Department of Biochemistry and Microbiology

LIPMAN LOG

Inside this issue

RUTGERS
School of Environmental and Biological Sciences

2017 Edition

photo by Penny Carlson

News from the Chair

Department Chair, Max Häggblom

We are pleased to present you this latest, and redesigned, issue of the Lipman Log, with highlights from the 2016-2017 academic year. This has been an eventful year, with new members to our faculty and staff, promotions, awards, theses defenses, …and renovations.

Liping Zhao joined the department in January 2017 (from Shanghai Jiao Tong University) as the Eveleigh-Fenton Chair in Applied Microbiology. Professor Zhao is internationally recognized as one of the leading researchers in microbial ecology, in particular the study of the gut microbiome. His work focuses on elucidating the interactions between nutrition and gut microbiota in onset and progression of chronic diseases such as obesity and diabetes. **Debashish Bhattacharya** joined our department (from Ecology, Evolution and Natural Resources) in July. Professor Bhattacharya studies the origin of the photosynthetic organelle, the plastid, in diverse algae and aims to understand how organelles are integrated into host metabolism. **Arek Kulczyk** is a new Assistant Professor with a joint appointment at the Center for Integrative Proteomics Research. He integrates structural approaches, in particular single-particle cryo-electron microscopy and single-molecule methods to study DNA replication and repair in human mitochondria. We also welcomed two new teaching faculty members Drs. **Sharron Crane** (Biochemistry) and **Ramaydalis Keddis** (Microbiology). Our non-tenure track faculty fill critical roles in the teaching, research, and engagement missions of our department.

The annual **Microbiology Symposium** continues to bring faculty and students from across Rutgers together to hear about the most recent advances in microbiology research. Liping Zhao was the keynote speaker, followed by short talks by current faculty and poster plus flash-talk presentations by our graduate and undergraduate students and postdocs. At the 2017 symposium we remembered H. Boyd Woodruff who passed away in January 2017.

Our scholarly and undergraduate and graduate programs in biochemistry and microbiology continue to flourish and it is 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. You can read more on the latest Ph.D. and M.S. theses, the awards our students have received and about their other activities.

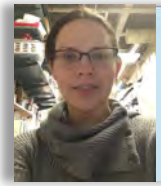
I wish to thank all our donors!! Your contributions provide important student scholarships, awards and travel fellowships and support our Fermentation Club seminar series. The Cuskey and Eveleigh **Graduate Student Travel Awards** continue to provide much needed support for our students to travel to national and international conferences to present their work, network, and learn. We hope that you will continue to show your support for the department and our scholarly programs. Our next “grand target” is the Douglas E. Eveleigh Endowed Graduate Fellowship to support incoming students in the Microbial Biology Graduate Program. Please see the back page to learn how you can contribute.

Department Newbies

FACULTY

Distinguished Professor Dr. Debashish Bhattacharya came to the Department from the Department of Ecology, Evolution and Natural Resources in July of 2017. He has investigated algal evolution, endosymbiosis and marine biodiversity using genomics and bioinformatics at Rutgers since 2009.

Dr. Sharron Crane was hired as Teaching Instructor in August of 2016, after holding the position on a temporary basis since February 2016. Dr. Crane is responsible for coordinating the Introduction to Biochemistry Lab laboratory classes and teaching Contemporary Issues in Biochemistry.



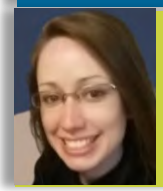
In August of 2016, Dr. Ramaydalis Keddis, formerly of Kean University, joined our faculty as a Teaching Instructor. Dr. Keddis coordinates the General Microbiology Laboratory and teaches Ethical Issues in Microbiology, Scientific Conduct and Ethics, and Living in the Microbial World.

As of September 2017, Dr. Arek Kulczyk, Assistant Professor, is our newest faculty member. Previously at Harvard University, Dr. Kulczyk uses single-particle cryo-electron microscopy (cryo-EM) to study DNA replication and repair, and develop correlative light and electron microscopy (CLEM) methods.

Dr. Yan Yan Lam joined our faculty as Assistant Research Professor in March of 2017. She came all the way from the University of Sydney, Australia to conduct research on the relationship between diet, gut microbiota, and obesity in Dr. Liping Zhao's lab.

Dr. Liping Zhao, previously of the School of Life Sciences and Biotechnology at Shanghai Jiao Tong University (SJTU), joined the Department in January of 2017 as the Eveleigh-Fenton Chair of Applied Microbiology. Read about Dr. Zhao's lab on page 10.

STAFF



In December 2016, Audrey Andrews became department Administrative Assistant upon the retirement of Beth Nugent. Audrey provides administrative support to department faculty and the department chair, and handles personnel matters in conjunction with the SEBS Office of Human Resources.

Allison Pohorence joined the undergraduate Biochemistry team in October 2016 as Program Administrator. Allison provides special permission numbers for the Biochemistry Department, while assisting the Biochemistry professors with daily tasks, such as preparing exams and entering grades.

Lindsay Robinson celebrated her one-year anniversary as Program Administrator in August 2016. Lindsay supports the undergraduate Microbiology and Microbial Biology graduate programs, and participates in Lipman Log production, website development, as well as seminar and symposium coordination.

2017 Symposium

Microbiology at Rutgers—Featured Speakers

Welcome: **Robert M. Goodman**, Executive Dean of SEBS

Historical perspective: **Erika Goder**, Alexander Library: The case of the Albert Schatz notebooks: Serendipity, archival evidence, and the importance of the history of science

Keynote presentation: **Liping Zhao**, Eveleigh-Fenton Chair in Applied Microbiology, Biochemistry & Microbiology: Gut microbiome: a new target for managing

Adam Kustka, Earth & environmental Sciences: Unraveling mechanisms of iron metabolism in marine eukaryotic phytoplankton

Jeffra Schaefer, Environmental Science: Mercury bioavailability and uptake in iron-reducing bacteria

Nicole Fahrenfeld, Civil & Environmental Engineering**:** Flux and treatment of microbial agents in wet weather flows

Nilgun Tumer, Plant Biology & Pathology: Why is *E. coli* producing Shiga toxin 2 more toxic than *E. coli* producing Shiga toxin?

Bryce Nickels, Waksman Inst. of Microbiology: The mechanism of RNA 5' capping with nicotinamide adenine dinucleotide (NAD+)

