

# The Lipman Log

2014



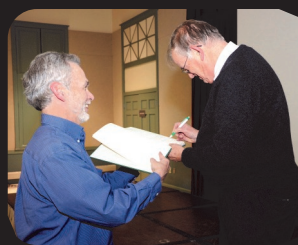
Anil Goyal and Doug Eveleigh



Arleen Nebel, Matt and Brianna



Sheer Fun!



Dennis Fenton & Doug Eveleigh



Zuelay Rosario-Cruz

## News from the Chair, Max Häggblom



Summer Greetings from Lipman Hall! This issue of the Lipman Log includes some of the highlights from the 2013-2014 academic year. We hope that you will enjoy reading about the various activities and accomplishments of our students and faculty, and the awards and recognition that they have received.

In February, our annual Microbiology Symposium honored our very special Prof. Douglas Eveleigh (see p. 2). Sheer Fun!!! It was a wonderful event and delight to have such a gathering of Doug's students, postdocs and colleagues pay tribute to his career. Truly inspiring! Doug now transitions onto a permanent sabbatical. To honor Doug and to support our next generation of students we have established the Douglas E. Eveleigh Endowed Graduate Fellowship and the Douglas E. Eveleigh Graduate Student Travel Award. Please see the back page on how you may contribute.

It is our pleasure to congratulate Dr. Costantino Vetriani on his promotion to Professor. You can read about his exciting research program in elucidating the microbial life of deep-sea hydrothermal vents on page 4. Costa currently serves as the Director of the Microbiology Undergraduate Program.

We also congratulate Dr. Diane Davis on her promotion to Assistant Teaching Professor. Diane is a highly effective teacher and has played a central role in our microbiology undergraduate program over her many years of service. Most recently she developed a new course "Living in the Microbial World" for non-science majors, that examines the impact of the microbial world on humankind.

We are delighted to have a new Instructor join our faculty, Dr. Natalya Voloshchuk, who teaches the Experimental Biochemistry laboratory courses. Our Instructors play a critical role in our ability to serve the increasing student body enrolled in the large service

and laboratory courses in biochemistry and microbiology. We also welcome our new Secretarial Assistant, Nalini Kual, and congratulate Jessie Maguire on her promotion to Business Assistant. Arleen Nebel retired in November 2013, after many years of dedicated service to our department and to Rutgers University.

Our scholarly undergraduate and graduate programs in biochemistry and microbiology are flourishing, and it is always a delight to follow the achievements of our students. Our graduate and undergraduate students are engaged in many exciting research projects with our faculty members (see pages 8-11). Rutgers Day-AgField Day continues to be a fun event and an opportunity to meet alumni and friends. "Boisterous Biochemistry and Marvelous Microbiology" is our program theme. As in previous years, the undergraduate and graduate students of our department coached budding scientists in the wonders of biochemistry and microbiology.

September 2013 we had the pleasure of presenting a plaque to Dr. H. Boyd Woodruff commemorating the description of a new bacterial species, *Seleniivibrio woodruffii* (Rauschenbach et al. 2013). The bacterium is named in honor of Dr. Woodruff, a Rutgers University alumnus, for his lifetime dedicated to the advancement of science and his contributions to soil and microbiology and the discovery of natural products important to human and animal health and agriculture. The H. Boyd Woodruff Graduate Fellowship in Microbiology established with the very generous endowed gift of Dr. H. Boyd and Jeannette I. Woodruff supported Ines Rauschenbach in her first year as a Ph.D. student at Rutgers.



Ines Rauschenbach, H. Boyd Woodruff and Max Häggblom

I wish to thank all our donors for your support. Your donations provide important student scholarships, awards and travel fellowships. We hope that you will continue to show your support for the department and our scholarly programs in the future.

**Editors: Douglas E. Eveleigh, Max M. Häggblom and Kathy Maguire**

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# Microbiology with Professor Douglas Eveleigh - *Sheer Fun!* February 7, 2014



Dick Monaghan



Doug Eveleigh Dennis Fenton, Christine Rotgers, David Benson, Diane Davis and Frank Ritacco



Jon Heinrichs, Jim Macmillan, Patricia Ryan and Laura Macmillan



Sudha Rani, Doug Eveleigh and Dinesh Yernool

**Professor Douglas E. Eveleigh**, Fenton Professor of Applied Microbiology, is a tour de force in microbiology with over 40 years of distinguished service to Rutgers and the broader scientific community. He has been a member of the Department of Biochemistry and Microbiology at Rutgers since 1970.

Professor Eveleigh's interest range from the microbial transformation of plant polysaccharides to the conservation of antique manuscripts and the history of microbiology. He is known internationally for his studies in industrial fermentations, particularly cellulase and gasohol. He and his students pioneered the field of cellulosic biofuels - 40 years ago! It is again a hot topic - and now many of his former students are leading the charge. Professor Eveleigh's interest in the history of science and of microbiology in particular inspired the creation of the American Society for Microbiology Milestones in Microbiology Program, which recognizes institutions and the scientists who worked there for significant contributions toward advancing the science of microbiology. Selman Waksman's Laboratory at Rutgers University was the first to receive this distinction in 2002. Over the years Prof. Eveleigh has spearheaded many events from symposia on the antibiotics discoveries to the re-enactment of the classic 1783 experiment by General George Washington and Thomas Paine of their discovery of the nature of the fiery Will-O'-the-Wisp of marshes and rivers.

Prof. Eveleigh's expertise is recognized in both the academic and industrial worlds and his role as an instructor and academic mentor is highly respected. Throughout his career he has taught general microbiology, microbial technology, industrial microbiology and microbial ecology. He has trained over 50 Ph.D. and M.S. students in his research laboratory, who have then gone on to distinguished careers in academia, industry and government. By conservative estimate more than 6000 undergraduate students have learned their microbiology from Prof. Eveleigh and been enriched by his enthusiasm and eclectic approach to teaching. He has infected countless students, staff and faculty colleagues alike with his passion and enthusiasm. With Doug, microbiology is "Sheer Fun"! Thank you for joining us in celebrating Microbiology with Professor Douglas Eveleigh.

