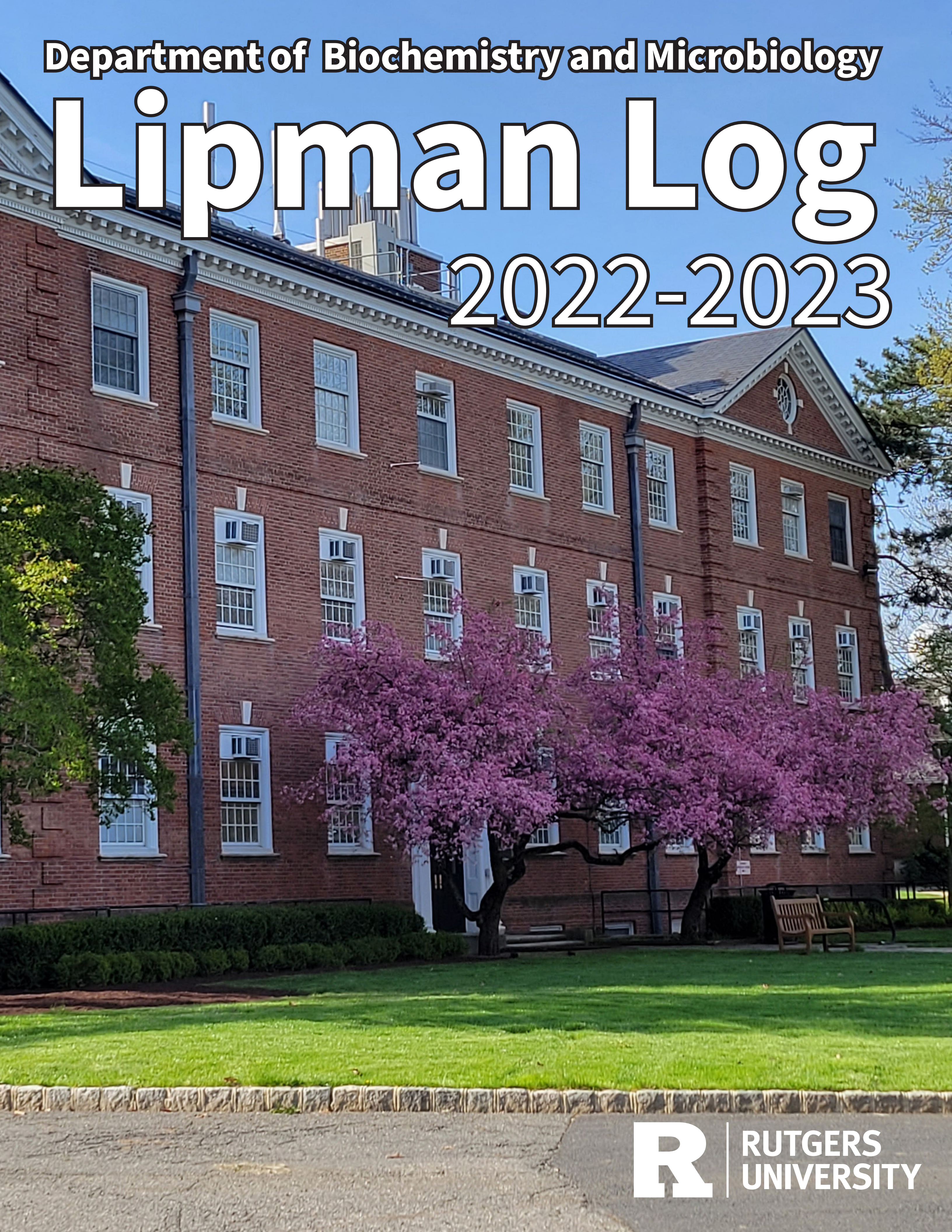
Department of Biochemistry and Microbiology

Lipman Log

2022-2023



RUTGERS UNIVERSITY

Greetings from the Chair

Max M. Häggblom, Ph.D.

Distinguished Professor and Chair
Department of Biochemistry
and Microbiology

Contents

Greetings from Lipman Hall,

This current issue of the Lipman Log highlights our activities from the 2022-2023 academic year. We have celebrated several newly minted Ph.D.'s, exciting new research projects and awards, and major advances and publications in the different areas of our scholarship. Our undergraduate and graduate students are engaged in a variety of inspiring research projects with our faculty members. You can read more on the latest Ph.D. theses, the awards our students and faculty have received and about other activities in the department.

We are delighted with the promotions of our superb teaching faculty: Dr. Ines Rauschenbach was promoted to Associate Teaching Professor. Dr. Sharron Crane and Dr. Ramaydalis Keddis were both promoted to Assistant Teaching Professor. Congratulations!

We will miss two dear colleagues who retired during the last year. In addition, we are sorry to see Professor Yana Bromberg leave Rutgers for a position at Emory University. Professor Keith Cooper retired in July 2023 after more than 30 years at Rutgers. He served as Chair of the department (1999-2001) and later Research Dean and Interim Executive Dean of SEBS. In this issue you can read more about how he and his students combined ecotoxicology, comparative pathology, and vertebrate toxicology to study the fate and impacts of various pollutant chemicals. Peter Andersson retired in September 2022 after 35 years at Rutgers. Peter joined the department in 1987 as a secretary and later became the department's Unit Computing Specialist. We all appreciated his expertise and capabilities in keeping the diverse hardware and software working smoothly. Indeed, Doug Eveleigh had described Peter as a polymath of operations. Peter is an accomplished photographer and over the years he had a key role in the videography and photography of departmental events and symposia.

We mourn the passing of two dear faculty colleagues. Theodore van Es, Professor Emeritus, passed away in October 2022. Theo joined the faculty of Rutgers College in 1968 and later moved to the Department of Biochemistry and Microbiology in 1992, where he worked until his retirement in 2012. David Pramer, Professor Emeritus, passed away in December 2022. He served as the first Chair (1965-1969) of the newly formed Department of Biochemistry and Microbiology (from the Departments of Agricultural Biochemistry and Soil Microbiology) and later as Director of the Waksman Institute.