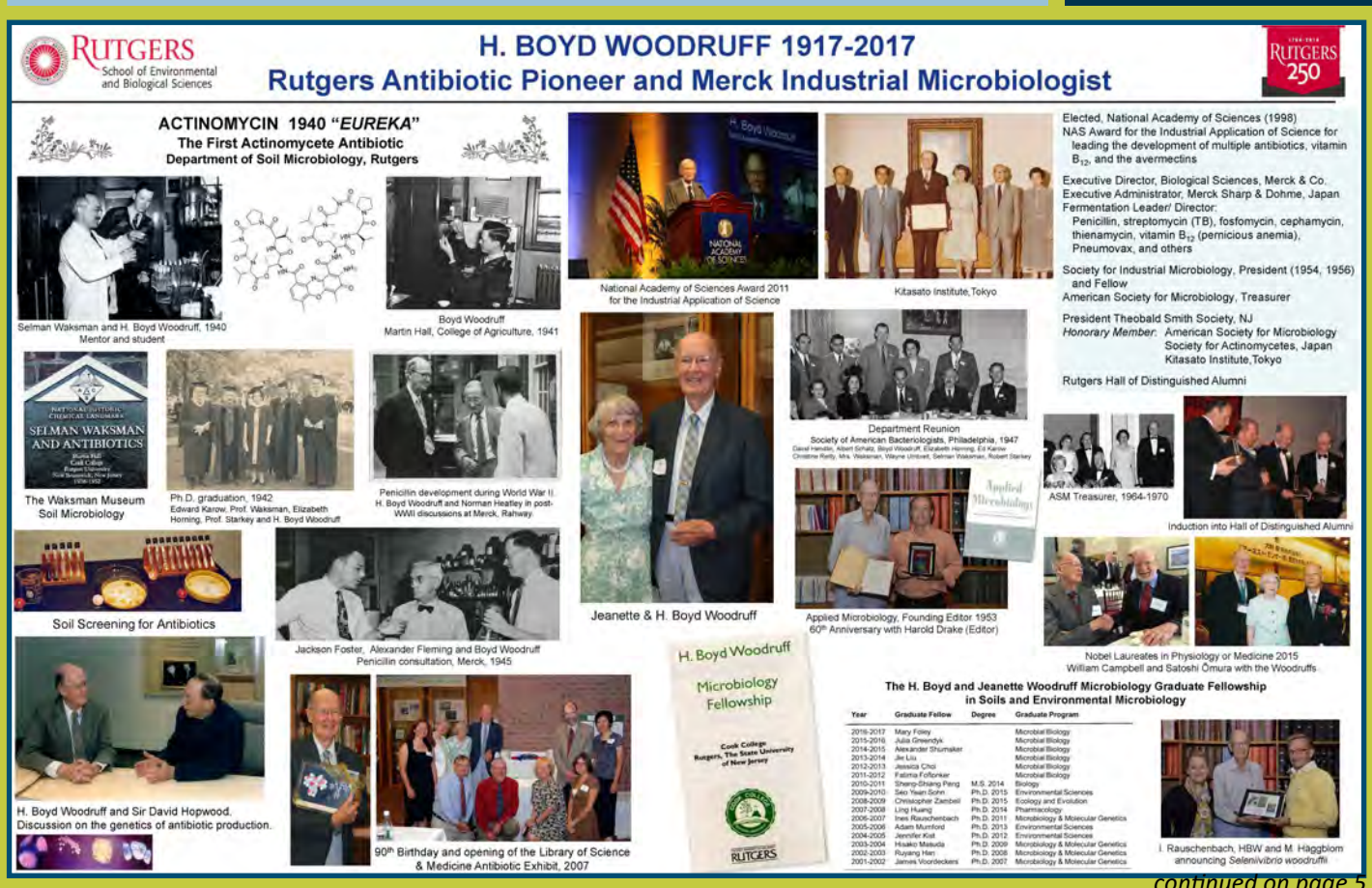
Neeraj Chauhan, Microbiology, Biochemistry and Molecular Genetics: Unraveling the mysteries of *Candida albicans* acetylome in fungal virulence

Orly Levitan, Marine & Coastal Sciences: Elucidating retrograde signal transduction processes in the diatom *Phaeodactylum tricornutum*

Diana Roopchand, Food Science & IFNH: Prebiotics for gut and metabolic health

Carla Cugini, Oral Biology, Rutgers School of Dental Medicine: Molecular analysis of oral bacterial species

Daniel Kadouri, Oral Biology, Center for Oral Infectious Diseases, Rutgers School of Dental Medicine: A predator a day might keep the doctor away



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H. Boyd Woodruff

In Memoriam: July 22, 1917-January 19, 2017

H. Boyd Woodruff, who passed on in 2017 at the age of 99, was one of our department's most illustrious alumni. As a graduate student in the Department of Soil Microbiology (1942), Boyd, with his mentor Selman Waksman, developed the world's third antibiotic, Actinomycin in 1940, following penicillin and tyrothricin. Though it proved too toxic for general use, it later was found effective in treating Wilms tumor. Actinomycin came out of a Eureka moment in antibiotic discovery, namely that soil microbes produce inhibitory metabolites that can be purified and applied. The actinomycin study was a cornerstone on which continued screening resulted in the subsequent avalanche of the world's antibiotics.

Jo Messing, Doug Eveleigh, Robert Goodman, Boyd Woodruff

Upon graduating, Boyd joined Merck and Co. and set to work on penicillin production. Merck produced the first commercial penicillin, which was rushed by plane from Rahway to New Haven to a delirious patient, Anne Miller, who recovered and lived into her 90s. At Merck, Boyd rose through the ranks to become Executive Director of Biological Science, leading the change of Merck from a chemicals-based company to one of the world's most respected pharmaceutical houses. Boyd helped steer the Good Ship Merck into an ocean of remarkable microbial products: the antipernicious anemia factor (vitamin B_{12}); immunosuppresants (FK506), essential in organ transplant operations; human cholesterol inhibitors (Merck's Lovastatin, the world's first statin); and Avermectin, a cure for river blindness, onchocerciasis. The discovery and development of these agents revolutionized world medicine and public health. When he retired, Boyd founded his own company, Soil Microbiology Associates, Inc., in 1982.

Boyd's accomplishments were remarkable in light of his background, growing up on a farm in southern NJ that lacked electricity. In 1935, Boyd was accepted into the Soil Chemistry program at Rutgers, and arrived with his flock of 150 chickens. (The sale of eggs helped pay for college, and there was occasional sustenance through chicken stew cooked on a hot plate in his room).

Boyd served twice as the Society for Industrial Microbiology president (1954-1956); American Society for Microbiology treasurer (ASM, 1964-1970), and Applied Microbiology founding editor, and editor-in-chief (1953-1962); this journal was renamed Applied and Environmental Microbiology, and is now the flagship of the ASM Society's journals.

Boyd and his wife Jeanette (Douglass College, 1941) established the H. Boyd and Jeanette Woodruff Microbiology Fellowship in soil/environmental microbiology at SEBS, and supported the H. Boyd Woodruff Undergraduate Scholarship Fund for scholars from Cape May, Cumberland or Salem Counties, NJ. They generously supported the development of the Waksman Soil Microbiology Museum in Martin Hall, where the Waksman antibiotics were discovered. The museum received national recognition in ASM Milestones (2002) and the American Chemical Society's National Historic Landmark (2005) Programs. Boyd and Jeanette were awarded the Rutgers University Medal for Philanthropic Excellence.

Boyd received many honors including the Charles Thom Award, Society for Industrial Microbiology, 1973, and honorary memberships in the ASM, 1982; the Kitasato Institute, Japan, 1982; the Society for Actinomycetes, Japan, 1995; and as a Fellow of the Society for Industrial Microbiology, 1983. At Rutgers he was recognized through the Theobald Smith Society (TSS) Selman A. Waksman Award (2007) for distinguished service, this also being a wonderful indirect tribute to his mentor, Selman Waksman. Earlier, Boyd had been elected as President of TSS. Boyd was also a George Hammell Cook Distinguished Alumnus (undergraduate) and elected to the Rutgers Hall of Distinguished Alumni.