### Speakers: All former students of Dr. Eveleigh:

**Richard Monaghan:** "It was like a fraternity rush, and then..."; **Keith Elliston:** "From bugs to brains - a random walk through a random forest..."; **David Benson:** "Mental porpoising and the motatorious life"; **Jennie Hunter-Cevera:** "I did it Doug's way: Mixing academia and industry and making the most of it"; **James McCarthy:** "How Queen Elizabeth's victory over the Spanish Armada helped me find a home in the Eveleigh lab"; **Tom Kelleher:** "Dr. Eveleigh's contribution to the Nantucket Field Station"; **Ivica Labuda:** "From Slovakia with love"; **Frank Ritacco:** "From Streptomyces to cell culture - with thanks to Doug for his guidance and friendship"; **Dinesh Yernool:** "Everything is superbly interesting: The DEE hypothesis-free model for research" and **Dennis Fenton:** "How I learned everything I needed to know in life in Doug's Lab".



Tom Jeffries



Anil Goyal



James Flip McCarthy, Linda and Doug Eveleigh



Tom Kelleher and Doug Eveleigh



## 2014 Waksman Outstanding Teaching Award from the Society for Industrial Microbiology and Biotechnology



**Professor Max Häggblom** received the **SIMB Waksman Outstanding Teaching Award** at the SIMB Annual Meeting in St. Louis, July 20-24, 2014. He was nominated for this award by his former undergraduate and graduate students and postdoctoral fellows. Dr. Häggblom has been on the faculty at Rutgers University since 1993, where he is currently Chair of the Department of Biochemistry and Microbiology. He teaches in the microbiology undergraduate and graduate programs, including the courses Applied Microbiology, Microbial Life, Analytical Methods in Microbiology, and the summer study abroad course Microbiology and Culture of Cheese and Wine. Dr. Häggblom's research interests are in microbial ecology, environmental biotechnology and in the bioexploration, cultivation and characterization of novel microbes. A common theme is the "unusual appetites" of bacteria, whether in the biodegradation and detoxification of xenobiotic chemicals or natural products, respiration of the metalloids selenium and arsenic, or life in the cold. He and his students and postdocs study projects that span from fundamental projects on the physiology, ecology and taxonomy of bacteria involved in

biotransformation and biodegradation of natural and anthropogenic chemicals to applied research projects focused on development of novel bioremediation technologies for degradation and detoxification of these compounds in soils, sediments and groundwater. The major thrust has been on characterizing the physiology and ecology of bacteria that degrade halogenated aromatic compounds, polycyclic aromatic hydrocarbons and the fuel oxygenate MTBE, and while unraveling underlying novel metabolic pathways discovering and characterizing new bacterial species and assessing their *in situ* microbial activities. A more recent research theme is the exploration of the bacterial diversity in Arctic soils and sediments and the response of the microbiota to changing environmental conditions. Prof. Häggblom has advised over 30 PhD and MS students (8 current), 60 undergraduate research students and 15 Post-Doctoral Associates.

**SIMB Waksman Outstanding Teaching Award.** Noble Laureate Dr. Selman Waksman was an outstanding teacher of microbiology at Rutgers University, who maintained very cordial and effective relations with industry throughout his career as an academic scientist. The recipient shall have been an active full time professor at a recognized institution of higher education for a minimum of 10 years or has attained emeritus status. He/she shall have an active involvement in research in his/her teaching field while carrying a teaching load, and involvement in or contributing to research that leads to advances in his/her career of industrial or applied microbiology or biotechnology. The nomination must be supported by letters from three former undergraduate or graduate students or postdoctoral fellows who have careers of their own in microbiology or biotechnology.



## Hans Fisher Fellowship for Outstanding Early-Career Scientists

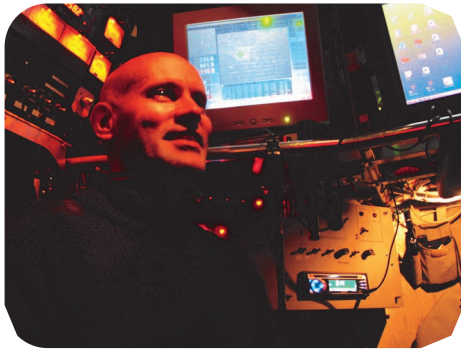


**Assistant Professor Yana Bromberg** has been awarded a **Hans Fisher Fellowship** for outstanding early-career scientists at the Institute for Advanced Study at the Technical University of Munich (TUM-IAS). This three-year fellowship supports a PhD-level graduate student to work under Dr. Bromberg's supervision. It also provides financial support that will allow Dr. Bromberg to spend time at TUM-IAS refining and developing advanced bioinformatics techniques, useful in medical research and industrial applications.

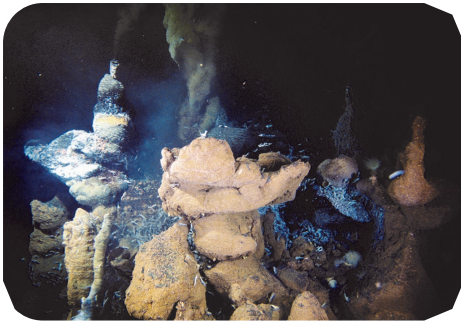
The fellowship funds "high risk, high reward" research and is named for TUM Professor Hans Fisher (1881-1945), a pioneering biochemist who received the Nobel Prize in Chemistry in 1930. Fellows are given the freedom to pursue research activities that have longer-term applications. The award is for 80,000 Euro, which will cover living and research expenses while at TUM-IAS, plus additional funding for graduate student support over three years.

Dr. Bromberg will collaborate with Dr. Burkhard Rost, head of the Unit for Computational Biology & Bioinformatics at the Department of Informatics of TUM to develop new computational algorithms for the exploration of the microbial world. Their methods for function-based microbial classification will highlight habitat-specific organismal differences and help detect emergent molecular pathways encoded in metagenomic samples, i.e. functions that can only be carried via whole microbial community-wide interaction. Dr. Bromberg hopes that her function-based approach to quantifying microorganism similarity, in conjunction with a new metagenomic functions mapping algorithm, will significantly contribute to the understanding of the microbial world. Thus, the proposed work will contribute to the innovation of the scientific or technological environment at Rutgers, TUM, and beyond.