As always, I thank all our donors that make many of our activities possible. Your contributions fund important student scholarships, awards and travel fellowships, and support our seminars and departmental activities. The Eveleigh Graduate Student Travel Awards, for example, provide much- needed support for our students to travel to national and international conferences to present their work, network, and learn. We continue fundraising for the Peter Kahn Endowed Biochemistry Scholarship to support biochemistry undergraduate students. We hope that you will continue to show your support for the department and our scholarly programs.

From all of us in the Department of Biochemistry and Microbiology our warm greetings!

In Memoriam

Theodorus Van Es

Theodorus Van Es died on October 8, 2022 at the age of 92. Dr. Van Es was born shortly before World War II in Rotterdam. Food was very scarce, and he told stories of himself and his mother riding on their bicycles into the countryside to buy eggs from a farmer they knew. It was dangerous, and they feared being shot at by fighter planes or being stopped at checkpoints. In the city they faced air raids from both the allies and the Germans. There was a famine in much of Western Europe after the war, so when he was fourteen the family migrated to South Africa. He completed his formal education at the University of Witwatersrand, earning a B.Sc. in Chemistry and Physics with honors in 1954, and his doctorate in Organic Chemistry in 1961. Along the way he worked in the gold mines collecting samples for analysis from deep underground and performing the analyses. He rapidly decided against further work in the mines!

Dr. Van Es taught and did research at Witwatersrand from 1957 through 1968 and returned there as Visiting Professor of Chemistry while on sabbatical in 1990-91. In 1968 he joined the faculty of what was then Rutgers College. Between 1979 and 1989 he served as Chair of Biochemistry and Director of the Graduate Program in Biochemistry on the Busch Campus. He moved to the Department of Biochemistry and Microbiology in 1992, in what was then Cook College, now the School of Environmental and Biological Sciences, where he remained until his retirement.

Dr. Van Es's research focused on the biochemistry and chemistry of carbohydrates, the development and properties of non-immunogenic enzymes with emphasis on their use as therapeutic agents, and in enzymatic reactions in organic solvents. The work led to a patent, shared with two colleagues, on non-immunogenic polypeptides (pegolated enzymes). As of the end of 1992, when he ceased to keep records, the patent had earned the university approximately $3 million. A Fulbright Award in 1986-87 enabled him to spend a year's sabbatical at the University of Botswana. While there he collaborated on the analysis of chlorinated pesticides from animal tissues from northern Botswana. The work was presented at a symposium in Gaborone in 1988. Professor Van Es was a dedicated teacher throughout his career. Over the years he taught many graduate and undergraduate lecture and laboratory courses. Since joining the Department of Biochemistry & Microbiology, his classroom teaching focused on large courses: Introductory Biochemistry, a one-semester course and our two-semester General Biochemistry course. In spite of the severe demands on his time of administrative positions, he always made time for individual students who came to him for help with material or for counseling. He would spend as much time in one-on-one conversation as needed and gained a reputation as one of the kindest of men. Typical of him was taking the time to help a stranded student change a flat tire on her car. She must have reported that to the dean, who sent him a wonderful letter of appreciation. In addition to classroom and laboratory course teaching, Professor Van Es, served on several M.S. or Ph.D. thesis committees each year. Five students earned their doctorates in his lab, in addition a very large number of udergraduates who did research with him. Colleagues like him are rare. We will miss him . -Dr. Peter C. Kahn

David Pramer

David Pramer, Distinguished Professor Emeritus of Microbiology, passed away in December 2022 at the age of 99. Dr. Pramer was the first Chair of the Department of Biochemistry and Microbiology [newly formed from the Departments of Agricultural Biochemistry and Soil Microbiology on Dr. Starkey's retirement] (1965-1969) and Past Director of the Waksman Institute. He also served the University as Director of Biological Sciences, Director of University Research, Associate Vice President for Research and Sponsored Programs, and Associate Vice President for Corporate Liaison. Indeed, wearing many hats at Rutgers.

David Pramer was awarded the American Society for Microbiology Founders Distinguished Service Award in 2002 and at the time reflected on his career: "When returning home unharmed from World War II, and being fortunate enough to enroll in college under the G.I. Bill, I promised myself to pursue a career that would enable me to contribute to making this a better world while doing work that would provide me with personal satisfaction as well. I was admitted to Graduate Study in Microbiology at Rutgers University. The Department Chair was Dr. Selman A. Waksman. Dr. Robert L. Starkey was my Thesis Advisor. Both men were Past-Presidents of the American Society of Microbiology and they made clear to their students that the ASM was our "Professional Voice", and that membership in the Society was obligatory, as was participation in the Society's Meetings. I did as I was taught. I have been an ASM member since 1950, I attended meetings regularly and I have had the privilege of serving on various ASM Committees and Boards. Moreover, as Professor of Microbiology, Chairman of the Department of Microbiology and Director of the Waksman Institute of Microbiology at Rutgers University, I have attempted to convey to my students and faculty associates an understanding of the importance of the ASM, not only for their welfare and the welfare of their chosen profession, but also for the well-being of the Country in which we live".

Dr. Keith R. Cooper Retirement

42 Years

Dr. Cooper pictured with his first (Dr. Vicki Kindt; right) and last (Dr. Gina Moreno; left)

Dr. Cooper arrived at Rutgers in 1981 and was a joint hire between the College of Pharmacy and the Dept. of Biochemistry and Microbiology. He has Master's degrees in marine biology (Texas A&M) and Industrial Toxicology (Thomas Jefferson Medical School) and received his PhD. In Animal Pathology University of Rhode Island). He also did a NIEHS postdoc. Because of his background in ecotoxicology, comparative pathology, and vertebrate toxicology he was given the task of being the bridge across the different schools and colleges. In the early years he was involved in working with a number of faculty across campuses in establishing the Joint Graduate Program In Toxicology (JGPT) which has been funded continuously since 1986 through a NIEHS Training Grant. As a professor he felt that there are 3 critical components that are required to be successful: training and teaching to both undergraduates and graduate students, cutting edge research and service through the university, state, and federal agencies. He was heavily involved in developing the biochemical toxicology curriculum in the Dept. of Biochemistry and the curriculum in the JGPT. Over the years he has taught many undergraduate and graduate courses: systems physiology, biochemistry, histology, pathology, biochemical mechanisms of toxicology, and several toxicology-based lab courses. In all his courses he stressed the idea of "systems approaches" to understanding the material to understand how chemical and molecular events resulted in higher organizational events that would be manifested in an altered homeostasis. The courses gave the students an understanding of how to apply the information they learned in basic science courses to current diseases and toxic responses in eukaryotic organisms. Many students pursued careers in the various areas of toxicology and related fields, but they all came away with understanding the importance of understanding the mechanism of action.