Reflecting Boyd's prestigious accomplishments at Merck, he was elected to the National Academy of Sciences in 1998. He was honored through the National Academy of Sciences Award for the Industrial Application of Science, 2011. Boyd noted, "It is an honor to be recognized as father of *Applied Microbiology*, the step-child of our Society publications." [ASM News 40: 503-506 (1974)]. H. Boyd Woodruff was staunch friend and true Son of Biochemistry and Microbiology.

Dr. Peter C. Kahn

I joined the faculty at Rutgers as an Assistant Professor in 1976 on a handshake. The hand I shook was Jim Macmillan's, then Chair of this department. There was no start-up package nor was there a signed contract. I started a month into the fall semester on a Friday. On the following Monday I gave my first lecture in General Biochemistry, which meant that I was never more than a lecture or two ahead of the class that term. I've taught that course ever since.

It was customary for new faculty to pay a courtesy visit to the dean on the first day, so Jim and I visited Grant Walton. Dean Walton asked if there was anything I wanted in my contract when it would ultimately appear. I replied that I would like a stipulation that I not be required to teach before 10:00 in the morning. He laughed and replied that second period began at 9:50 AM. Would I agree to teach at 9:50? I agreed, and for many years General Biochemistry started at 9:50. Thus, I am not required to teach before that hour, although I do so to help colleagues from time to time! As we were leaving the dean's office, it occurred to me to ask, "What is my salary?" That had never been discussed. It was $14,500, $3,000 more than I had been receiving as a postdoc. Times have changed!

For research space, I was allocated half a bench in an old lab. There I found a cardboard canister containing a pound of asbestos powder. This caused a problem, as the Health and Safety people had no protocol for it.

Dr. Kahn a few years ago

Cook College, as SEBS was called then, had no spectrophotometer capable of high precision and high sensitivity ultraviolet and visible light spectroscopy. I could not assay enzymes or measure spectra without one and convinced the dean the college needed one, and I offered to maintain it and make it available to anyone who might need it. I've done that ever since. The heavy device wouldn't fit through the lab door, so it was set up initially in the hallway. Since I build furniture as a hobby, I built a table for it. The instrument has been updated extensively, but it is still heavy and still reposes on that table. It is no longer in the hallway, though!

There were no computers on the campus then. The spectrophotometer had a digital output, however, so the department convinced the dean the college needed to get into laboratory computing. The smallest computers then were called minicomputers to distinguish them from large mainframes. Ours had to be mounted in a five foot tall rack. Its eight inch disk drives were also in the rack. To boot the machine we used a punched paper tape reader. Typed input, including programs, was entered and output received on a nearby teletype machine. A graphics terminal also stood nearby. All this occupied a lot of floor space. Communication with the university's mainframe was via a telephone modem.

Teaching was from my hand-written notes. I used blackboards (and still do, occasionally); there were no transparency projectors and certainly no internet. Transparency projectors changed the way I taught, as it became simple to give out my notes on paper. Laptops, projectors and software which allows display, movement and examination of protein and nucleic acid structures in class has given visual immediacy to material.

It is often said that biochemistry stands on two legs: structure and function. Neither can be understood without a grasp of the other. The static images of proteins, nucleic acids and other molecules in textbooks don't convey the three dimensional structures well enough. As more and more structures have become available through the Protein Data Bank (PDB), the modern molecular biosciences have come to require that students gain a more visceral understanding of how structure dictates function and how function dictates both molecular forms and the evolution of structure.

To convey this with immediacy, a colleague, Richard Ludescher, and I applied for a Higher Education Challenge Grant (HECG) from the USDA to set up an advanced computational laboratory for teaching structural biology. The grant enabled us to buy computers, and the university renovated space in Lipman Hall. We offered a set of self-paced self-teaching tutorials that focused on a

40 Years at Rutgers

single protein or nucleic acid or a complex. These are now an integral part of General Biochemistry; some of them are used in other courses, as well. A second HEGC allowed development of the course Homology Modeling of Protein Three Dimensional Structure, in which advanced undergraduates and graduate students actually build 3D atomic structures of proteins with sequences are similar to those of other proteins in the PDB. After many years I have had to suspend it due to having taken on sole responsibility for General Biochemistry.

For many years biochemistry majors had to take "P. Chem." in the Chemistry Department. The courses offered there, however, do not meet the needs of our students, so I created Physical Biochemistry, a one-semester course that I taught for many years. A colleague now teaches it.

My research has focused on how proteins interact with the molecules surrounding them within cells. Most are water molecules, whose properties are radically different from those of ordinary water. Without them, there would be no living systems on this planet. Hydration research led me to propose that certain changes in protein structure would make the proteins more stable at higher temperature (for an enzyme to be commercially useful it has to work while hot). Most enzymes are denatured at high temperature, though. As a test we made changes in a convenient protein. They worked; the protein became more stable. That led to a paper, and the editors used an image of the protein as the cover of that issue of the journal (I'm bragging!). The university took out a patent on the method.

from the years before the beard

Conversations with Doug Eveleigh about stabilization led me to an enzyme, cellulase, which catalyzes breakdown of cellulose. The breakdown products can be converted to fuel by microorganisms. While on sabbatical leave in Finland I cloned the cellulase gene and designed four mutants. The project has now become a hybrid of research and teaching. In collaboration with Natalya Voloshchuk, who teaches Experimental Biochemistry, the class is developing expression of the wild type and mutant proteins, including purification and characterization. Each year for the past three they have improved on what the prior class accomplished. Each class spends a session in my lab to learn about spectroscopic characterization by circular dichroism. They receive the, work it up, and submit it to a server in England for analysis of secondary structure. This is advanced biophysics. The eventual paper will include the class as coauthor.

Most of the work in my lab is done by research undergraduates as part of their honors theses. Working with them has been one of the most satisfying parts of my academic career.

During the war in Vietnam, I gave talks at the UN. In 1980, a few years after I started at Rutgers as an assistant professor, I had a call from the NJ state government. By this time veterans had been dealing with medical problems that the men attributed to Agent Orange exposure. The Veterans Administration and the rest of the government dismissed them as "cry babies." The caller remembered one of my UN talks and asked if I would serve on the newly-formed New Jersey Agent Orange Commission. Thus, in 1981 I became one of seven unpaid commissioners. I gave talks to veterans' groups and their families all over the state on the science. That led to talks across the country to legislative groups, veteran's organizations, churches, and colleges.

As I read the literature on dioxins, one of which was the contaminant in Agent Orange that seemed the likely source of the problems, I became increasingly concerned. At an environmental toxicology meeting I met Christoffer Rappe, a Swedish chemist and the world's foremost dioxin researcher. His lab developed the methods now in common use to detect parts per trillion of dioxins and related compounds. Over a bottle of scotch we formed a collaboration to study blood and adipose tissue levels of these compounds in men who had handled Agent Orange while in Vietnam. Blood measurements of these compounds had never been done, so we wanted to correlate blood and fat levels, thereby avoiding the need for fat tissue biopsy in the future.

None of the work would have been possible without the team here in New Jersey. Mike Gochfeld of EOHSHI, co-principal investigator, was involved from the beginning.

He served in Vietnam as a doctor, and is now an

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occupational medicine and environmental toxicology specialist. A number of Vietnam combat veterans were involved in the planning and work, and became co-authors on papers, as did others.