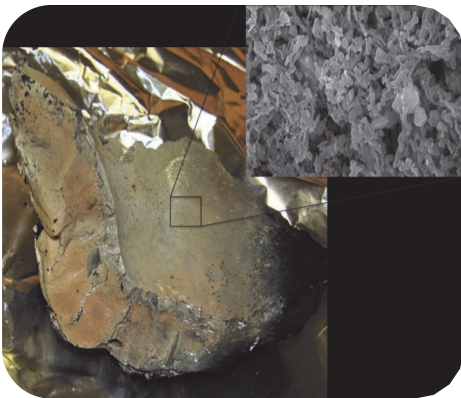
## Costantino Vetriani — Microbiology of Deep-Sea Hydrothermal Vents



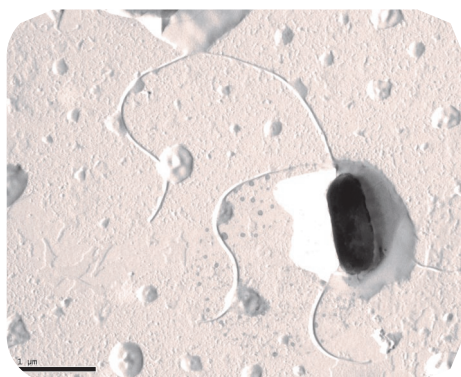
**Costantino Vetriani** Professor in the Department of Biochemistry and Microbiology and IMCS, and is the director of the Microbiology Undergraduate Program at Rutgers University. He studies microorganisms that live in the deep ocean. He began his research activity in a clinical microbiology lab and, as a PhD student, trained as a prokaryotic molecular geneticist. In 1995 he moved from Rome, Italy, to the United States, where he joined the Center of Marine Biotechnology in Baltimore, MD and, later on, Rutgers University. In 1995 Costa Vetriani participated in the Microbial Diversity summer course at the Marine Biological Laboratory in Woods Hole, MA. For him, that was a career changing experience, and one that he would recommend to any microbiology student. Since 1996 Costa Vetriani has participated either as research or chief scientist in 16 deep-sea expeditions in the Pacific and Atlantic Oceans, and dove in the Deep-Submergence Vehicle Alvin many times. Costa Vetriani is a passionate SCUBA diver and underwater photographer. For more information about Costa Vetriani's research, visit the Deep-Sea Microbiology Lab website: <http://marine.rutgers.edu/deep-seamicrobiology/>



Snake Pit, a deep-sea hydrothermal vent on the Mid-Atlantic Ridge. White shrimp are the dominant fauna at this site. An actively venting black smoker is visible in the background. Depth: ~ 3500 m.



Fragment of seafloor basalt covered with a white microbial biofilm, recovered from an active vent following the 2006 volcanic eruption. The inset is a Scanning Electron Micrograph (SEM) of the microbial biofilm. Note the high cell density and complex structure.



Of all environments on Earth at which life flourishes, deep-sea volcanoes are probably the most extreme. Temperatures within many of these systems range from 2-400°C, pressures are in excess of several hundred atmospheres, and concentrations of hydrogen sulfide and many heavy metals (e.g., Cu, Zn, Fe, Cd, Pb) frequently exceed levels normally considered toxic to biological systems. During the cycling of seawater through the earth's crust along the mid-oceanic ridge system, where most deep-sea volcanoes occur, the reaction of seawater with crustal rocks at high temperatures enriches the hydrothermal fluids with reduced organic and inorganic chemical species. The hydrothermal fluids are then emitted from warm ( $\leq 25^\circ\text{C}$ ) and hot ( $\sim 350^\circ\text{C}$ ) submarine vents at depths reaching about 4000 m. Since sunlight does not reach the deep ocean, the organisms that inhabit deep-sea vents do not rely on photosynthesis for the production of organic carbon. Instead, microbes that colonize deep-sea vents take advantage of redox gradients (e.g., oxic/anoxic region between oxygen-depleted hydrothermal fluids and oxygen-rich seawater) to mediate the transfer of chemical energy into biochemical energy (e.g., ATP). Microbes then use the energy stored in ATP to synthesize organic carbon from carbon dioxide, a process overall known as chemosynthesis (synthesis of organic carbon using chemical energy). In 2006 a volcanic eruption occurred along the East Pacific Rise (EPR) ridge crest between 9°48'N and 9°51'N. Seafloor images along the ridge crest documented an extensive flow of fresh lava, which was covered with white microbial biofilms in areas of vigorous hydrothermal flow venting. During a series of oceanographic expeditions on the R/V Atlantis, Dr. Vetriani, in collaboration with R. Lutz, G. Luther, T. Shank, S. Sievert and N. Le Bris, among other researchers, used the Deep-Submergence Vehicle Alvin to explore the post-eruptive vents on the EPR. During our dives we collected microbial biofilms using experimental microcolonizers and we conducted co-located *in situ* fluid chemical measurements. The microorganisms that colonize deep-sea vents are expected to be able to adhere to and colonize solid substrates (to establish biofilms and to better access nutrients in these highly turbulent environments), to be metabolically versatile (to take advantage of the dynamic redox gradients typical of these environments), and to use detoxification mechanisms that allow them to survive in an environment where many toxic heavy metals are present at high concentrations. Back in the laboratory, we are investigating these microbial biofilms using several experimental approaches, including electron microscopy, microbial growth experiments, genomics, transcriptomics, next generation sequencing and bioinformatics.

Parallel sequencing analyses of the biofilms' metatranscriptome (i.e., the total pool of transcribed RNAs) indicate that biofilms exposed to different temperature (up to about 50°C) and biological regimes (presence/absence of animal colonists) are dominated by a group of Proteobacteria, the Epsilonproteobacteria, which are optimally adapted to colonize environments defined by sharp redox gradients. Furthermore, microbial growth experiments led to the isolation of several pure cultures of Epsilonproteobacteria that can establish biofilms, regulate community gene expression using chemical signals, and conserve energy using various inorganic chemical species found in vent fluids. Finally, the genome sequences of some of these organisms are helping us to identify specific metabolic pathways critical to survive in the harsh deep-sea vent environment. We are currently using these organisms as laboratory experimental models to understand their physiology, metabolism and gene expression. This integration of multiple approaches is critical to understand the ecology and evolution of deep-sea microorganisms.