Dr. Cooper's research has involved working with teams of researchers on emerging contaminants of concern. He emphasizes that all the research projects are driven by the graduate students and undergraduates working in the lab. In the early years he worked on benzene's toxicity and mechanism of action on hematopoietic systems in rodents and fish. He was heavily involved in ecological studies and mechanisms of action of 2,3,7,8-dioxins/furans. His laboratory research started to move toward using embryonic and juvenile fish for comparative toxicological studies. He is considered a world expert in this area of research. He and his students established some of the lowest levels resulting in altered embryonic development in vertebrates and invertebrates, which were the basis for setting current limits. He has been an advocate and helped develop the course of action for cleaning up the Passaic River. Although this work was carried out in the late 80s and early 1990s the dredging of the Passaic River only begun a few years ago and is ongoing. His work in mammalian toxicology involved studies examining pesticides (Mancozeb/Maneb) and other low molecular weight compounds that cause neurologic effects. The mancozeb work has been used to set national and internationally acceptable application limits. The work on monochloroacetic acid work resulted in the development of antidotes for acute toxicity. MTBE (the gas additive) was shown to cause vascular agenesis, and this resulted in a number of papers that worked on the mechanism through the VEGF pathway both in lower and higher vertebrates. He has carried out research on BPA, phthalates, PCBs, mercury, ocean acidification, and impacts of oil spills on aquatic organisms. His latest work involved PFAS (for ever chemicals), micro and nano plastics and several ruthenium based anticancer drugs. The projects described above resulted in 25 PhDs and many MS. Degrees. His students are scattered across the world and the United States.

Dr. Cooper has served as Chair of the Department of Biochemistry, Research Dean, and Interim Executive Dean here at SEBS. He has served on and chaired a number of N.J. State Councils (Pesticide, Drinking Water Quality, SAB Water Quality) over the years. He has also served on national committees (NAS. NIH, NIEHS, EPA).

Peter Anderson Retirement

35 Years

Peter Anderson retired on September 1, 2022 after 35 years at Rutgers.

Peter joined the Department of Biochemistry and Microbiology in 1987 as a full-time, temporary, Secretary Word Processing in the departmental office which was then located in Rooms 326 and 327 of Lipman Hall.

In the Spring of 1988 he was hired full time as Secretary Word Processing with Professor Peter Kahn's "Pointman Project", a research program to ascertain the Dioxin residues in Viet Nam Veterans and the health effects that may have been caused by Dioxin exposure from Agent Orange. After the Pointman Project ended, in September of 1991, Peter continued as a departmental Secretary Technical. With the deployment of office computers at the time, Peter personally took the lead in becoming "the Departmental office computer guru". He officially became the department's Microcomputer Coordinator in May 1996. In March 2000 he became the department's Unit Computing Specialist.

In 2007 Peter joined SEBS Information Technology Services, supporting the Dept. of Ecology and Evolution and the Dept. of Entomology while continuing to support the Dept. of Biochemistry and Microbiology. His duties included maintaining and upgrading and networking office and laboratory computers, printers, projectors. His expertise and capabilities in keeping the diverse hardware and software working smoothly were widely recognized and appreciated. He accomplished his duties with boundless energy, enthusiasm, and an enthusiastic smile. Doug Eveleigh described Peter as a polymath of operations. In 2012 Peter received the SEBS Staff Excellence Award, a well-deserved recognition of his service and accomplishments.

Peter spent his entire career at SEBS in Lipman Hall. A "people person", he mentioned on numerous occasions that he saw his primary role as one of supporting our people, our faculty, staff and students, and that maintaining the computing hardware and software was just the means to that end. He noted in his farewell email that it was the quality and diversity of the people in Lipman Hall and his faith in the value of their work that made his tenure here enjoyable and fulfilling. He also reminisced about his early days in the department: "We had a few generic IBM clone computers, initially running DOS, but later running Windows 3.1. It was still the era of typewriters, manually filled out forms and carbon copies. When phone calls came in, we would fill out pink "While You Were Out" slips and put them in the recipient's mailboxes… ...I remember when, around 1994, Jim MacMillan had moved from DOS to

Windows 3.1, he said we all should upgrade to Windows 3.1. I told him I liked DOS and he said "Oh, DOS! You've got to get with the times!" Later, when Jim purchased the first Pentium computer, we all stood in the third-floor hallway marveling at the CD drive opening and closing!... ...The "Lunch Room" was a mini-fridge with a coffee pot on top of it in Room 328. It was a focal point of the department and we would sooner or later get to see everyone during the day as they stopped in to get coffee. In that way we had a good sense of what was going on throughout the department."

Peter is an accomplished photographer. Notable was Peter's role in the videography and photography of the re-enactment, along the Delaware and Raritan Canal, of "The Discovery of Flammable Gas by George Washington and Thomas Paine, November 5th, 1783" for its 225th anniversary on November 5th 2008. Peter videotaped the departmental seminar given in May 1995 by Albert Schatz, co-discoverer of streptomycin. He photographed the many annual "Microbiology at Rutgers University" symposia held by the department since 2007. He photographed numerous special events commemorating the discoveries of antibiotics such as the recognition of the Waksman Lab in Martin Hall as a "Milestone in Microbiology" on April 12th 2002 and its designation as an ACS National Historic Chemical Landmark on May 25th 2005. In addition, he photographed faculty retirement events and Doug Eveleigh's Investiture as Endowed Chair in Applied Microbiology in April 2002. More recently, he photographed the SEBS Microplastics Symposium held in March 2019. Peter has organized and archived these pictures and videos and scans of event flyers, brochures and ephemera as a rich digital record of the department history going back to the early 1990s. Readers of the Lipman Log have enjoyed his pictures since the inaugural issue in 2003.

We thank Peter for his many years of engaged, enthusiastic secretarial and IT support and his friendly, welcoming presence to all who have passed through Lipman Hall over the years.

We wish Peter all the best in his new endeavors!