We recruited ten spray handlers and matched them for rank, race, and other characteristics with unexposed controls. The men were brought to New Jersey and hospitalized in Patterson, NJ for several days for detailed medical examinations. After a 24-hour fast, each gave a unit of blood and underwent a surgical biopsy of fat tissue from the buttock. I was present in the operating room, scrubbed and gowned, and weighed the samples as they were being taken. If there was not enough, the surgeon would take more.

The samples went into specially washed bottles with two labels. One had each man's assigned ID number; the other was blank. I drove the frozen bottles to the office of a retired New Jersey Supreme Court judge. He and his staff removed our label and wrote their own ID number on the blank one before returning them to me. Thus, neither I nor the chemists knew which bottles came from exposed or unexposed men. The samples were shipped to Sweden for analysis.

Dr. Rappe brought the last set of results to the US himself. We went to the judge's office to break the code, and it was clear even without statistical analysis we had an unequivocal result. The handlers had 9-10 times more of the dioxin in Agent Orange than the controls. The 1988 paper was the featured article in an issue of the weekly Journal of the American Medical Association. That paper and several others led to congressional testimony and briefings for congresspeople and their staffs. It was also presented at an international dioxin meeting in Japan.

In Vietnam one soldier would walk ahead of his platoon, looking for the enemy and drawing fire toward himself so his unit could see where it came from and respond. He was called the point man. It was a dangerous assignment. Our dioxin work was called the Pointman Project. Because everyone who lives in the advanced industrial countries of the world carries a body burden of industrial chemicals, there is a sense in which the veterans may be serving as point men for us all.

A significant amount of the 2,4,5-T component of the Agent Orange used in Vietnam was manufactured here in New Jersey in Passaic. Hygiene at the plant was poor, to put it mildly. The plant is on the bulkhead overlooking the Passaic River. When there was a particularly bad batch, the workers would shovel it into the river. The river, which empties into Newark Bay, is tidal. I've seen photographs of glistening white piles of 2,4,5-T crystals exposed at low tide. As the material washed down into the bay, it contaminated shellfish and fatty fin fish. In another paper we found high levels in crabs, lobsters and striped bass. There is a ban on eating them, but in a cruel irony, there are Vietnamese refugees who live near the bay who eat what they catch.

For many years the office above mine was occupied by C. Reed Funk, a plant breeder who developed the university's turf grass breeding program, which brings in a large amount of money. We became friends and used to go to lunch together. Dr. Funk had a very long view of agricultural problems; his time horizon was decades, and he was fully aware of the state of perennial crop agriculture all over the world. Dr. Funk switched his interest to tree crops, and got me interested in them. He also arranged the hiring of a hazelnut tree specialist, a young man who has been developing hazelnuts as a New Jersey crop. We wrote a proposal to set up tree crop research and development stations all over the world. It became the first of two papers, the other being a large review. I'm also involved in trying to start tree crop work in Colombia, and I've given talks on agricultural matters.

slicing open a bottle of bubbly

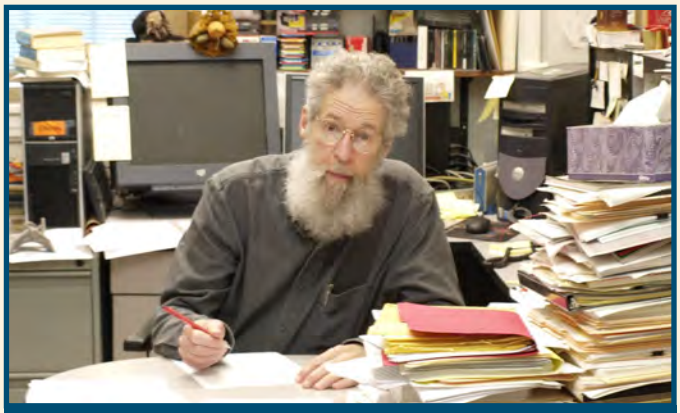
During the war in Bosnia an old friend from anti-Vietnam War movement days started a project to bring students whose educations had been terminated by the fighting to study in the U.S. The Bosnian Student Project brought seventeen people to earn degrees here at Rutgers. The university supplied the tuition. I signed my name guaranteeing all other expenses: room and board in the dorms, clothes, books, dental care – all that was needed to support the student. For each a host family was found so

the student would have a place to go when the university was closed. My wife and I hosted several and helped them acclimate to the US. All have succeeded. Many have married and have children. One young woman married a Roman Catholic man in a ceremony at a Brooklyn church. Her parents unfortunately could not come, so she asked me to serve in lieu of her father. Thus an American Jew escorted a Bosnian Muslim down the aisle of a Catholic church! Only in the US! Another student recently became a tenured professor of chemistry in Colorado. They are essentially extensions of my family.

I have had a satisfying career here, and it isn't over yet. There has been a darker side, though. In 1976, Cook College was a liberal arts college. Although it emphasized science and agriculture, students could major in many of the traditional liberal arts subjects. Over the course of several university reorganizations the liberal arts were removed, and we are now the School of Environmental and Biological Sciences (SEBS). Central control over hiring and budgeting has steadily increased. Decisions about future directions are made by only a few people. Although various bodies exist in which faculty and students may participate, it is far from clear that those bodies have much real control. The university is more like an industrial corporation. Our "products" are student degrees and research that other corporations can use to make money. On the research side the government emphasizes "translational" research, which is supposed to move research from the laboratory to the market place. The university reorganizes itself to compete for the translational funds. Thus is basic research deemphasized even though it is the goose that lays the translational golden eggs.

On the student side young people are increasingly encouraged to go into "STEM" majors so they will become trained for the workforce. The function of the university is simply to supply a trained work force to keep the economy growing. The liberal arts are everywhere on the defensive. Education, though, is not the same as training. You can train a robot. You can train a monkey. But you cannot educate them. There was a time when the aim of education was to help young people become citizens in the full sense of the word. A job and a career would follow as natural consequences. Decades of emphasis on training instead have produced generations of students - and politicians and business leaders - to whom college is simply the utilitarian route to well-paying jobs. We are supposed to produce graduates who will become docile cogs in the economic machinery of the country. The preeminence of our higher education system, earned in the aftermath of World War II, is thereby eroding.

Part of the erosion is research funding. The federal government has pinched it so severely that sharp young people now question whether useful academic careers are even possible. Universities, Rutgers among them, scramble so hard for that shrinking pie that anything which doesn't bring in money is not favored. Support for teaching has also eroded. We have seen a gradual disinvestment in higher education by the states. State universities used to be very inexpensive relative to income. No longer. The assertion made by conservatives, who have dominated for many years, is that the primary beneficiary of a college education is the student, so the student and his or her family should bear most of the cost. The notion that education is good for society as a whole, common after the World War, and therefore deserving of social investment, is mostly gone. The state invests in higher education in order to stimulate the economy. As individuals we're all now supposed to be on our own. Scratch for whatever you can. Shrinking resources relative to costs sets people and groups and departments against one another. Because research grants bring in money while most teaching brings in little or none, researchers who get grants are favored, while teaching gets mostly lip service. Although there are awards for teaching the rewards are meager compared to those for research with one big exception. That is the inner satisfaction of doing it well and the resulting appreciation expressed by students both for the formal instruction and for the informal time taken with them in one-on-one conversation. That and the research projects I intend to complete keep me going.