Electron micrograph of *Caminibacter mediantlanticus*, an Epsilonproteobacterium isolated in Dr. Vetriani's laboratory from a deep-sea hydrothermal vent. The flagella, which are used by the bacterium to swim, are visible. The genome sequence of this bacterium has been completed with funding from the G. & B. Moore Foundation



# Our Faculty



## Awards/Grants/Activities

**Professor Keith Cooper** was appointed by Governor Christie as Chair of the Drinking Water Quality Institute for the New Jersey Department of Environmental Protection.



The **Dismukes** group to lead Rutgers participation in SOFI Demo Project - **The Solar Fuels Institute** is leading a demo project to promote awareness for alternate energy sources. Rutgers is proud to join this team in contributing Electrocatalytic Oxygen Evolution Reaction (OER catalysts).

**Dr. Tamar Barkay** spent the Fall of 2013 on sabbatical at Montana State University researching the interactions of microbes with mercury in Yellowstone National Park hot springs.

The **Barkay lab** has received a lot of buzz at the beginning of 2014 with the funding of a new project, and the addition of new researchers. Our new project funded by the National Science Foundation/office of Polar Programs, "*Collaborative research: Effects of trophic status alterations on pathways of mercury methylation in northern wetlands*" examines how methylation of mercury is affected by global warming induced changes to wetlands in Alaska. This project is a collaboration between our lab and that of Mark Hines, Department of Biological Sciences at UMass Lowell, and the USGS lab in Madison, Wisconsin David Krabbenhoft, Research Hydrologist, Geochemist.



**Max Haggblom** was awarded a grant from the National Science Foundation: Natural Attenuation and Enhanced Biodegradation of Methyl tert-Butyl Ether in Anoxic Aquifers (2013-2016). Methyl tert-butyl ether (MTBE) is an intriguing groundwater pollutant. MTBE is a synthetic chemical with no natural sources and its biodegradation is a challenge to microorganisms. Our project seeks to elucidate the activity of bacteria that mediate degradation of MTBE in anoxic subsurface environments. Novel microorganisms and their genes responsible for transformation/degradation of MTBE will be identified to develop tools for monitoring natural attenuation and enhanced biodegradation of MTBE in contaminated aquifers and sediments.

## Events

In March Max Haggblom, with assistance from Preshita Gadkari and Stacy Brody, led an afternoon tasting and exploration of the microbiology and culture of cheese and wine. While savoring the complex tastes and aromas of different cheese and wine varieties, the fifty participants learned how bacteria and fungi are central in processing milk into cheese and how the complex chemical and biological reactions during maturation give wine their character. The proceeds of the event provided travel scholarships for two students who attended the Study Abroad Course on the **Microbiology and Culture of Cheese and Wine** taught in June in Burgundy, France.



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## Our Faculty

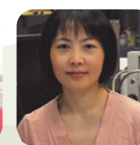


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## Our Faculty and Students



### Teaching



This Summer, **Professor Bill Ward** began his 4<sup>th</sup> year of teaching “*Experiments with GFP: The Art and the Science*” to gifted and talented youngsters from area middle schools and high schools. This hands-on biochemistry lab course, was held in Lipman Hall on the Cook Campus of Rutgers University, New Brunswick, NJ from July 7 to July 25, 2014. Two sections were available, one in the morning from 9 am to noon and one in the afternoon from 2 pm to 5 pm. “Experiments with GFP” a Rutgers Summer Session course that offers 3 college credits, has grown to be the largest of its kind at Rutgers University. It may also be one of few university courses that integrates the arts with the sciences. Registration for each section is limited to 24 students. The class is divided into 4 groups, each with an instructor who enjoys working with bright youngsters. The same instructor plays with his/her group throughout the three weeks—whether they are working in the lab or engaging in discussions in the adjoining lecture room.

**THE ART:** Conducting biochemical experiments with the amazingly brilliant green-fluorescent protein is an aesthetic experience all by itself. But, viewing live comb jellies (ctenophores) glowing in the dark, and then later, seeing their 8 rows of fused cilia diffracting daylight into a rainbow of colors is an incredible spectacle. Artistic aspects of the course are not confined to viewing bioluminescence. Each student, individually, was given an opportunity to design, on paper, an aquarium system suitable for maintaining comb jellies in an artificial sea water environment. Later, they created beautiful wall hangings directly from dried comb jellies collected off the coast of NJ. On the last day of the course, the kids, and sometimes the instructors, participate in an optional talent show. The most memorable show of talent was performed in the inaugural course by a 10-year-old boy who did 15 minutes of non-stop impromptu stand-up comedy. Move over Jerry Seinfeld!

**THE SCIENCE:** We began the lab exercises by extracting recombinant GFP from genetically transformed, non-pathogenic bacteria (*E. coli*). Safety is stressed in the lab, as each student wears goggles, lab coats, and gloves. Lab exercises with GFP include: high speed centrifuging to remove particles from the extract, ammonium sulfate precipitation to collect the protein fraction, three-phase partitioning (a seldom used, but spectacular method for purifying proteins), hydrophobic interaction column chromatography, and then a final “polishing” step by gel filtration. Throughout the process we monitor GFP purity by UV-Vis spectrophotometry and fluorometry. Students experiment with ion exchange separations on membrane absorbers, they test pH sensitivity of GFP, and they estimate the isoelectric point of the protein. Final purity is judged by high performance size-exclusion liquid chromatography. Every method was explained by the instructors in their small clusters. A 40-page course manual, called “Introduction to Chemistry and Biochemistry,” was emailed to each student.

Students with limited exposure to chemistry, but study this material before class begins, are able to follow nearly all of the chemistry introduced in the lab and in group discussions.

Lab exercises are not limited to work with GFP. On July 21, there was an all-day bus trip (8 am to 5:30 pm) to south Jersey (Stone Harbor), where naturalists took everyone on a flat-bottom boat cruise (on the Skimmer) through the salt marsh and then guided the group on a walk through sand dunes leading to the ocean beach. We pulled a large plankton net through the bay, hoping to collect some jellyfish or other marine creatures. In the lab, students did simple colorimetric tests for peroxidase from crude extracts of soybean hulls and from root vegetables like sweet potatoes, white potatoes, and celery roots. The colored product of this reaction (a teal blue solution) was then used to test for BPA (bis-phenol-A) in ordinary store receipts. Students were given prototype BPA test kits to take home to their parents and teachers to show them how to detect BPA in store receipts. Students keep notebooks, write a final lab report, take one quiz a week, and take a final exam.

