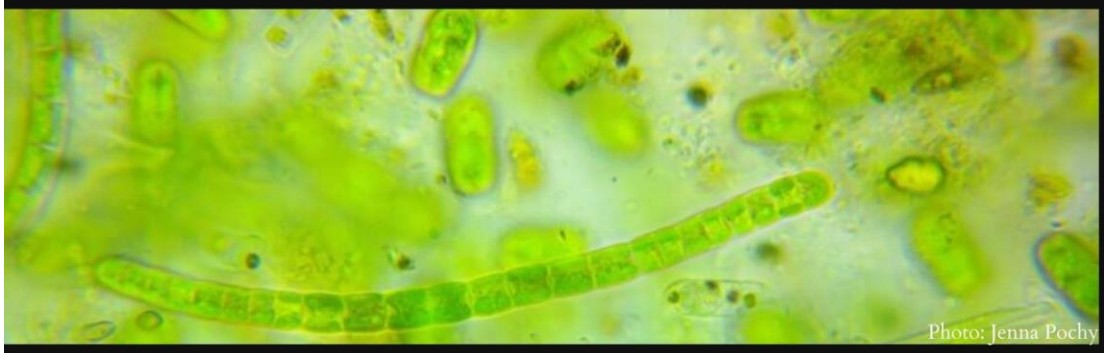
MICROBIAL SCIENCES



18TH ANNUAL SYMPOSIUM
SATURDAY APRIL 17, 2021

CHRISTINA FAHERTY
Effects of bile on Shigella: new perspectives for an old pathogen

ARPITA BOSE
Exploring the electric side of photosynthesis

DAMIAN KRYSAN
The genetics of fungal adaptation to the host

MELISSA DUHAIME
The Virus Guide to Programming Bacteria: How to Infect a Starving Host

SHIRONG LIU
Raise commensals with specificity: a role of microRNAs found in the gut

ODED BEJA
Microbial Rhodopsins revisited

SCIENCE ART

Ana Maria Porras David Goodsell Tal Danino Vineetha Zacharia

SATURDAY, APRIL 17, 9AM - 5PM EST
ZOOM + YOUTUBE LIVE
#MSISYMPOSIUM

MSI
Microbial Sciences Initiative

Introduction

Today's Symposium is organized by the Harvard University Microbial Sciences Initiative (MSI). MSI is an interdisciplinary science program that fosters a comprehensive understanding of the richest biological reservoir of the planet - the microbial world. Microbes have an impact on every aspect of our existence. Yet, their intrinsic invisibility has meant that they have remained largely unknown, their effects and enormous potential often unrecognized. The recent recognition of the vast microbial diversity and the genomics revolution have propelled the microbial sciences into a new era of investigation.

MSI plays a key role in this emerging area by creating a focal point for microbial studies with links to already existing science departments and schools at Harvard, as well as partners beyond the University. MSI encourages interactions among microbial scientists across the Boston area and beyond and connects work on microbial sciences to ongoing work in related areas including molecular biology, medicine, biogeochemistry, evolutionary biology, and environmental engineering.

MSI supports activities that foster interdisciplinary research, including colloquia, seminars, and weekly discussions of microbial science issues. The initiative also runs several programs for students, such as a graduate consortium and, for undergraduates, a summer fellowship program and a secondary field. Further, MSI has played a key role in the recruitment of several new faculty.

It is our hope that this Symposium will, by presenting the breadth and depth of microbial sciences today, stimulate discussion among members of our scientific community that will help strengthen this integrative science initiative. We thank you for your attendance and welcome you to today's activities.