Awards & Activities

2023 Student Awards

Selman A. Waksman Award:
Miranda G. Barnes

Theodore Chase Award:
Nicholas Jansma
Andrew D. Sam
Likhitha Patlolla
Sarah M. Sywanycz

Strumeyer Award for Excellence in Biochemistry:
Daniel Ambrosio

Eveleigh Travel Award:
Lauren Hall
Chloe Costea
Neil Simmons
Franklin Roman Rodriguez
Matthew Finegan

Max Häggblom, Kerala Erudite Scholar-in-Residence

Max Häggblom, Distinguished Professor and Chair of Biochemistry and Microbiology, was invited as the Kerala Erudite Scholar-in-Residence, March 2-10, 2023, under a program sponsored by the Kerala State Higher Education Council, India. His visit was coordinated and hosted by Prof. Salom Gnana Thanga V. in the Department of Environmental Sciences at University of Kerala.

This Scholar-in-Residence Program was established to provide funding for universities in Kerala to invite scholars to share their expertise and knowledge with the scientific community and students allow them the opportunity to develop international connections and research collaborations. Over the 8-day visit, Prof. Häggblom met with faculty and students and presented research seminars on environmental microbiology at the University of Kerala, Mar Ivanios College and Women's College, and Rajiv Gandhi Centre for Biotechnology in Thiruvananthapuram, and at St. Mary's College in Thiruvalla. In addition to his seminars on the topics of microbial ecology, biodegradation, biogeochemical cycling, and preparing a scientific paper, he also held a laboratory tutorial on working with anaerobic bacteria.

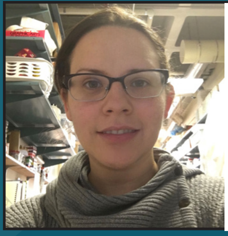
Debashish Bhattacharya Receives Prestigious Miescher-Ishida Prize for Advancing the Field of Endosymbiosis

Distinguished Professor Debashish Bhattacharya was awarded the 2022 Miescher-Ishida Prize by the International Society of Endocytobiology (ISE) and the University of Tübingen, Germany. Dr. Bhattacharya was recognized for his many contributions to the field of plastid endosymbiosis. Including determining the place of algae in the tree of life, investigating the biology of extremophiles, and bringing high-throughput genomics methods to address many questions in algal evolution.

Promotions & Anniversaries

Ines Rauschenbach
promoted to Associate Teaching Professor

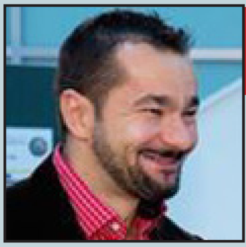
Sharron Crane
promoted to Assistant Teaching Professor



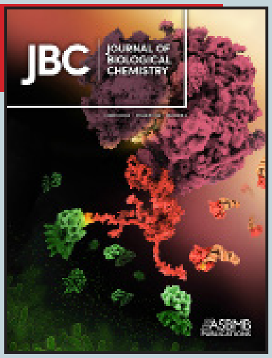
Ramaydalis Keddis
promoted to Assistant Teaching Professor

Karla Esquilín-Lebrón hosted a group of 4-H STEM Ambassadors to explore the “Microbes in and around us”

The 4-H STEM Ambassador program welcomes New Jersey youth from middle and high school to the SEBS campus to participate in hands-on activities as they learn alongside Rutgers faculty in their respective discipline. Now in its 14th year, the program supports young people from six urban communities around New Jersey, with the objective of supporting and encouraging first generation college students in the pursuit of STEM careers. Seven STEM Ambassadors spent the day with Dr. Esquilín-Lebrón to learn about our New Jersey state microbe Streptomyces griseus, antibiotic production and the human microbiome. We clarify misconceptions about microorganisms, the production and use of antibiotics and the importance of microbes in our daily life. Students got a chance to learn about the diverse microbiology topics the faculty in our department research and the opportunities of pursuing a STEM degree at Rutgers. The STEM Ambassadors will take the knowledge they have gained this past week back to their respective communities and teach-back to their younger peers at local YMCAs, libraries, and afterschool programs.



The Kulczyk Lab Determines a Cryo-EM Structure of the Bacterial Toxin and Ribosomal P-stalk Complex River deltas



Kulczyk's laboratory, in collaboration with Nilgun Tumer's laboratory, determined a cryo-EM structure of Shiga toxin 2a (Stx2a) in complex with the native ribosomal P-stalk. Stx2a is the virulence factor of Shigella dysenteriae and enterohemorrhagic Escherichia coli, and it is homologous to the ricin toxin. The catalytic A1 subunit of Stx2a interacts with the ribosomal P-stalk for loading onto the ribosome and depurination of the sarcin-ricin loop, whichhalts protein synthesis. The cryo-EM structure, recently published in the Journal of Biological Chemistry, provides the important insight into the intrinsic dynamics of the Stx2a-P-stalk interaction, and identifies residues involved in binding. The structure will be critical for the design of selective small molecule inhibitors for the treatment of bacterial infections.

Grants

Liping Zhao

Cranberry Institute Grant
Mutual Mentoring Grant Program: Team Grant Program.

Ning Zhang

2022-2026. National Science Foundation (NSF) “Fungi in the pine barrens ecosystem - biodiversity, systematics and function” PI. $750,000

Charles Dismukes

2022-2023. DOE-SBIR “Emissions-free bio-ethanol production through an add-on electrochemical CO2-to-Ethanol carbon utilization technology” A. Laursen, PI RenewCO2 INC. $112,125, subcontract.

2023. RenewCO2 “Fundamental Understanding of Electrochemical CO2 Selectivity to Monoethylene Glycol” K. Calvinho, RenewCO2 INC. $ 25,003.