We are pleased to report that **Professor Bill Ward's** electronic book chapter, “*The Art of Protein Purification*,” published by InTech on Jan 20, 2012, has gained wide acceptance by the international readership. Also published in book form, this 27-page chapter has been downloaded more than 6000 times. Congratulations on the significant impact that your work has achieved.



### 4H Summer Scholars Program



Members of the **ASM Student Chapter** participated in the 4H Summer Scholars Program in July teaching a lab to high school students about fermentation, and leading a hands-on activity to explore the wonders of biochemistry and microbiology. The young students were surprised to learn that yogurt is actually made by bacteria! They fermented their own yogurt and also measured ethanol production in yeast. At the end of the day the students prepared posters of their results and what they learned.

You can see more on Youtube:

<https://www.youtube.com/watch?v=ZRQXrdf9YNA&list=UUkG94HYnQvAv6eTwRR9vArQ>



## Our Graduate Students Ph.D Theses / Master Theses

**Timothy Arthur** Microbial Biology (MS 2014)  
On bacteriocin delivery systems and potential applications.  
Advisor: Michael Chikindas



Bacteriocins are antimicrobial peptides produced by a variety of bacteria. These peptides can act as antibiotic synergists or alternatives to enhance the therapeutic effects of current infection treatments and decrease the prevalence of resistant strains. Two bacteriocins, namely nisin and pediocin PA-1, are currently being used by the food industry; however, the introduction of these and others into the biomedical industry, and further development of food applications, have been challenged by the slow development of reliable delivery systems. For bacteriocins, these systems rely on novel and pre-existing technologies. Many essential variables need to be accounted for to formulate successful delivery methods. In this review, documented and potential bacteriocin delivery systems are examined, with special attention paid to how those systems are being implemented in the food and medical industries.



**Mpho Batlhophi**, Microbial Biology (MS 2014)  
The inhibitory effects of ammonia, volatile fatty acids and heavy metals on microbial communities during anaerobic digestion of waste.  
Advisor: Donna Fennell

Anaerobic digestion serves as a crucial method deployed in the degradation of organic matter which results in sludge stabilization and a decrease in the level of pathogens. Research shows that anaerobic digestion has been used for a long time to stabilize sewage. In this process, a consortium of microorganisms converts degradable compounds into methane and carbon dioxide. The supremacy gained by anaerobic sludge digestion over aerobic digestion is so far attributed to, in addition to other factors, production of methane. However, in some cases, the complexity of the chemistry and microbiology of anaerobic processes, its sensitivity to toxic substances and operating factors can render the process inefficient. Some of the toxic substances that hamper methanogenic activity include, but are not limited, to higher concentrations of cyanide, volatile fatty acids, heavy metals, and ammonia. Recent studies have elucidated on the sensitivity of methanogens to toxic compounds. This review will focus on the inhibitory effects of ammonia, heavy metals and volatile fatty acids on methanogens during anaerobic digestion of sludge, with emphasis on the main steps of the anaerobic digestion process, the current knowledge about the biochemistry behind hydrogenotrophic and acetoclastic methanogenesis, and the advantages of anaerobic waste digestion.



**Sean Carey**, Microbial Biology (MS 2013)  
Heavy pnictogen oxidation in *Bosea* sp. str. WAO  
Advisor: Lily Young

Recently, some bacteria have been observed to grow when exposed to antimony but oxidation is not noted. No bacteria have been tested to grow on or oxidize bismuth. Both of these pnictogens, from group 15 on the periodic table, could support autotrophic growth by serving as an electron donor. *Bosea* sp. str. WAO is able to oxidize arsenic, the lightest metallic pnictogen, for autotrophic growth. *Bosea* sp. str. WAO was given different concentrations of antimony and bismuth in minimal media that would only stimulate autotrophic growth. Concentrations of the redox species of antimony and bismuth were measured by a modified antimony procedure and a novel colorimetric titration method to test for bismuth. The results showed a stoichiometric decrease in the reduced species of antimony and bismuth over time and an increase in the oxidized species. The concentration of *Bosea* sp. str. WAO was observed to increase when either antimony or bismuth had been present, showing that both antimony and bismuth could be used for autotrophic growth.

**Allison Hicks**, Microbial Biology (MS 2013)  
Cell tropism predicts long-term nucleotide substitution rates of mammalian RNA viruses.  
Advisor: Siobain Duffy



The high rates of RNA virus evolution are generally attributed to replication with error-prone RNA-dependent RNA polymerases. However, these long-term nucleotide substitution rates span three orders of magnitude and do not correlate well with mutation rates or selection pressures. This substitution rate variation may be explained by differences in virus ecology or intrinsic genomic properties. We generated long-term nucleotide substitution rate estimates for mammalian RNA viruses and compiled comparable published rates, yielding a dataset of 118 substitution rates of structural genes from 51 different species, as well as 40 rates of non-structural genes from 28 species. Through multiple regression analyses, we evaluated the relationships between these rates and four ecological factors: target cell, transmission route, host range, infection duration; and three genomic properties: genome length, genome sense, genome segmentation. Of these seven factors, we found target cells to be the only significant predictors of viral substitution rates, with tropisms for epithelial cells ( $P < 2 \times 10^{-5}$  for the structural genes) or neurons ( $P < 3 \times 10^{-7}$  and  $P < 0.01$  for the structural genes and non-structural genes, respectively) as the most significant predictors. Further, one-tailed t-tests showed that viruses primarily infecting epithelial cells evolve significantly faster than neurotropic viruses ( $P = 1.83 \times 10^{-10}$  and  $P = 6.30 \times 10^{-4}$  for the structural genes and non-structural genes, respectively). These results provide strong evidence that the fastest evolving mammalian RNA viruses infect cells with the highest turnover rates: the highly proliferative epithelial cells. Estimated viral generation times suggest that epithelial-infecting viruses replicate more quickly than viruses with different cell tropisms. Our results indicate that cell tropism is a key factor in viral evolvability.