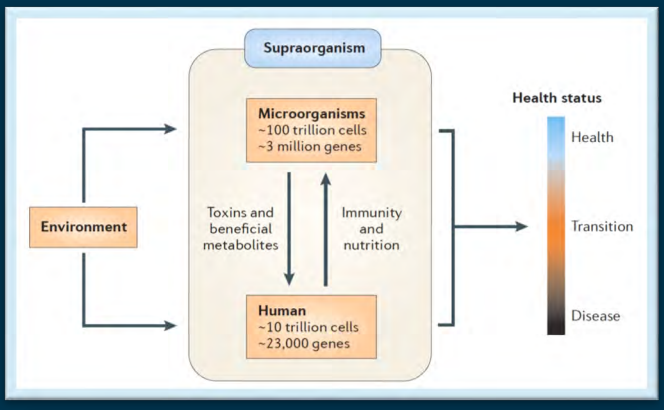
Dr. Kahn hard at work in his office.
All photos provided by Max Häggblom and Douglas Eveleigh.

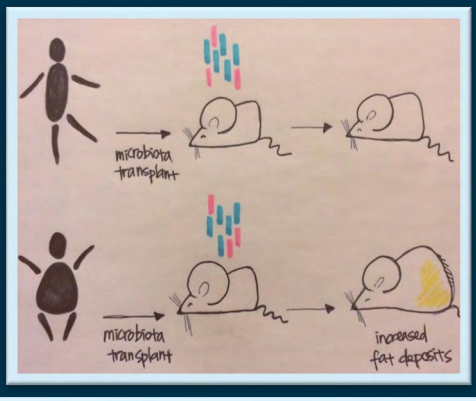
Liping Zhao

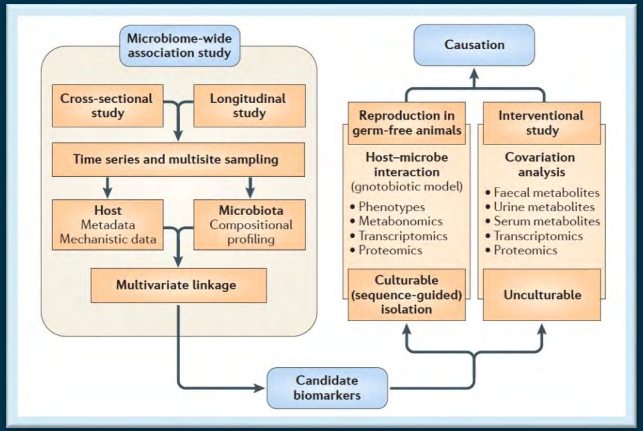
Dr. Liping Zhao was appointed the Eveleigh-Fenton Chair of Applied Microbiology in January of this year and he is delighted to join the Lipman Hall family. Liping's research focuses on using dietary interventions to restore and/or maintain healthy gut microbiota to improve human metabolic health. Recognizing the vastly variable nature of the human gut microbiota and the complex dynamic interactions between the gut ecosystem and host metabolism, Liping calls for a data-intensive approach for personalized interventions. The idea is to understand each individual's unique microbial composition and functions, then tailor therapeutic strategies, primarily a probiotic-enriched diet, probiotic supplementation or even microbiota transplantation, to optimize the mutualistic relationship between the gut ecosystem and the human host.

During renovation of his Lipman Hall lab, Liping and his team are based at the Institute for Food, Nutrition & Health, which works out well: their first research project at Rutgers will be a randomized clinical trial that explores the feasibility of using intensive repeated sampling and data analysis to inform on personalized dietary intervention and its effect on glucose homeostasis in patients with type 2 diabetes. The 6-month study will begin recruitment in late September/early October. Do look out for ads and flyers and help spread the word!

Liping and his team can't wait to move back to Lipman Hall, where they will pursue most of their research, starting with exploring *in vitro* bacterial fermentation capacity as a screening tool to tailor dietary fiber supplementations, and botanicals and traditional Chinese medicine as protective agents for beneficial bacteria in the human gut. All in all, Liping is a hard-core microbiologist. In his Lipman Hall lab, he will do his favorite part of microbiome research - isolation and characterization of functionally important gut bacteria. After all the fancy omics and big data analysis, we still need the PURE CULTURES! We hope to see them around very soon!







Lipman Hall Renovations—Zhao Lab

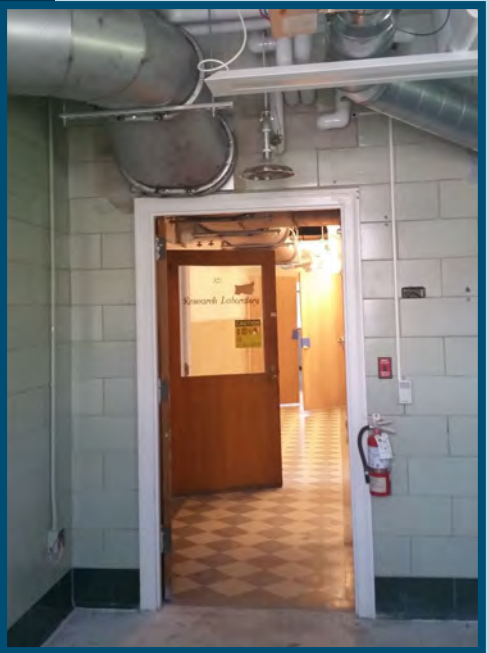
One of the 3rd floor labs in progress

This brand-new lab bench is ready for work!

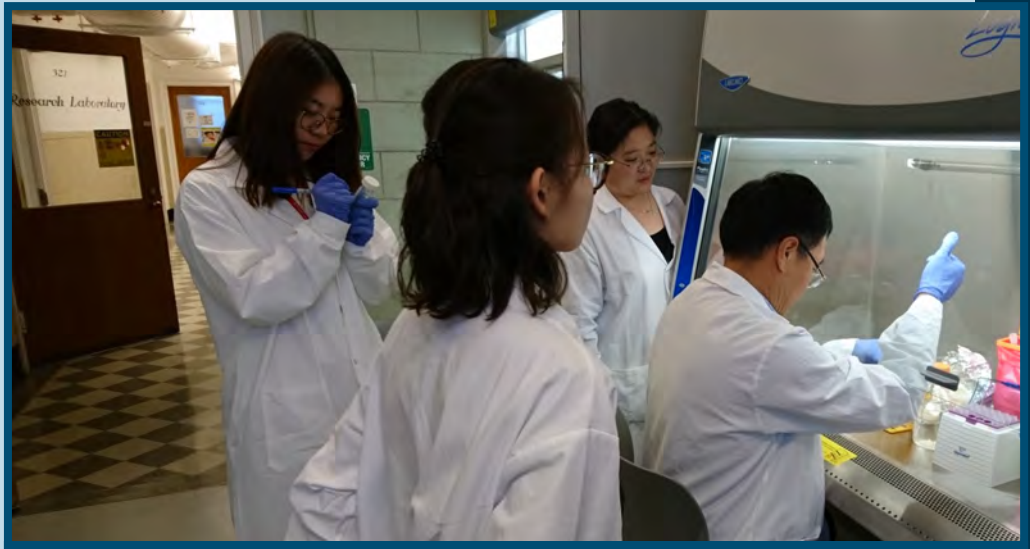
After many months of work, the 3rd floor laboratories are back in use! We are happy to welcome Dr. Liping Zhao and his team to Lipman Hall!