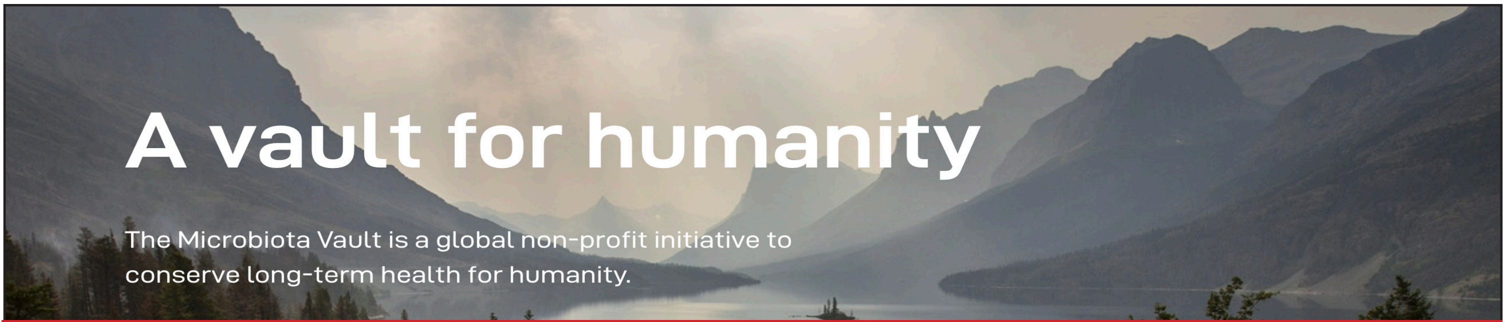
2023-2025. NSF STTR “Scalable CO2 electrolyzers for the production of formic acid” A, Laursen, RenewCO2 INC. $300k/ 18 Mo. Subcontract.

Tamara Crawford
Administrative Assistant
20 Years

Jessie Maguire
Business Specialist
20 Years

Max Haggblom
Department Chair
30 Years

Activities Continued



Maria Gloria Dominguez-Bello Established the Micorbiota Vault Initiative

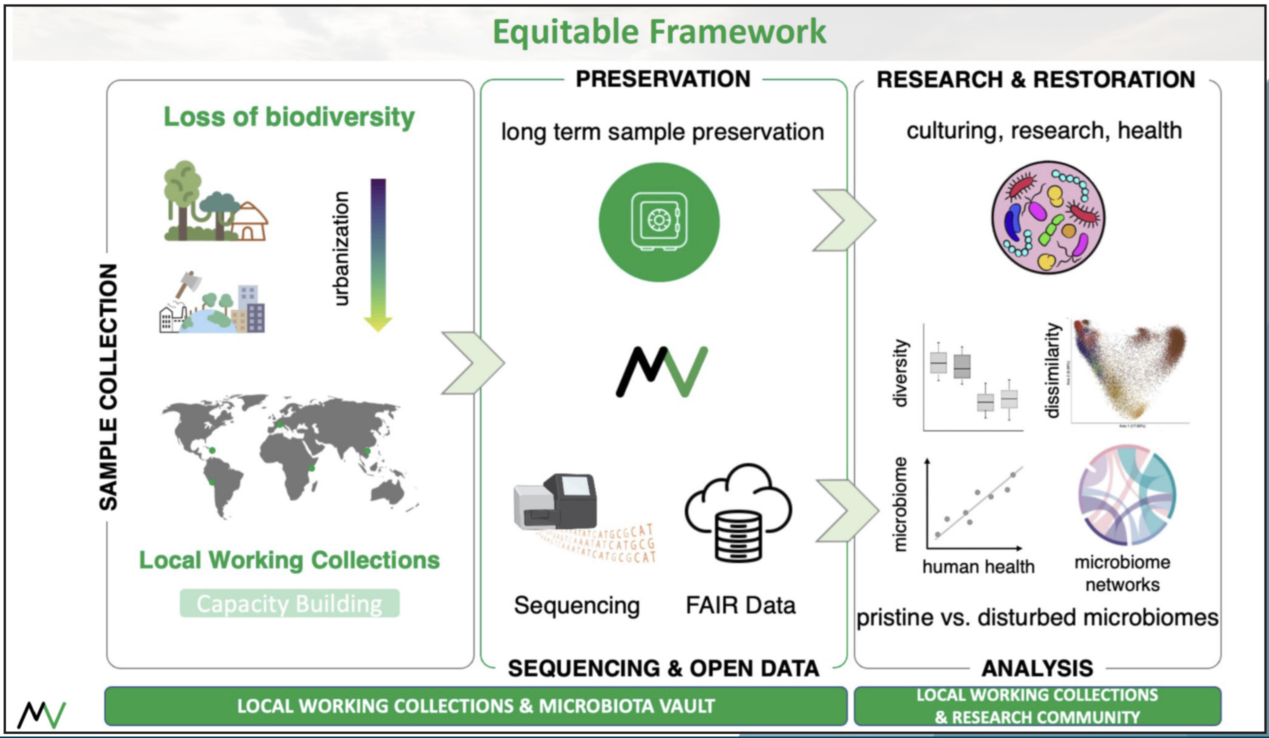
Maria Gloria Dominguez Bello leads the establishment of the Microbiota Vault, a global non-profit initiative to educate on and preserve microbiome diversity in order to forever secure the basis of the naturally evolved diversity important to humankind.

Microbial diversity is recognized to be globally threatened by urbanization and environmental change proceeding at an unprecedented pace. This includes loss of microbial diversity and an imbalance of health-relevant functions. In analogy to the Svalbard Global Seed Vault, the Microbiota Vault initiative is establishing a backup biobank and sequencing data to be deposited in open access databases, for the long-term preservation of microbial biodiversity that is critical for human and planetary health (See Dominguez-Bello MG, Knight R, Gilbert JA, Blaser MJ. Preserving microbial diversity. Science 2018, 362:33-34. doi.org/10.1126/science.aau8816).

The Microbiota Vault will closely interact with local working collections all over the world for the safe storage and preservation of microbiota samples and collections from around the world. Samples are collected by the local working collections across a range of systems (human, agricultural, environmental) to preserve the microbiome from natural systems where the microbiome is still fully intact. At the request of local collections -and compliant with the needed permits-, samples can be sent for storage in a safe vault and the deposited specimens can be sequenced for open access of the data.

Although the Microbiota Vault does not do research, its mission is to educate, support preservation and promote research by scientists globally, to determine the importance of microbes for health. Data deposited in open research repositories can enable cataloguing the microbial genetic diversity will fuel fundamental research on the importance of global biodiversity and genetic novelty at a global scale. Research in collaboration with the local working collections using genomics and metabolomics technologies will enable to catalogue the genetic and biosynthetic diversity of microbiome samples stored in the Microbiota Vault on behalf of local collections. The Microbiota Vault initiative provides an equitable framework for the study and preservation of microbial diversity worldwide. It collaborates closely with Local Working Collections supporting equitable and inclusive approaches to microbiome research and preservation.