**Jason Krychiw**, Microbial Biology (MS 2014)  
Potential for manipulation of viruses of the Oomycete *Phytophthora infestans*  
Advisor: Bradley Hillman



**Jorge Montalvo**, Microbial Biology (MS 2013)  
Virus infection in the globally important Coccolithophore, *Emiliania huxleyi*.  
Advisor: Kay Bidle



**Nicholas Rose**, Microbial Biology (MS 2013)  
Mechanisms for extracellular electron transfer to anodes in bioelectrochemical systems and insoluble iron by *Geobacter sulfurreducens* and *Shewanella oneidensis*  
Advisor: Charles Dismukes







**Seanguoy Ho** Microbial Biology (MS 2014)  
RNA polymerase inhibitor activity against  
*Staphylococcus epidermidis* biofilms  
Advisor: Richard H. Ebright

Biofilms are defined as the structural phenotype of microbial communities enclosed in the self-produced polymeric matrix mainly composed of extracellular polysaccharides (EPS). *S. epidermidis* is associated with chronic diseases involving implant medical devices due to its strong ability to form biofilms and they are difficult to eradicate. Rifampin, one of the most active antibiotics used to treat biofilm-associated infections, is a bacterial RNA polymerase (RNAP) inhibitor; however strong bacterial resistance to this drug leads to the need to find more active compounds acting at the same target: bacterial RNAP. In this study, I test whether other bacterial RNAP inhibitors are also active against *S. epidermidis* biofilms by determining their Minimum Biofilm Eradication Concentration (MBEC) as compared to those of antibiotics functioning through target other than bacterial RNAP (reference antibiotics). Two biofilm assays were used: MBEC P&G assay using Calgary Biofilm device (peg assay) and glass biofilm assay. In the peg assay, biofilm density of  $6 \log_{10}$  of cfu/peg was obtained and used for biofilm susceptibility testing. In addition to Rifampin, three novel synthesized bacterial RNAP inhibitors were found to be more effective in completely eradicate *S. epidermidis* biofilms in vitro: 3RHTK27, 3RHTK44 and OMTK13 with MBEC value of  $25 \mu\text{g/ml}$ ,  $12.5 \mu\text{g/ml}$  and  $50 \mu\text{g/ml}$ , respectively. None of the other antibiotics were able to eradicate *S. epidermidis* biofilms (MBEC >  $400 \mu\text{g/ml}$ ). These three RNAP inhibitors were also found to be effective in glass biofilm assay having MBEC values of  $6.25 \mu\text{g/ml}$ ,  $3.125 \mu\text{g/ml}$  and  $25 \mu\text{g/ml}$ , respectively. These three compounds are interesting candidates for further development as antibacterial and anti-biofilm agents. Not all RNAP inhibitors which are active against planktonic cells are active against *S. epidermidis* biofilms. Seeing the same pattern of result from two different assays that reference antibiotics tested were not capable of eradicating biofilms while three out of eleven bacterial RNAP inhibitors tested were active is encouraging and suggesting that RNAP makes a good target for finding drugs to treat biofilm-related diseases.



**Jennifer McConnell**, Microbial Biology (MS 2013)  
Experimental validation of a predictive model for *Salmonella* growth in raw ground beef under dynamic temperature  
Advisor: Donald W. Schaffner

When food is transported at ambient temperatures for extended periods of time, or when power is lost during natural disasters; foodborne pathogens can multiply. Current US Food and Drug Administration (FDA) Model Food Code guidelines state that food can be kept out of temperature control for up to 4 h or up to 6 h if the food product starts at an initial  $41^\circ\text{F}$  ( $5^\circ\text{C}$ ) and the temperature does not exceed  $70^\circ\text{F}$  ( $21^\circ\text{C}$ ). This project validates existing ComBase computer models for *Salmonella* spp. growth under changing temperature conditions in raw ground beef as model system, using scenarios that would exceed Food Code guidelines. The growth rate of a 5-strain cocktail of *Salmonella* spp. meat isolates was inoculated in 20% fat ground beef at a concentration of 4-log CFU/g. Inoculated ground beef samples were temperature abused for different lengths of time and to different maximum temperatures. The temperature profiles represent loss of proper refrigeration, warming, and then cooling following a linear temperature gradient. When maximum temperatures were low, there was generally good agreement between the ComBase models and experiments. When maximum temperatures were closer to the optimum growth temperature for *Salmonella* ( $37^\circ\text{C}$ ), predictive models were fail-safe. Faster cooling times limit the growth of *Salmonella*, so rapidly cooling foods (e.g. in a freezer) after extended temperature abuse can work as a risk mitigation measure. Validation of these models will be useful to extension professionals advising consumers, restaurateurs transporting food in unrefrigerated vehicles, and retailers facing a power outage. These finding may also be useful to those seeking to improve the science base of the FDA Model Food Code.



**Pooja Mishra**, Microbial Biology (MS 2013)  
Characterization of the arsenate and selenate reducing bacterial community of agricultural soils of the Mekong River Delta, Vietnam.  
Advisor: Max M. Häggblom

Arsenic and selenium occur as metalloids in the Earth's crust and microorganisms can utilize the oxyanions of arsenic and selenium as terminal electron acceptors for respiration in the process of dissimilatory reduction. In this study the microbially mediated reduction of selenium and arsenic in agricultural soils of the Mekong river delta, Vietnam was investigated. By employing culture dependent enrichment setup and terminal restriction fragment length polymorphism (T-RFLP) community fingerprinting, we have been able to show the microbially mediated reduction of As and Se oxyanions in agricultural soils and sediments of staple crops such as rice and cabbage. An arsenate and selenate reducing bacterium belonging to the Enterobacteriaceae was isolated from the rice soil irrigated by ground water. Microbially mediated transformations of As and Se may modulate the toxicity of these elements and change their mobility and bioavailability, which affects their translocation and accumulation in plants. This study is providing basic information on the role of bacteria in As and Se biotransformation in agricultural soils of the Mekong river delta.



**Kimberly Anne Cruz**, Toxicology (Ph.D. 2014)  
Exocellular polysaccharides production by bacteria as a mechanism of mercury tolerance.  
Advisor: Tamar Barkay

Bacteria have adapted mechanisms of mercury (Hg) tolerance to survive in environments containing elevated Hg concentrations. The potential of extracellular polysaccharides (EPS) production by bacteria as a mechanism of Hg tolerance has not been previously investigated.