PROGRAM SCHEDULE

Welcome and Opening Remarks **9:00**

Peter Girguis, PhD

MSI Co-director

Session I – Environmental Microbiology **9:10 – 12:00**

9:10-9:15

Session Introduction

Peter Girguis, PhD - MSI Co-Director

9:15-9:45

Arpita Bose, PhD

Washington University in St. Louis

"Exploring the Electric Side of Photosynthesis"

9:45-10:00

Vineetha Zacharia, PhD

10:00-10:30

Oded Beja, PhD

Technion – Israel Institute of Technology

"Microbial Rhodopsins Revisited"

10:30-10:45

Tal Danino, PhD

10:45-11:15

Melissa Duhaime, PhD

University of Michigan

"The Virus Guide to Programming Bacteria: How to Infect a Starving Host"

11:15-12:00

Session I Panel Q&A

Lunchtime Program **12:00 – 1:00**

Trivia with *Skype a Scientist*

Session II – Medical Microbiology **1:10 – 4:00**

1:10-1:15

Session Introduction

Michael Gilmore, PhD - MSI Co-Director

1:15-1:45

Shirong Liu, PhD

Brigham and Women's Hospital, Harvard Medical School

"Raise Commensals with Specificity: A Role of MicroRNAs Found in the Gut"

1:45-2:00

David Goodsell, PhD

2:00-2:30

Christina Faherty, PhD

Massachusetts General Hospital/Harvard Medical School

"The Effects of Bile on Shigella: New Perspectives for an Old Pathogen"

2:30-2:45

Ana Maria Porras, PhD

2:45-3:15

Damian Krysan, PhD

University of Iowa

"The Genetics of Fungal Adaptation to the Host"

3:15-4:00

Session II Panel Q&A

Closing Remarks **4:00-4:05**

Hannah Gavin, PhD

MSI Program Manager

Happy Hour **4:10-5:00**

Arpita Bose

Associate Professor, Biology and Earth & Planetary Sciences

Washington University in St. Louis

Lab Website | Twitter

Education:

- Postdoctoral training at MIT and Harvard
- Ph.D. University of Illinois Urbana-Champaign
- M.S. University of Illinois Urbana-Champaign
- M.Tech. All India Institute of Medical Sciences
- B.S. Delhi University

Selected Honors and Awards:

- Life Sciences Research Foundation Postdoctoral Fellowship
- L'Oréal USA For Women in Science Fellowship
- Packard Fellowship
- Changing the Face of STEM Mentorship Awards
- DURIP Award
- AEOP Mentorship Awards

Research Interests:

I am an Associate Professor of Microbiology and a Packard Foundation Fellow in the Department of Biology at Washington University in St. Louis (WUSTL) with a courtesy appointment in the Department of Earth and Planetary Sciences and an affiliation with the Environmental Studies Program. I am also an affiliate faculty at the Center for Water Innovation. My interests are in geomicrobiology, microbial physiology, microbial ecology and evolution, biogeochemical cycling, gene regulation, microbial metal respiration and Earth history. During my graduate work and post-doctoral research, I used genetics, biochemistry and molecular biology to understand microbial metabolism. My Master's research at the All India Institute of Medical Sciences, New Delhi, dealt with understanding the physiological response of Mycobacterium tuberculosis to hypoxia. For my PhD research I studied methanogenesis performed by the poorly understood archaea, in the lab of Prof. William Metcalf at the University of Illinois at Urbana. I was a Howard Hughes Medical Institute research associate for a year in the lab of Prof. Dianne Newman at the Massachusetts Institute of Technology, where I studied photoferrotrophy performed by purple non sulfur bacteria. I thereafter moved to Prof. Peter Girguis' lab at Harvard University, where I used a combinatorial approach to study microbial metabolism at the environmental level. My research focuses on understanding various microbial metabolisms. I intend to apply this basic understanding of microbial metabolism to engineer microbial systems for sustainable biochemical & bioenergy production as well as tackle issues such as bioremediation and biofouling. I also hope that my research would reveal basic geomicrobiological phenomena that shape our planet and possibly others.