For more information, see:
https://www.microbiotavault.org/



Microbiology of arsenic-contaminated agricultural soils in the Mekong River and Red River deltas

Max Häggblom (Department of Biochemistry ad Microbiology) and John Reinfelder (Department of Environmental Sciences) visited Vietnam to initiate collaborative research on microbial arsenic metabolism in rice paddy soils with investigators at Can Tho University, College of Agriculture and Hanoi University of Science and Technology, School of Biotechnology and Food Technology.

Arsenic (As) contamination of groundwater is of serious concern in many regions of Southeast Asia, including Vietnam, and is linked to As contamination of paddy soils, which threatens the health of populations relying on rice as a staple crop. Rice consumption is a key pathway for the dietary intake of both essential trace elements and toxicants, including As which is harmful to human health. Although generally present in the environment at low levels, As is actively metabolized by microorganisms, a process that has a strong impact on its mobility and bioavailability. Microbially mediated transformations modulate the toxicity of As and change its mobility and bioavailability, which in turn may affect its translocation and accumulation in plants. Hence, microbial transformations of As can have a direct effect on the nutritional quality of various crops, especially rice. In pilot experiments we aim to cultivate and isolate As-respiring bacteria from agricultural soils in the Mekong and Red River watersheds to obtain site-specific reference strains for physiological characterization and for use in molecular monitoring of community dynamics and activity. With our collaborators we will design a combination of greenhouse experiments and field site analyses comparing water management and rice cultivation methods to demonstrate the activity of As-reducing microbes under in situ conditions and determine how their abundance and activity are affected by changes in the redox environment and differences in site water and soil chemistry.

In addition to sampling of As-contaminated agricultural soils in the Mekong River and Red River deltas, Profs. Häggblom and Reinfelder presented research seminars and taught a short course on environmental microbiology and science for M.S. and Ph.D. students and early career scientists at Can Tho University and Hanoi University of Science and Technology.

The research visit was funded by an International Collaborative Research Grant from Rutgers Global.

DBM Newbies

Shreya Ghosh

Shreya joined Liping Zhao's lab in July 2022 to characterize the effects of nutritional formula, food components, natural products, and xenobiotics on the gut microbiota, and develop and conduct clinical interventions that promote beneficial gut bacteria for the prevention and/or treatment of human diseases.

DBM Newbies Continued

Jennifer Sun
Rutgers
Presidential Postdoctoral
Research Fellow

Jennifer S. Sun joined the Biochemistry and Microbiology Department at Rutgers University in December 2022 as a Rutgers Presidential Postdoctoral Research Fellow. Jenn's academic journey began at Rutgers in 2009, where she completed her B.A. in Molecular Biology & Biochemistry (SAS '13). During her undergraduate years, Jenn conducted research in the Departments of Entomology and Chemistry & Chemical Biology. With Dr. Randy R. Gaugler, she investigated the relationship between mosquito larvae and parasitic mermithid nematodes. With Dr. G. Charles Dismukes, she studied protein and lipid biosynthesis in the diatom Phaeodactylum tricornutum and completed an undergraduate thesis on photoassembly efficiencies of natural isoforms of Photosystem II D1 subunit. Jenn's passion for scientific exploration led her to pursue a Ph.D. in Molecular, Cellular, and Developmental Biology at Yale University with Dr. John R. Carlson, where she mapped insect chemosensory receptors and profiled their ligands. From this map, Jenn identified and characterized a mis-categorized olfactory protein (Obp59a) involved in humidity detection. After graduating in 2019, Jenn continued her scientific pursuits at Princeton University as a postdoctoral fellow in Dr. Bonnie L. Bassler's laboratory, this time examining how phage VP882 hijacks bacterial quorum sensing to facilitate viral spread. In 2021, Jenn then joined the New York Genome Center and New York University as a Senior Scientist and Grant Writer, contributing to the acquisition of multiple R01 and foundational grants for the lead PI, Dr. Neville E. Sanjana. Inspired by her academic experiences, Jenn resolved to return to Rutgers and pursue a research and teaching faculty position. During this most recent career change, Jenn is deeply grateful for the support she has received from esteemed colleagues – Max Häggblom, Jeffrey Boyd, G. Charles Dismukes, Yana Bromberg, Ines Rauschenbach, Alvaro Toledo, and Wendie Cohick. Jenn is blessed to be back at Rutgers, working with several talented and driven undergraduate researchers – two Research in Microbiology students in 2022-2023; and one Aresty Research Assistant and three George H Cook Thesis students in 2023-2024.

Situated within Lipman Hall, Jenn's research team focuses on the impact of microbial symbiosis on insect host behavior. Insects' ability to sense and react to their environment contributes to the persistence of species. Chemosensation is not only instrumental in insects identification of food, mates, and predators, but olfaction in particular is influential to geographical distribution and overall survival. Insect endosymbionts have recently been shown to influence the plasticity of these insect olfactory systems, modifying insect behavior in response to volatile signals. Previous studies have unraveled mechanisms involved in the acquisition, maintenance, and transmission of endosymbionts, and other groups have studied effects of endosymbionts on insect reproduction.

Yet, little is known about how endosymbionts directly affect transmissibility of insect-borne diseases through mating-independent mechanisms. Even less is known about which and how endosymbionts impact host-seeking behavior in insect vectors of disease. An investigation of the impact of endosymbionts on insect olfactory systems, particularly in harmful insect vectors of human diseases, is thus required. Jenn and her team are thus tackling the following Aims: Assess changes to the olfactory system in response to gut microbial community composition, beginning with Drosophila melanogaster as a model organism (Figure two); Reveal endosymbiont-mediated mechanisms underlying changes to the host olfactory system; and Characterize endosymbionts present in Aedes albopictus. The discoveries they make may be useful in devising new, highly-targeted, environmentally-safe strategies for control of insect pests and/or the diseases they transmit.

Williams A, Stephens TG, Shumaker A, & **Bhattacharya D** (2023) Peeling back the layers of coral holobiont multi-omics data. iScience.

