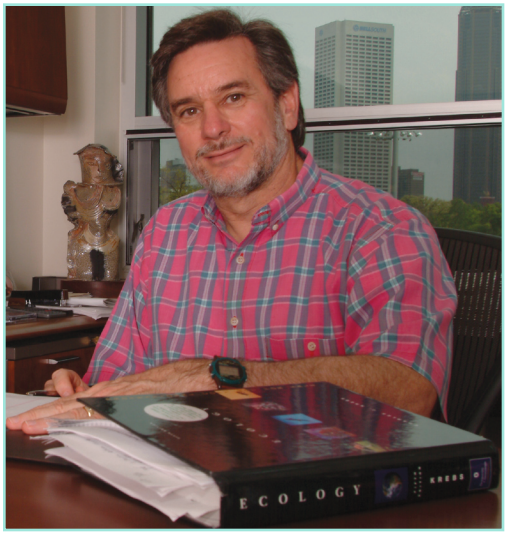
Georgia Institute of Technology

School of

BIOLOGY

Spring 2010



Welcome to the Spring 2010 edition of the School of Biology newsletter. Although this has been a difficult year with budget cuts and hiring restrictions, we have managed to chart a course through these challenges to minimize damage. In fact, we have had an exciting Spring, interviewing 14 candidates for three faculty positions that are replacements for faculty who have moved on. As a result, we expect the School to emerge from the financial crisis stronger than ever.

This newsletter contains five examples of research projects by School of Biology faculty, ranging from using nanoparticles to fight ovarian cancer to the influence of the Amazon River on the Atlantic Ocean. These works are being published in the top scientific journals and increasingly cited and recognized by the international scientific community. Professors are mentoring research scientists, post-docs, graduate, and undergraduate students, training the next generation of biologists to solve important problems with serious societal impacts.

These projects are being sponsored by a number of federal agencies like the National Science Foundation, National Institutes of Health, NASA, and Department of Defense. Despite the weak economy, School of Biology scientists had a record year attracting external funds to support their research. We are on track to exceed a School record $10 million dollars in new sponsored dollars this year.

Take a look on page five to see the Biology faculty and students winning awards. Again it has been a banner year in both research and teaching.

We are beginning the planning for a new Biology building to be built on the corner of Atlantic and 10th Street in the next 4 years. This will house up to 60 researchers, including all current faculty in the School of Biology, administrative offices, teaching labs for sophomore through senior courses, and some classrooms. It will enable us to continue to attract the very best faculty and to train students in state of the art labs for the challenges of the 21st century.

We also are excited to commemorate this Fall the 50th anniversary of the School of Biology at Georgia Tech. Since its founding in 1960 with five microbiologists and radiation biologists from the Georgia Tech Research Institute (GTRI), Biology has grown into the largest undergraduate major in the College of Sciences. We are contacting retired faculty to learn what they are doing now and encouraging alumni to update us on their professional accomplishments. Go to: www.biology.gatech.edu/alumni/ if you would like to be included. We will share these stories with you in the Fall newsletter and reminisce about the good old days at Tech.

If you would like to help the School of Biology continue to attract and retain the best quality students and faculty, please consider making a donation at http://www.biology.gatech.edu/contribute/contribute.php. Your support will be much appreciated and contribute substantially to the professional development of students and faculty in the School of Biology. If you would like to discuss specific ways to help the School, please call or email me and we can have a more detailed conversation about how you might contribute. Even though you have left Georgia Tech, we hope that you will continue to participate in the excitement of the discoveries happening everyday in the School of Biology.

Best wishes,

Terry W. Snell

Professor Terry Snell
Interim Chair
School of Biology

Urban environments and gene expression in humans

According to a study by Biology's Greg Gibson and colleagues, both genetic and environmental factors influence variations in gene expression for two dominant ancestries living in southern Morocco. This study was published in the December 6th issue of *Nature Genetics*.

Gene expression is commonly used by researchers to gauge levels of gene activity, as misregulation of gene expression can often contribute to disease and disrupt developmental processes. In addition, rural and urban lifestyles are associated with differences in incidence of numerous diseases, including asthma, diabetes and cancer. In order to investigate the genetic and geographical effects on gene expression, Gibson and colleagues analyzed gene expression variation in blood leukocyte samples from 194 Arab and Amazigh individuals from an urban city and two rural villages in southern Morocco.

They found that environmental location had a substantial effect on gene expression. However, further work is necessary to determine how these expression differences might be relevant to different health risks in urban and rural locations. The team also analyzed the genomes of the 194 individuals and found that there were a few hundred genetic variants that influenced gene expression levels in all sampled locations. The study shows that in addition to genetic factors, environmental factors also contribute to gene expression variation.