Vineetha Zacharia

Postdoc

University of California Berkeley

Twitter

Education:

- Ph.D. UT Southwestern Medical Center
- B.S. University of Oklahoma

Research and Science Art Interests:

I study the multicellular life cycle of the soil-bacterium Streptomyces coelicolor, which produces a diverse array of natural products, including antibiotics. I use fluorescent reporters to monitor the spatiotemporal expression patterns of key regulators involved in natural product biosynthesis and development in S. coelicolor. For my science art, I paint watercolor-style paintings using the blue pigmented antibiotic actinorhodin, which is secreted as droplets by S. coelicolor. I dip my paintbrush directly into actinorhodin secreting colonies to make my Actino Art!

Oded Beja

Professor of Biology

Technion - Israel Institute of Technology

Lab Website | Twitter

Education:

- Ph.D. Weizmann Institute of Science
- M.S. Weizmann Institute of Science
- B.S. Hebrew University of Jerusalem

Research Interests:

Present estimates suggest that the majority of microorganisms in most environments are not amenable to growth in pure culture. It is therefore 'not easy' to study their environmental role in the lab. This problem can now be bypassed by accessing the genomes of these microorganisms using metagenomics. Identifying protein coding genes and biochemical pathways that can shed light on their physiological properties and ecological function. My lab mainly focuses on different light harvesting systems with a special interest in microbial rhodoopsins.

Tal Danino

Associate Professor, Department of

Biomedical Engineering

Columbia University

Website | Twitter

Education:

- Ph.D. University of California, San Diego
- B.S. University of California, Los Angeles

Research and Science Art Interests:

The themes of my work connect the hidden microscopic universe with the impact it has on our macroscopic society as a whole, and convey where we are today in an increasingly digital and biotechnological world. Control over bacteria is balanced while also embracing them as active collaborators that continuously evolve over time. As a result, each iteration of my work is unpredictable and unique, although I often play with the notion that they seem to have been perfectly calculated and arranged in their final forms. Ultimately, this work reveals the emergent effects of the hidden microscopic universe on the macro scale—suggesting that scales from the human body to the body politic are fundamentally reshaped by biotechnology. Through the use of living organisms, the medium becomes the message as the synergy of scientific and artistic techniques communicates and queries our senses of the human condition and other creatures that we share our environment with.

Melissa Duhaime

Assistant Professor, Ecology and Evolutionary Biology

University of Michigan

Lab Website | Twitter

Education:

- Ph.D. Max Planck Institute for Marine Microbiology
- M.S. Max Planck Institute for Marine Microbiology
- B.S. Cornell University

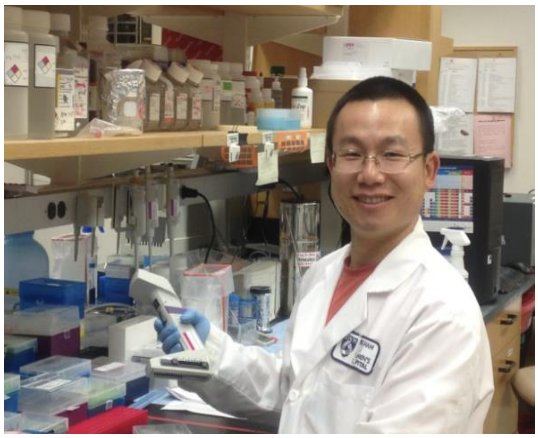
Research Interests:

We study microbial interactions on ocean and lake particles to better understand their consequences for microbial ecosystem functions and environmental health. In the oceans, we study how virus-microbe interactions influence the fate of marine snow particles. In lakes, we study how microplastic biofilm activity influences the transport and fate of the plastic pollution, as well as carbon and nitrogen cycling. This work is rooted in the analysis of large-scale viral and microbial omics datasets, model phage-host system development, and laboratory and field-based study.

Shirong Liu

Instructor in Neurology

Brigham and Women's Hospital/Harvard Medical School



Education and Training:

- Postdoctoral training at

  Brigham and Women's Hospital/

  Harvard Medical School
- Ph.D. Saarland University

Research Interests:

Interested in the evolution of host-microbe interactions, the role of microbiome in diseases and the manipulation of microbiome to treat autoimmune diseases, metabolic diseases, and cancer.