The objective of my dissertation was to determine if EPS produced by bacteria sorb Hg as a tolerance mechanism. Purified EPS with different chemical compositions isolated from bacterial pure cultures from microbial mats in French Polynesian atolls were assessed for Hg sorption. The data showed that EPS sorbed up to 82% of Hg from solution, that this sorption was dependent on EPS composition, and the sorption was a saturable mechanism. To determine if EPS production could alter Hg tolerance in bacteria during growth, an *E. coli* K-12 strain and its EPS defective mutant were obtained. A disc inhibition assay was performed demonstrating Hg inhibited growth in a dose-dependent manner. Assessment of EPS production between the two strains showed the wild-type produced two times more EPS than the mutant. Finally, EPS production and Hg tolerance were examined in bacteria isolated from an environment with naturally elevated Hg concentrations. Eight obligate and facultative chemolithoautotrophic bacteria tolerant to  $10 \mu\text{M}$   $\text{HgCl}_2$  were isolated from the East Pacific Rise at  $9^\circ\text{N}$ . Two of the isolates were selected for further characterization. Purge and trap experiments revealed that neither isolate reduced  $\text{Hg}^{2+}$  to  $\text{Hg}^0$  suggesting that the mer operon is not used for mercury tolerance. Three of the facultative chemolithoautotrophic strains produced EPS during growth. For two strains, there was 8% and 32% increase in EPS production during growth in the presence of Hg, suggesting EPS may be involved in tolerance. Together these data indicates that EPS production is a potential mechanism of mercury tolerance in bacteria.



## Our Graduate Students

**Honors and Awards:** Join us in congratulating the following students on their awards:



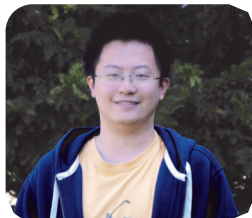
**Zuelay E. Rosario-Cruz** (4th year Ph.D. candidate in the Microbial Biology program) is the recipient of the Douglas E. Eveleigh Travel Award and the American Society for Microbiology (ASM) Travel Award. She works with Dr. Jeff Boyd and her research focuses on studying the physiological role of bacillithiol in the human pathogen *Staphylococcus aureus* which will be used to attend the 2014 ASM General Meeting in May 17-21 at Boston, MA. She received the honor to present in the Outstanding Student Poster category, in which only 40 students are selected for their outstanding research efforts. The title of her poster is "Investigating the role of Bacillithiol in iron-sulfur cluster metabolism in *Staphylococcus aureus*".



**Preshita Gadkari** (Häggbloom Lab) is the recipient of the Douglas E. Eveleigh Travel Award. Preshita will be using the award to fund her travel to Finland where she will be conducting research at the Finnish Forest Research Institute in Rovaniemi with Dr. Minna Männistö from June-mid July, as well as

attending an international Arctic microbiology meeting June 14th-17th in Kilpisjärvi, Finland north of the Arctic Circle where she presents her research. Preshita additionally received a \$1700 travel award from the Rutgers Graduate School to fund her summer research in Finland.

**Chensheng Zhu** (Bromberg Lab) received The Stephen M. Cuskey Travel Award. He will use the award to present a poster '*GenSpec, genome-based species identification for archaea*' at the 2014 ISMB (Intelligent Systems for Molecular Biology) annual meeting in Boston this July.



**Ashley Grosche** (Vetriani Lab) is a recipient of the Stephen M. Cuskey Travel Award for 2014. She will be using the travel support to attend the 10th International Congress on Extremophiles (Extremophiles 2014) this September, which will be held in St. Petersburg, Russia. This year's program of

Extremophiles will include the lectures of distinguished scientists working in the fields of diversity, metabolism, genetics, biopolymers and biotechnology of extremophilic prokaryotes.

**Tong Liu** (Häggbloom Lab) and **Xiao Qian** (Dismukes Lab) have been selected as recipients of the **Robert S. and Eileen A. Robison Scholarship Award for 2013.**

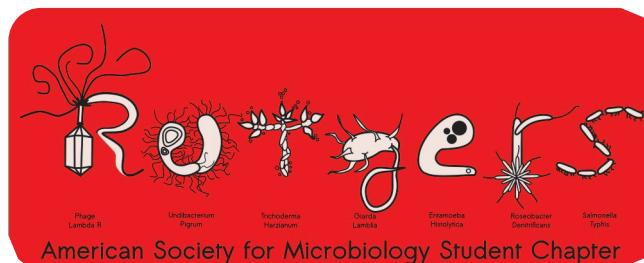
**Tong Liu** obtained her bachelor's degree in Environmental Engineering from South China University of Technology and joined Environmental Sciences program in 2009. She is working with Dr. Max Häggbloom and her research interests are environmental microbiology and biodegradation. Currently her study is focused on identification and characterization of methyl tert-butyl ether (MTBE)-degrading microorganisms in groundwater. Besides academic life, Tong actively participated in outreach activities at Rutgers University. She has served as secretary of American

Society for Microbiology, Rutgers Student Chapter, chair of International student affair committee instructor of New Jersey 4H express arts and university senator in the past five years.

**Ann Charles** (Microbial Biology GP) from Haiti started volunteering at **YES: Youth Empowerment Services** located in New Brunswick NJ. YES is committed to the development of young people into healthy productive adults in our communities. With all the struggles young people face today and the uncertainty of the future; Youth Empowerment Services is a place young people can come to find help. Y.E.S.'s life transforming programs are designed to provide prevention and intervention for at risk youth. Ann volunteers there weekly, and we thank her for her service to the community!



Congratulation to **Javiera Norambuena Morales** (Barkay Lab) the recipient of the **Hachnasarian Fellowship** which is awarded to students majoring in agricultural or biological sciences, based on academic performance.



**The American Society for Microbiology Rutgers Student Chapter** has recently elected new officers for the 2014-2015 academic year. Ann Charles and Nicole Lloyd will be taking over as co-presidents, while Ishita Jain and Aakansha Roberts will serve as secretary and treasurer, respectively. Preshita Gadkari will fill the new "outreach" position. The society has also debuted their latest t-shirt, designed by Patricia Barcala Dominguez. Proceeds will go towards an educational group trip.