It's been quite an adventure: the labs were gutted, down to the gas pipes, and new equipment was brought in (we all breathed a sigh of relief every time a large piece fit in the elevator!).

The bathroom tile is so nice!



In progress—note the hall lighting!



Liping and his lab members process samples in one of their renovated labs.

Awards & Activities

Travel Award Recipients

The Douglas E. Eveleigh and Stephen M. Cuskey Travel Awards enable graduate students in the Department of Biochemistry and Microbiology to present their research at conferences across the country and around the world. The 2017 recipients are:

Stephen M. Cuskey Travel Award

Suha Eleya: SIMB Annual Meeting and Conference, Denver, CO

Nicole Lloyd: FEMS Conference, Valencia, Spain

Tiffany Louie: Gordon Research Conference, Mount Holyoke College, MA

Javiera Norambuena Morales: Astrobiology, Coyhaique, Chile

Aakansha Roberts: SIMB Annual Meeting and Conference, Denver, CO

Douglas E. Eveleigh Travel Award

Hassan Al-Tameemi: ASM Microbe Conference, New Orleans, LA

Kate Annunziato: SETAC Conference, Minneapolis, MN

Rayan Faisal: SIMB Annual Meeting and Conference, Denver, CO

Jie Liu: Gordon Research Conference, Mount Holyoke College, MA

Sushmita Patwardhan: SIMB Annual Meeting and Conference, Denver, CO

Alexandra Pushkar: Goldschmidt Conference, Paris, France

Pictured, L to R: Nicole Lloyd, Jie Liu, Rayan Faisal, Suha Eleya, Tiffany Louie, Sushmita Patwardhan, Hassan Al-Tameemi, Kate Annunziato, Keith Cooper, Javiera Norambuena Morales, Aakansha Roberts.

Max Häggblom Named Scholar at Can Tho University

Dr. Max Häggblom (Distinguished Professor and Chair of the Department of Biochemistry and Microbiology) was named a **US-Faculty Scholar** for the 2016-2017 academic year by the **Vietnam Education Foundation**. The Vietnam Education Foundation (VEF) is an independent U.S. Federal Government agency created by the U.S. Congress with the mission to strengthen the U.S.-Vietnam bilateral relationship through educational exchanges in the STEMM fields. Prof. Häggblom received a grant of $43,600 from the VEF U.S. Faculty Scholar Program to teach the course "Environmental Microbiology in a Changing World" at Can Tho University (CTU) in southern Vietnam.

Can Tho University (CTU), established in 1966, is recognized as a premier university in the Mekong Delta of Vietnam. Can Tho University targets to be one of the leading higher education institutions and has an enrollment of about 54,000 undergraduate students, 3,000 M.S. students, and around 300 Ph.D. candidates. CTU has over 2,000 staff members including nearly 1,200 teaching staff and 800 supporting staff. The College of Agriculture and Applied Biology at CTU has given high priority to education and research to solve the present and emerging problems in sustainable agriculture. Research in the Department of Soil Sciences addresses some of the most pressing challenges in the Mekong delta, including increasing pollution in soil and in water caused by extensive use of chemical fertilizers and pesticides in cultivation, increasing soil degradation due to declining soil organic matter and over exploiting soil for rice production.

The course was co-instructed with Dr. Duong Minh Vien (Lecturer – Vice Head of Department of Soil Science, CTU, and former Visiting Scholar in the Häggblom Lab) and was offered as a combination of on-site teaching in Vietnam and interactive, real-time videoconferencing. The semester-long course was structured around lectures, laboratory demonstrations, short research projects, and student team projects with the aim of providing students and young research staff with a fundamental knowledge about microorganisms in natural and engineered environments, their roles in the cycling of elements, and their ability to degrade both natural and anthropogenic chemicals in the environment. The knowledge gained by the participants in the course will enable them to take a modern approach to their teaching and research work.

The Mekong River delta is an important agricultural area for Vietnam and South East Asia, but is facing pollution problems from agricultural and industrial activities such as wastes of agricultural processing and production. The misuse of pesticides is also an environmental problem, resulting in water and soil pollution, and in the loss of beneficial soil and aquatic organisms. In addition, polychlorinated *dibenzo-p-dioxin* pollution in some areas sprayed with Agent Orange during the Vietnam War is still an unsolved environmental issue. Mitigation of these issues will contribute to the sustainable development of agriculture in the Mekong river delta as well as to reduce the threat of these pollutants to human health. Prof. Häggblom has on-going research collaborations with Dr. Duong Minh Vien on the biodegradation of chlorinated pesticides and dioxins.

photos provided by Max Häggblom

SEBS 2017 Excellence Award Winners

International Excellence Award: Dr. Max Häggblom
Max Häggblom has since 2001 led an international research team focused on Arctic microbial ecology. A visiting professor at the Chinese Academy of Science and the Forest Research Institute in Finland, he initiated the first International Conference on Polar and Alpine Microbiology, and is the chief editor of the journal FEMS Microbiology Ecology. Max has taught in Finland, India, China, Germany, Italy, Peru, France (the popular annual Microbiology and Culture of Cheese and Wine course), and Vietnam; he is a US-Faculty Scholar for the Vietnam Education Foundation and has been appointed a US-Indo Professor by the American Society for Microbiology.

Yana Bromberg, Jessie Maguire and Max Häggblom. Photo by Eric Gautier.

Research Excellence Award: Dr. Yana Bromberg
Yana Bromberg, recognized by her peers throughout the world as a leader in bioinformatics and computational biology, analyzes large data sets of genome and protein sequences from which she gleans insights into genome organization, evolutionary relationships, protein functions, and disease processes. Her research is funded by the PhRMA Foundation, the NIH, a Hans Fischer Outstanding Early Career Scientist Fellowship and an NSF Career Award.

Staff Excellence Award: Jessie Maguire
Jessie Maguire is essentially the fiscal officer of her department. On the staff at Rutgers since 1995, she guides faculty and students through the maze of financial protocols at Rutgers. She has a reputation of getting things done quickly and well and is widely considered the "go-to" resource person in the department. Jessie was recently promoted from Business Assistant to Accounting Assistant.

Read more at http://sebsnjaesnews.rutgers.edu/2017/05/a-celebration-of-excellence-2017

Student Research Abroad

Nicole Lloyd, a Ph.D. student under the direction of Tamar Barkay, was selected as a recipient of the 2016-2017 Chateaubriand Fellowship. The Chateaubriand Fellowship is a grant offered by the Embassy of France in the United States that supports outstanding Ph.D. students from American universities who wish to complete research in France. Nicole spent six months at L'Université de Lyon 1 in Lyon, France, working under the supervision of Dr. Sylvie Nazaret. Sylvie's lab studies the role of efflux pumps in antimicrobial resistance in the environment. Nicole was able to advance her thesis work on the connection between mercury and antibiotic resistance in the environment by taking advantage of the collaborative environment, new ideas, and advanced technologies available at the university. When not working, Nicole spent time travelling around Europe and also presented her work at the 7th Congress of European Microbiologists (FEMS 2017) in Valencia, Spain.