Van Etten J, Stephens TG, & **Bhattacharya D** (2023) A k-mer-based approach for phylogenetic classification of taxa in environmental genomic data. Systematic biology, syad037. Advance online publication.

Lee Y, Cho CH, Noh C, Yang JH, Park SI, Lee YM, West JA, **Bhattacharya D**, Jo K, & Yoon HS (2023) Origin of minicircular mitochondrial genomes in red algae. Nature communications, 14(1), 3363.

Van Etten J, Benites LF, Stephens TG, Yoon HS, & **Bhattacharya D** (2023) Algae obscura: The potential of rare species as model systems. Journal of phycology, 59(2), 293–300.

Cho CH, Park SI, Huang TY, Lee Y, Ciniglia C, Yadavalli HC, Yang SW, **Bhattacharya D**, & Yoon HS (2023) Genome-wide signatures of adaptation to extreme environments in red algae. Nature communications, 14(1), 10.

Hudspeth JD, Boncella AE, Sabo ET, Andrews T, **Boyd JM**, Morrison CN (2022) Structural and Biochemical Characterization of *Staphylococcus aureus* Cysteine Desulfurase Complex *SufSU*. American Chemical Society Omega. PMID: 36506149.

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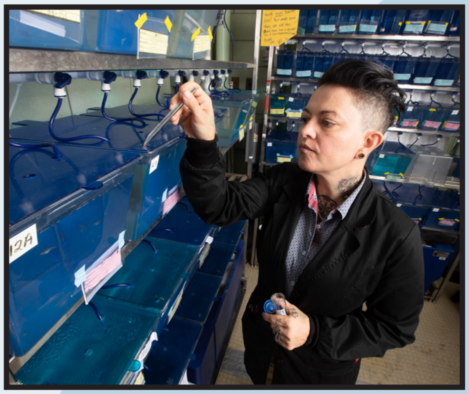
Graduate Research Ph.D. Theses

Gina Moreno, PhD |**Graduate Program: Environmental Science: Aquatic |Ecological Toxicology| Advisor: Keith R. Cooper**

Structure Activity Toxicity Of Different Micro-Nanoplastics On Developing Zebrafish (*Danio Rerio*) Based On Individual Polymer Chemistry

Plastic is an umbrella term for many polymers with different monomeric chemical structures. Plastics and their breakdown products are ubiquitous in our ecosystem with an estimated ~390 million metric tons produced in 2021. In the environment, plastics are broken down into micro and nano plastics (MNPs), and little is known about the toxic effects of MNPs on eukaryotic organisms. The studies described in this dissertation examine the toxicity associated with exposure to specific plastic polymers on Zebrafish (Danio rerio). Both environmentally collected and pure plastic polymers were used to examine the impact of environmental breakdown on toxicity. The 10 monomeric chemical structures tested exhibit different toxic responses, including cardiac anomalies, yolk sac alterations and growth perturbations. Field weathered plastics did show different responses compared to non-weathered plastics. These observations reinforce the importance of not combining plastics into a single toxic category when assessing comparative risk but should be based on the polymers monomeric chemical structure. Policy and management decisions could be based on a Life-Cycle analysis and ecological impacts for the individual polymer plastics.



Apostolos Zournas, PhD

Graduate Program: Biophysics / Biochemistry | Advisor: Charles Dismukes

Computational and biophysical tools to investigate the coupling of the light and dark reactions of photosynthetic organisms at the photosystem and cellular levels

Photosynthetic molecular machinery is the primary source of energy in the biosphere of the earth and understanding these processes is crucial for addressing the world's growing food and energy needs. Plants, algae, and cyanobacteria have evolved over billions of years to harness the light energy of the sun and convert it to chemical energy to produce biomass and perform all the required cellular processes. This process involves extracting electrons from water and creating a proton gradient, which is essential for carbon fixation through the Calvin Benson Bassham (CBB) cycle. These are traditionally monitored using O2 evolution and Chlorophyll Fluorescence yield, associated with the water-splitting protein, Photosystem II (PSII). The thesis aimed to extract that mechanistic knowledge of these processes. An ordinary differential equation (ODE)-based model of PSII, namely RODE1, and developed a framework to discretize the solutions of the ODEs to connect them to the parameters calculated in the Kok-type HMM models. Charge separation in the donor side of PSII is tightly controlled by the acceptor side, where electrons are transferred to Plastoquinone (PQ) which shuttles the electrons downstream to the Photosynthetic Electron Transport Chain (PETC). The study also explored backward transitions within PSII, which involve electrons moving from the acceptor to the donor side. This process is influenced by the state of the PQ at the donor side, providing insights into Cyclic Electron Flow around PSII (PSII-CEF) mechanisms. The model was expanded to include the appropriate reactions and applying it to O2 evolution data acquired from Chlorella ohadii, a desert crust alga. The process of backward transitions is again regulated by the donor and the acceptor side. The PSII microstates that allow for backward transitions were loosely bound PQ at the donor side (QB) and carry a single electron in the form of a semiquinone, rather than being fully oxidized (0 e-) or fully reduced (2 e-). The proposed mechanism is a potential pathway for Cyclic Electron Flow around PSII (PSII-CEF) that can be used for photoprotection (dissipative PSII-CEF) or to increase the proton gradient across the thylakoid membrane (generative PSII-CEF). The last objective was to develop a method to study the PETC from water to CO2. Using Fast Repetition Rate fluorometry (FRRf) we showed how the kinetic features respond to altering photosynthetic electron transport through multiple treatments and and identified the redox events that each kinetic feature corresponds to.