**Facebook** <https://www.facebook.com/groups/135353114604/>  
**Website:** [http://dbm.rutgers.edu/asm\\_studentchap.html](http://dbm.rutgers.edu/asm_studentchap.html)

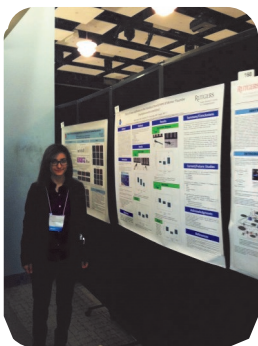


Aakansha Roberts, Ishita Jain, Preshita Gadkari, Nicole Lloyd and Ann Charles



# Our Undergrad Students

## Honors and Awards



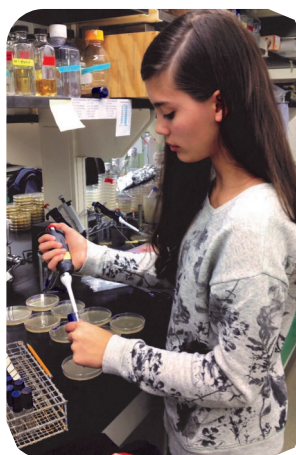
Congrats to **Dan McCracken** and **Carly McGinnis**, winners of this years Theodore Chase and David Strumeyer awards (respectively) for Excellence in Biochemistry! Dan and Carly also served as student instructors for General Biochemistry. We wish them the best of luck!



**Congratulations** are in order for a job well done for both our undergraduates and graduate students! At the Hudson/Delaware Society of Environmental Toxicology and Chemistry (SETAC) meeting held on April 23-24, 2014 at the Jamaica Bay Wildlife Refuge, New York our graduate and undergraduate students dominated the poster session awards. **Dan Millemann** won First Prize and **Tiffany Kung** won second in the graduate student category. Our Biochemistry undergraduates won all three slots: First Place - **Ms Ghadeer Abuhamneh**, Second Place - **Fatima Toor** and Third Place went to **Deanna Case**.



Congrats to our Microbiology major, **Valerie T. Raziano** awarded the Selman A. Waksman Award 2014; Herbert Estate/Kelly Scholarship and Rutgers Scarlet Scholarship.



**Emily Rea** a student working in the Boyd lab who attends Black River Middle School in Chester, and is part of Immaculate Heart Academy's STEM program in High School. In this year's science fair, she won the first place Nursing Award from the N.J. State Nursing Association for her experiment on wound care for EB (*Epidermolysis bullosa*) patients. She studied the effectiveness of different antibacterial solutions on *Staphylococcus aureus*. Her project, Wound Care Wonders, also, focused on raising awareness about EB and the Debra Foundation. She won a Broadcom Masters nomination for her project.

## What's Shaking!



A party was held in honor of **Arleen Nebel's** retirement on October 14, 2014 at Fresco's. Arleen started working for the Department of Biochemistry and Microbiology 25 years ago. She plans on spending more time enjoying her family, traveling and going to those Broadway plays. Beside being a "card shark" (she loves Bridge) she also loves shopping, cooking and reading. We will miss her! The Department wishes her well in her retirement!

She loves experimenting with food and enjoys cooking. She is "Ms. Creative" likes to write poems. Nalini "loves working with everyone here, and thanks all for accepting me so openly."

The Department welcomes **Nalini Kaul**, our new program coordinator for the Biochemistry major. Nalini has been with Rutgers since 2011 in the Disability Services Office, and then the Materials Science Engineering Department. Before that she worked for more than 20 years as a Foreign Service National in India for the U.S. Department of Agriculture. This is her first full-time job in U.S. and she really is enjoying working here; the interaction with students, staff & faculty who have been so humbly helpful. Nalini always has a smile on her face and a positive attitude. On a personal note, she is married with a loving spouse and blessed with two teenage daughters.



Congratulations to **Seo Yeon Sohn** (Häggblom Lab) on the birth of her son Ian, birthday 3/31/14 weighing in at 6lbs 15 oz. and 20½ inches long.



Some new faces in the **Barkay lab** include **Josh Roden**, who joined the lab to work on the new NSF project, and two new Microbial Biology graduate students, **Nicole Lloyd** co-president of the Student Chapter of the ASM, and, and **Javiera Norambuena Morales**, a Microbial Biology Ph.D student. Nicole is studying how exposure of fish to mercury affects mercury and antibiotic resistance in their GI tract microbiome. Javi is investigating the role of cellular sulfur metabolism in mercury resistance in the thermophilic bacterium *Thermus thermophilus*.



### Department of Biochemistry and Microbiology Donor Opportunities

Through the years, students in the Department of Biochemistry and Microbiology at Rutgers University School of Environmental and Biological Sciences (SEBS) have been supported in many ways - grants, assistantships, corporate support and fellowships endowed by individuals, just to name a few. Financial support is critical to the ongoing success of our students, and allows them the opportunity to focus fully on their education and research. The next generation of gifted scientists in microbiology and biochemistry need your support. As traditional funding mechanisms become more difficult to secure, we turn to our community of dedicated alumni and friends to support those who will come after them, and continue their legacy of achievement.

There are many ways for you to have an impact. Please consider investing in our students by making a gift to the following funds:

**1. The Douglas E. Eveleigh Endowed Graduate Fellowship:**

The Douglas E. Eveleigh Endowed Graduate Fellowship is being established to honor Dr. Eveleigh and his decades of service to Rutgers and our students. Our goal is to fully endow this graduate fellowship at \$750,000, which will provide a stipend plus full tuition for a first-year student in the Microbial Biology Graduate Program.

**2. Graduate Student Travel Awards:**

**The Stephen M. Cuskey Graduate Student Travel Award**

**The Douglas E. Eveleigh Graduate Student Travel Award**

The Stephen M. Cuskey Graduate Student Travel Award honors the memory of the late Dr. Stephen Cuskey ('82). The Douglas E. Eveleigh Graduate Student Travel Award honors the legacy of Prof. Doug Eveleigh and his steadfast commitment to students at Rutgers. Both awards are given annually to one or more students travelling to academic or industry conferences related to their research.

**3. Department of Biochemistry and Microbiology Fund:**

Donations to our department gift fund will support research and travel for our undergraduate students in biochemistry and microbiology, graduation awards, the invitation of seminar speakers to our Fermentation Club Seminar series, and other activities of the department.

For online donations, follow the link from <http://dbm.rutgers.edu/> or see:

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