David S. Goodsell

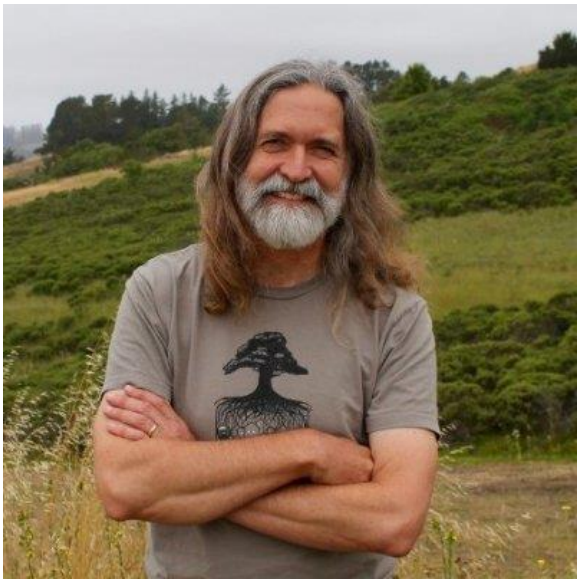
Professor of Computational Biology

Scripps Research Institute

Research Professor

Rutgers State University

Website | Twitter



Education and Training:

- Ph.D. University of California, Los Angeles
- B.S. University of California, Irvine

Research and Science Art Interests:

I divide my time between research and science outreach. My research centers on methods for computational structural biology and their application to drug design, protein function prediction, and modeling of the molecular structure of entire cells. Current work includes development of AutoDock, the most widely-used computational docking program in the scientific community, and CellPack, a new method for creating three-dimensional atomic models of large portions of cells. I am currently applying these methods to HIV biology and structure and function of bacterial cells. In my science outreach work, I have developed new visual methods for exploring molecular and cellular structure. This includes three decades of work on depiction of the cellular mesoscale, and development of non-photorealistic rendering methods for molecular and cellular subjects. I currently create outreach materials for the RCSB Protein Data Bank, including a popular monthly column that presents molecular structure and function for general audiences. I have written four general-interest books on molecular biology, cell biology and bionanotechnology, and have collaborated with science museums, filmmakers, educators and popular authors on the creation of educational and outreach materials.

Christina S. Faherty

Assistant Professor of Pediatrics

Massachusetts General Hospital/Harvard Medical School

Lab Website | Twitter

Education:

- Postdoctoral training at The Center for Vaccine Development, University of Maryland School of Medicine
- Ph.D. The Uniformed Services University of the Health Sciences
- B.S. Rutgers

Selected Honors and Awards:

- Outstanding Oral Presentation, Graduate Student Colloquium
- Uniformed Services University Kadner Institute Participant
- American Society for Microbiology NRSA T32 Vaccinology Fellowship
- Center for Vaccine Development NIAID K22 grant Poster of Distinction Ribbon
- DDW Meeting Plenary Session Presenter
- World Congress of Pediatric Gastroenterology, Hepatology, and Nutrition Journal Cover

Research Interests:

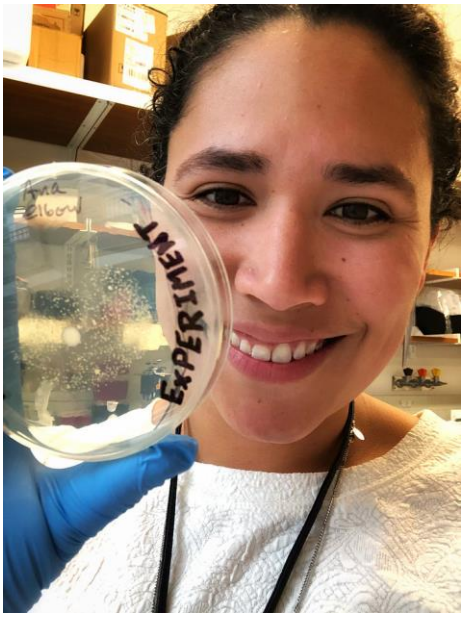
My primary research focus is aimed at addressing crucial gaps in knowledge regarding how the bacterial pathogen Shigella transits the small intestine, enters the colon, and establishes infection. Despite over 50 years of research, a successful vaccine against Shigella remains elusive; and thus, a better understanding of human-specific interactions of Shigella with the gastrointestinal tract is needed to facilitate therapeutic development. By using a combination of factors to mimic the small intestine, we have demonstrated mechanisms by which Shigella survives host transit and regulates virulence. We have also employed human-derived organoid models to study pathogenesis; and therefore, use the most human-specific conditions possible in the laboratory setting. We hope our research will facilitate new vaccine development strategies to target Shigella. Additional research includes collaborative efforts to develop novel bacteriophages to target Shigella and studying other gastrointestinal pathogens like Vibrio, Salmonella, and the Escherichia coli pathovars.

Ana Maria Porras

Assistant Professor

University of Florida

Website | Twitter



Education and Training:

- Presidential Postdoctoral Fellow Cornell University
- Ph.D. University of Wisconsin-Madison
- M.S. University of Wisconsin-Madison
- B.S. University of Texas at Austin

Research and Science Art Interests:

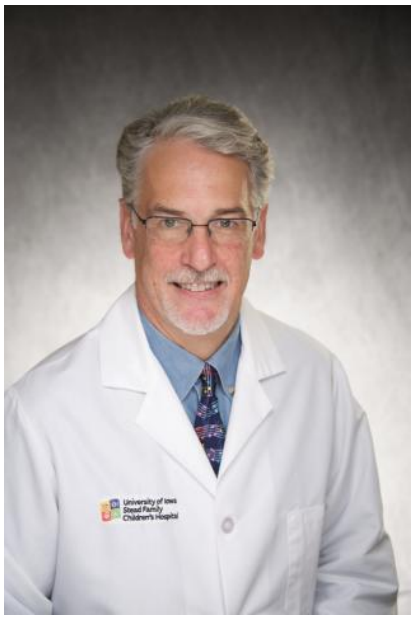
I am a biomedical engineer with experience in both tissue engineering and the human gut microbiome. Leveraging my unique training, I am developing biomaterials-based models of disease to study how beneficial and pathogenic microorganisms regulate human health. I am particularly interested in understanding how geographic differences in gut microbiota composition impact host health, and, specifically, susceptibility to infectious disease. In parallel to my research, I use crocheted art to teach about the microbes within and around us. Every #MicrobeMonday and #MicroMartes I share a new crocheted microbe and tell a short story about its biology, discovery, or a recent finding on my social media accounts (@AnaMaPorras and @anaerobias, in English and Spanish respectively). I believe in the power of art to communicate across cultural and national barriers and, at the same time, I am an advocate for and practitioner of multilingual science communication.

Damian J. Krysan

Professor, Samuel J. Fomon Chair in Pulmonology/Allergy/

Infectious Diseases

University of Iowa



Education and Training:

- M.D. Infectious Disease Fellowship University of Michigan
- Postdoctoral training at Emory University
- Ph.D. Northwestern University
- B.A. Grinnell College

Selected Honors and Awards:

- American Association for the Advancement of Science Fellow
- American Academy of Microbiology Fellow

Research Interests:

My laboratory is focused on understanding fungal pathogenesis and identifying new antifungal drugs. We use genetic approaches, with an emphasis on genetic interaction analysis, to understand the mechanistic basis of key virulence traits in the human fungal pathogens Candida albicans and Cryptococcus neoformans. Our drug discovery efforts utilize a novel high throughput screening assay to identify structurally and mechanistically novel antifungal molecules. Once a hit molecule is identified and validated, we undertake its pre-clinical evaluation including mechanism of action, medicinal chemistry optimization, pharmacologic characterization and initial in vivo efficacy studies. To date, we have advanced one molecule to a Phase II clinical trial.