Pictured: Nicole Lloyd

Biochemistry Teaching Lab

News from the Undergraduate Biochemistry Teaching Lab

We are excited to report that we successfully integrated new technology into the learning process in our biochemistry teaching laboratory. Three general biochemistry laboratory courses offered by the Department of Biochemistry and Microbiology at SEBS take place in our teaching lab: Introductory Biochemistry Lab (11:115:313, coordinated by Dr. Sharron Crane) and two Experimental Biochemistry courses (11:115:413 and 11:115:414, coordinated by Dr. Natalya Voloshchuk). During the 2016-2017 academic year, these courses integrated iPads and LabArchives (an electronic lab notebook, or ELN). This shift was inspired by a similar transition that took place in the Undergraduate Microbiology Teaching Lab in 2015, and facilitates both good laboratory practice (GLP) and collaborative learning.

Detailed record keeping is a fundamental to good laboratory practice, and in a number of clinical, industry, and academic settings, the shift to ELNs has already been made. LabArchives was selected as an ELN platform for its well-developed instructional course management option. LabArchives also allows students to share data with their labmates, so that only one person needs to collect raw experimental data: this streamlines many lab activities. With the use of ELNs instructors and teaching assistants provide timely feedback to our students, and the students are never without a notebook, facilitating learning process. In addition, because paper notebooks and lab manuals are no longer being used in the laboratory, chemical hygiene and biosafety are greatly improved, and paper waste is reduced.

The iPads have a number of uses in the teaching lab aside from access to LabArchives, lab activities and protocols. They allow students to take pictures of their experiments, which can be referenced later as they are compiling their reports. They also have timers, which come in handy during lab experiments! These two features completely eliminate the need for cell phones in the lab. In addition, iPads allow full internet access: thus, students can more independently direct their own learning experiences because they can research information on their own rather than rely completely on the instructor or teaching assistant.

Purchase of the iPads, keyboards and styluses was made possible by funds awarded to Dr. Crane, Dr. Voloshchuk, and Dr. Ines Rauschenbach (Microbiology) by the SEBS Instructional Computing Fund (ICF). The iPads and LabArchives were first used in Introductory Biochemistry Lab at the beginning of the Fall 2016 semester. At the end of that semester, 34.5% of students in that course reported enjoying the use of iPads in the lab: this proportion almost doubled to 67% in the Spring 2017 semester, indicating the successful integration of these new materials into the course. The majority of Experimental Biochemistry students (72%) liked iPad/LabArchives use in the lab. Among the advantages of working with iPad/LabArchives students list ease of data access, organization, and sharing, as well as convenience of protocol access, procedure editing, and imaging.

With positive experiences with iPad/ELN by students, instructors, and teaching assistants, we continue looking for methodologies to use technology to advance learning experience in our laboratory courses.

Above: Our teaching team: (left to right) Sharron Crane, Gina Moreno, Natalya Voloshchuk, Javiera Norambuena, Jie Liu, Tiffany Louie, Kate Annunziato. Not pictured: Brittany Karas and Nicole Lloyd.

Left: Students working in the teaching lab.

Our Faculty in Print

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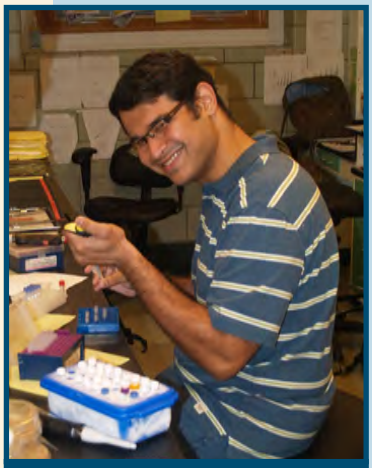
PhD Theses

Ameya A. Mashruwala, Microbial Biology
(PhD 2017)
Advisor: Jeff Boyd
Current Position: Postdoctoral Fellow in Bonnie Bassler's lab at Princeton

The Influence of Oxygen Upon the Lifestyle Choices of *Staphylococcus aureus*

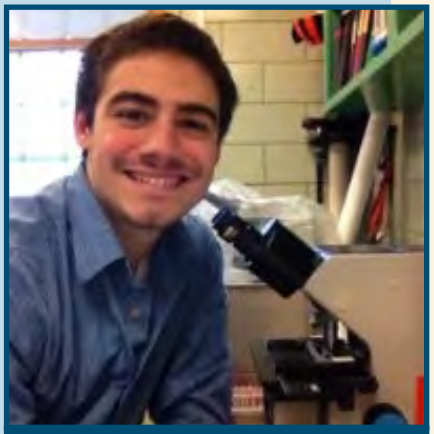

Ameya Mashruwala

Biofilms are communities of microorganisms attached to a surface or each other. Biofilm-associated cells are the etiologic agents of recurrent *Staphylococcus aureus* infections. Oxygen is utilized by S. aureus as a terminal electron acceptor. Infected human tissues are hypoxic or anoxic. This thesis reports that oxygen influences biofilm formation in its capacity as a terminal electron acceptor for cellular respiration. Impaired respiration led to programed cell lysis resulting in DNA release, which contributed to biofilm formation. In summation, this thesis defined the basis for how cellular respiration dictates the lifestyle choices of S. aureus.

Daniel Millemann, Environmental Sciences
(PhD 2017)
Advisor: Keith Cooper
Current Position: Research Scientist at the NJ Department of Environmental Protection

The Deepwater Horizon Oil Spill and its Potential for Acute and Chronic Toxicity in Gulf of Mexico Ecosystems

The Deepwater Horizon oil spill (DHOS) was an unprecedented event causing the release of 4.9 million barrels of crude oil into the northern Gulf of Mexico on April 20th, 2010. The unique nature of the spill caused potential exposure scenarios to major coastal regions of the Gulf of Mexico including wetland habitats, benthic reefs, the air-sea interface, and pelagic zones between the leaking wellhead and the coast. In the aftermath of large disasters such as the DHOS, the main question that is asked is what are the long term impacts to the natural resources and habitats affected. One such resource, the economically and ecologically important filter-feeding species Gulf menhaden (*Brevoortia patronus*), was the primary species of concern in this dissertation. Menhaden play a key role in the transfer of energy up the food chain and serve as an important forage species for many secondary and tertiary consumers. It was hypothesized that Gulf menhaden exposed to crude oil will show lesions in the gills and heart representative of acute and chronic exposures, based on the time of collection and exposure scenario. The role of particulates in the toxicity of crude oil, as well as the sensitivity of menhaden and differences in target organ/phenotype of fish species that inhabit similar habitats was also studied. The results highlight the importance of evaluating different species for their sensitivity to environmental pollution and also present data on particulate accumulation and tissue damage. These findings are relevant to both industrial particulate matter and micro plastics within the aquatic environment.