Microbial Biology Graduates

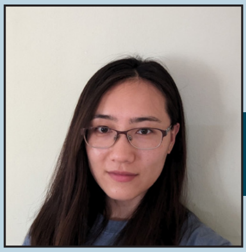
Degree	Name	Advisor
Ph.D.	Benjamin Diaz	Kay Bidle
Ph.D.	Aishwarya Deshpande	Nicole Fahrenfeld
M.S.	Lauren Hinger	Alvaro Toledo
M.S.	Kathryn Kingsley	James White
M.S.	Megha Soni	James White
M.S.	Josmary Medrano	Martin Blaser

Amanda Williams, PhD

Graduate Program: Microbial Biology | Advisor: Debashish Bhattacharya

Elucidating the stress phenome in reef building corals through a multi-omics approach

Coral bleaching, or the expulsion of the algal symbionts providing coral polyps with their fixed carbon needs, precipitated by anthropogenic stress has emerged as a global threat to coral survival. Although much of the bleaching mechanism has eluded investigation to date, I obtained key findings regarding the holobiont's thermal stress response through applying multiomics techniques (transcriptomic, proteomic, metabolomic, and metagenomics) to support the production of diagnostic tools capable of detecting coral stress before extensive bleaching occurs. The discovery of clear metabolic biomarkers (i.e. dipeptides, ketone bodies, immune cells, and various proteins) of thermal stress early in the bleaching process, as well as for the coral reproductive cycle, will enable their detection for conservation efforts. I developed a protocol to obtain qualitative measures for two of these biomarkers through the use of commercially available in vitro diagnostic test strips. Additionally, I analyzed how well each omics dataset interacts across the coral holobiont and how well their overall patterns correlate with thermal stress. I found that transcriptomic and proteomic data broadly capture the stress response of the coral, but the complexity and nature of metabolome and microbiome data complicates their analysis and integration because their patterns are affected by multiple factors beyond the applied thermal stress treatment. Ultimately, my thesis highlights the potential, as well as the limits, of multiomics data applications concerning data interpretation and diagnostic test development for the coral holobiont.



Ying Wang (Elsa), PhD

Graduate Program: Microbial Biology | Advisor: Liping Zhao

The Effect Of Combinatory Dietary Fibers On The Gut Microbiota And Human Gastrointestinal Health

Dysbiotic gut microbiomes, marked by the proliferation of harmful bacteria, are associated with various gut diseases like irritable bowel syndrome, inflammatory bowel disease, and conditions in distant organs such as obesity, type 2 diabetes (T2DM), acute and post-acute COVID-19. A high-fiber diet rich in diverse fibers has been found to alleviate T2DM by selectively promoting short-chain fatty acid (SCFA)-producing gut bacteria while suppressing pathogens such as a guild of endotoxin producers. A high fiber formula with selected ingredients was tested in an in vitro fermentation system using stool samples from T2DM patients and healthy individuals. This formula boosted the production of beneficial acetic, propionic, and butyric acids and brought microbial metabolite profiles of T2DM patients closer to those of the healthy subjects. Eight key bacterial groups (co-abundance groups,CAGs) responded to the high fiber formula intervention with 3 potential SCFA-producing CAGs being increased and 5 potential pathogenic CAGs being decreased by the formula. Each CAG consisted of members from widely different taxa indicating that the gut microbiota responds to combinatory fiber treatment as potential guilds rather than taxonomic groups. Selective promotion of SCFA-producing CAGs may reduce gut dysbiosis and enhance the gut microbiota's functionality. The formula alleviated severe gastrointestinal symptoms in a post-acute COVID-19 patient and demonstrated the potential of in vitro fermentation for predicting microbiome changes resulting from dietary interventions. To increase sensitivity in detecting dietary fiber-induced changes during early-stage in vitro fermentation, the DNA extraction method was optimized. By combining lysozyme pretreatment with chemical and mechanical treatments, saturated cell lysis was achieved, enabling the detection of microbiome differences between samples with different fiber treatments. Overall, my research revealed that the high fiber formula may modulate the microbiome into a healthier state via promotion of SCFA-producing bacteria alleviate GI symptoms of post-acute COVID-19 syndrome and potentially other functional GI disorders.

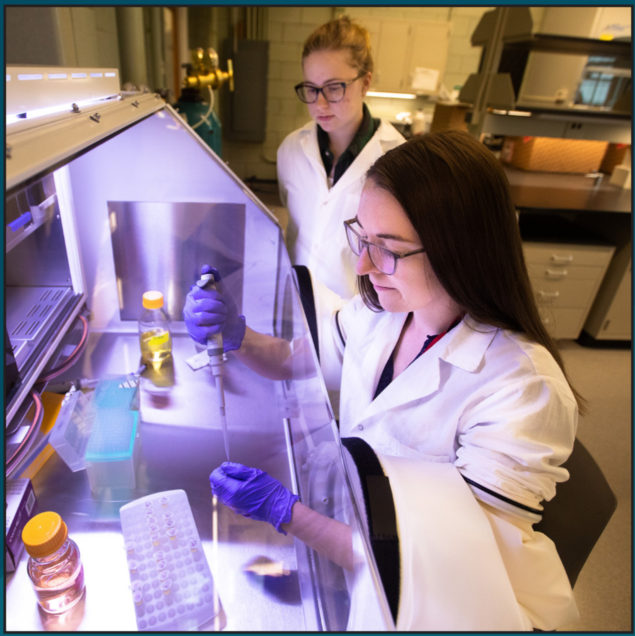
Michelle Laura Zeliph, PhD

Graduate Program: Microbial Biology | Advisor: Max M. Häggblom

Bugs on Drugs: The Microbially Mediated Fate of Pharmaceuticals in Anoxic Environments

Pharmaceuticals and personal care products (PPCPs) are emerging contaminants in aquatic ecosystems throughout the world. These compounds are biologically active and can thus pose a risk to aquatic biota. The major goal of this study was to determine how environmental conditions, including redox, PPCP input, and salinity, impact the biodegradability of select PPCP compounds and the bacterial communities responsible for their degradation in anoxic estuarine sediments and WWTP sludge. The degradation of acetaminophen, aspirin, ibuprofen, and diclofenac was studied in sulfate-, nitrate-, and carbonate-rich anaerobic cultures established using sediment from the Arthur Kill, Hudson River, Jiulong River, and Raritan River, and activated sludge from a Central New Jersey WWTP. Similar PPCP degradation profiles were observed across these sites. Acetaminophen and aspirin were found to be readily degradable, while diclofenac and ibuprofen were largely found to be recalcitrant. Different species of bacteria with diverse metabolisms were responsible for aspirin degradation in sulfate-rich cultures and varied based on the source of inoculum. When PPCP degradation was studied in microcosms established using sediment and site water collected along a freshwater-estuarine gradient in the Raritan River, the bacterial communities in enriched aspirin- and acetaminophen-degrading cultures were found to differ depending on the PPCP, but community profiles were similar along the gradient.

Thank you for your Support



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Editors: Max Häggblom, Lindsay Vasy

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