Daniel Millemann

Carrie Jantzen, Environmental Sciences
(PhD 2017)
Advisor: Keith Cooper
Current Position: Toxicologist at Avon

Toxicological Profiles of Perfluoroctanoic Acid (PFOA), Perfluorooctane sulfonate (PFOS) and Perfluornonanoic acid (PFNA) in Zebrafish (*Danio rerio*)

Perfluorooctane sulfonate (PFOS), perfluorononanoic acid (PFNA), and perfluorooctanoic acid (PFOA) are all members of the anthropogenic and persistent perfluoroalklyated class of compounds (PFASs). These compounds have similar structures and have been commonly grouped together in toxicity, treatment, and disposal analyses. It was hypothesized that PFOS, PFNA, and PFOA would result in similar toxicity profiles throughout different life stages of zebrafish (*Danio rerio*). At 5 dpf, all

continued on next page

PFASs resulted in gene expression changes of transforming growth factor *tcf3a* and adaptor protein *ap1s1* and all fish were smaller size. PFOS exposed fish had the greatest number of endpoint and gene expression changes. At 14 dpf, all PFAS exposed fish showed hyperactivity and increased organic ion transporter *slco2b1* expression. In adult fish, PFNA males were the most affected in behavior but all three PFASs resulted in gene expression changes in *slco* transcripts. Adult fish chronically exposed to PFOA had reproductive and fecundity affects, including reduced egg production, morphometric effects, and delayed development of the offspring. Chronic PFNA exposure had similar but less severe effects, and PFOS exposure resulted in P_0 affects but no immediate reproductive changes. The null hypothesis of was rejected at each time point and exposure; PFOS, PFNA, and PFOA exposure resulted in dissimilar toxicity profiles between compounds. The development age of the fish and the endpoints assessed determine which compound was having the greatest effect. In acute embryonic studies PFOS appeared to have the greatest effect. PFNA, in particular the males, are the most affected at the adult stage in terms of behavior. PFOA shows the greatest negative effects on reproduction after a chronic exposure. Additionally, multiple pathways such as *ap1s1*, *slco* and *tgfb1a* were identified as affected by PFASs and further studies are needed to determine if these altered genes during development and maturation may underlie the mechanism(s) of action for these compounds.

Carrie Jantzen

Chengsheng Zhu, Microbiology and Molecular Genetics (PhD 2017)
Advisor: Yana Bromberg
Current Position: Postdoctoral Associate in Yana Bromberg's lab
Functional Analysis of Microbial Genomes and Metagenomes

Microorganisms are capable of carrying out molecular functionality relevant to a range of human interests, including health, industrial production, and bioremediation. Current microbial taxonomy is phylogeny-guided, *i.e.*, the organisms are grouped based on their evolutionary relationships. Due to horizontal gene transfer, evolutionary relatedness cannot guarantee genome-encoded molecular functional similarity. In my PhD, I established a computational framework for comparison of microorganisms based on their molecular functionality. In the *fusion* (functional-repertoire similarity-based organism network) representation, organisms can be consistently assigned to groups based on a quantitative measure of their functional similarities. The results highlight the specific environmental factor(s) that explain the functional differences between groups of microorganism. I further created *fusion*DB, a database that maps bacteria and their functions to available metadata: habitat/niche, preferred temperature, and oxygen use. Its web interface allows mapping new microbial genomes to the functional spectrum of reference bacteria. In addition, I also built *mi-faser* (microbiome functional annotation of sequencing reads), a meta-genomic/-transcriptomic analysis pipeline combining an algorithm that is optimised to map reads to molecular functions encoded by the read-correspondent genes, and a manually curated reference database of protein functions. With *mi-faser*, I identified previously unseen oil degradation-specific functions in BP oil-spill data, and revealed the role of gut microbiome in Crohn's disease pathogenicity, showing that the patient microbiomes are enriched in both the functions that promote inflammation and those that help bacteria survive it.

Chengsheng Zhu

Microbial Biology Graduates 2017

Ph.D. Defenses

Ameya Mashruwala
Advisor: Jeff Boyd

Ann Charles Vegdahl
Advisor: Don Schaffner

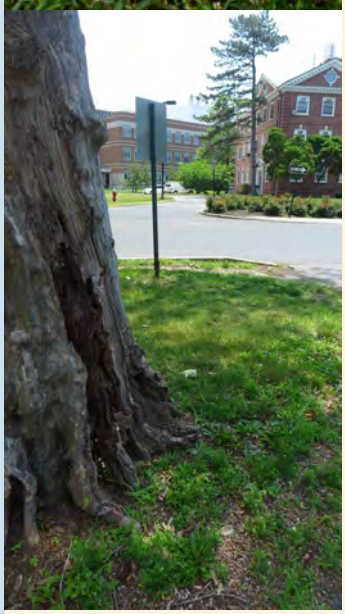
Jessica Choi
Advisor: Nathan Yee

M.S. Thesis Defenses

Ahmed Al-Shiti
Advisor: Gerben Zylstra

Julia Greendyk
Advisor: Nancy Woychik

Hoa Vu
Advisor: Charles Dismukes



photos above by Doug Eveleigh .

Dr. Bill Ward Teaches Pre-College Students

As a Rutgers biochemistry Professor, Dr. William Ward has been teaching protein biochemistry to gifted and talented pre-college students for the past five years. Working in cooperation with Ms. Liz Beasley, director of the Summer Session program, Dr. Ward offers to pre-college students a unique course called Experiments with GFP: The art and the Science. This 3-week-long, 3-hour-per-day course is quite unusual as it integrates hands-on protein biochemistry with several hands-on art/design projects. Branching out into some of these atypical areas, our course covers most of the STEM initiatives. We run the course out of the 2nd floor biochemistry lab suite in Lipman Hall, approximately 40% of the time in the laboratory and 60% in the adjacent classroom.

Operating for five years, this course has drawn the attention of area school teachers, school administrators, and students at middle school and high school levels. In those 5 years, about 150 students have taken our course. Many have stayed on as Rutgers freshmen, using this pre-college experience to "jump-start" their college careers. Experiments with GFP--- has been on the "radar screen" of a number of companies interested in science education. In particular, the course has drawn the attention of Carolina Biological Supply, a company that supplies science education materials and equipment to schools throughout the country. After several months of discussions, Dr. Ward's company, Brighter Ideas, Inc., has just signed a contract with Carolina Biological Supply. Professor Ward and his technician Chris Turner, at Brighter Ideas, will be providing Carolina Biological Supply with freeze dried, GFP-transformed *E. coli* cells for use in educational kits at the pre-college level. Carolina's GFP-based kits can be used at several educational levels, depending upon the sequence of courses offered at each school.

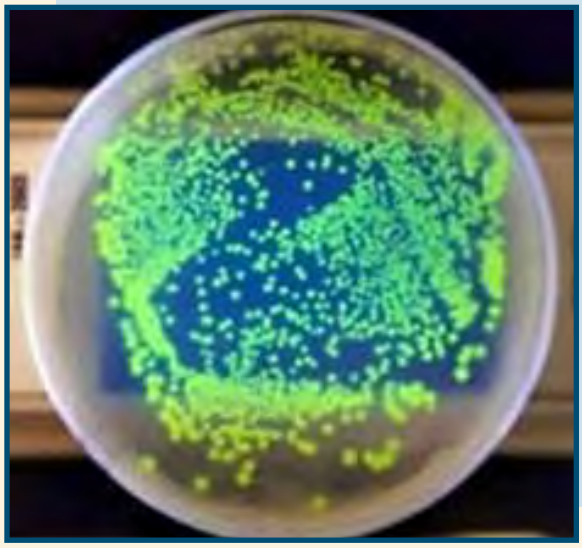


photo of green fluorescent protein

Make a Gift

Through the years, students in the Department of Biochemistry and Microbiology have been supported in many ways: grants, assistantships, corporate funds and fellowships endowed by individuals, just to name a few. Financial support is critical to the ongoing success of our students, and allowed them the opportunity focus fully on their education and research. The next generation of gifted students 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.

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