Magnetic nanoparticles show promise for fighting cancer

Researchers from the School of Biology and the Ovarian Cancer Institute have further developed a potential new treatment against cancer that uses magnetic nanoparticles to attach to cancer cells, removing them from the body. The treatment, tested in mice in 2008, has now been tested using samples from human cancer patients. The results appear online in the journal *Nanomedicine*.

"We are primarily interested in developing an effective method to reduce the spread of ovarian cancer cells to other organs," said School of Biology Professor John McDonald, who is also the chief research scientist at the Ovarian Cancer Institute. The idea came to the research team from the work of Ken Scarberry, then a doctoral student in Biology at Tech. Scarberry originally conceived of the idea as a means of extracting viruses and virally infected cells. At his advisor's suggestion, Scarberry began looking at how the system could work with cancer cells.

Montoya and colleagues to study influences of Amazon River on Atlantic Ocean

Biology Professor Joe Montoya, in collaboration with a team of other researchers, has been awarded a three year grant from the National Science Foundation to study the influences of the Amazon River on the Atlantic. The investigators hypothesize that large tropical river plumes with low nitrogen:phosphorus ratios provide an ideal niche for organisms that can fix nitrogen, and that this is responsible for significant carbon export in the Amazon River Plume. The PIs have identified a potentially significant but poorly understood, ecosystem-controlled, climate-sensitive carbon sequestration pathway that seems to violate the expectation of an inefficient open-ocean biological pump. Primary production fueled by external sources of nitrogen such as nitrogen fixation can drive a net transfer of carbon from the atmosphere to the ocean. Thus, this may represent a significant, yet previously overlooked biological pump mechanism.

Interdisciplinary team to study how understanding ecological networks may lead to a better industrial "ecology"

Drs. Bert Bras (Mechanical Engineering) and Marc Weissburg (Biology) were recently awarded a three year grant from the National Science Foundation to examine how the application of ecological principles leads to more sustainable resource networks in industries that exchange goods and services. The research collaboration will identify properties of ecological networks (such as food webs) that can be applied to networks of co-dependent industries, determine whether existing industrial networks are organized in ways similar to ecological ones, and examine whether industrial networks that incorporate features of their ecological counterparts function more efficiently and produce lower environmental burdens than current organizational schemes. A major goal is to examine how ecological principles may allow for the construction of future industrial symbioses to result in sustainable closed loop industrial network design. Dr. Bras is the head of the Sustainable Design and Manufacturing Program and member of the Center for Biologically Inspired Design at Georgia Tech. Marc Weissburg is co-director and founding member of the Center for Biologically-inspired Design (www.cbid.gatech.edu). This novel engineering-biology effort will involve substantial student collaboration and co-advisement, and was funded by the Chemical, Bioengineering, Environmental and Transport Systems Division of NSF.

New project to study interactions between microbes

Frank Loeffler (L), Kirsti Ritalahti and Kostas Konstantinidis (Biology and Civil & Environmental Engineering) have received a $460,000 grant from the National Science Foundation for an interdisciplinary project that advances scientific understanding and fosters environmental engineering applications. Soil, sediment and subsurface environments harbor a tremendous diversity of microbes, and understanding how such complex systems evolve, function, and respond to environmental changes has been a major research goal. While previous reductionist approaches that focused on individual bacterial populations have provided a wealth of valuable information, if we wish to truly understand how complex microbial communities function, the interactions and interdependencies between different populations inhabiting the same environment must be explored.

The premise of this project is that many bacteria engage in unknown interactions with neighboring organisms, and that these interspecies links can be characterized using microbiological and genome-enabled approaches. Dehalococcoides and free-living, pleomorphic spirochetes (FLiPS) are members of natural river sediment and aquifer microbial communities. Dehalococcoides are highly specialized bacteria that gain energy for growth by removing halogen substituents from many hydrocarbons, including priority pollutants. This process is called organohalide respiration, and as the bacteria breathe halogenated hydrocarbons (just like we breathe air), the contaminants are detoxified. Dehalococcoides bacteria grow very poorly in isolation but perform robustly in mixed cultures when FLiPS are present. Conversely, FLiPS benefit from Dehalococcoides, and a major goal of the project is to explore the biomolecular basis of these microbe-microbe interactions. This project will characterize unexplored microbe-microbe interactions (symbiosis) at the fundamental, molecular level and shed light on the evolutionary mechanisms that lead to beneficial interactions between distinctly different microbial populations.

This research project will generate new understanding on how microbe-microbe interactions develop, operate, and persist, while affecting specific functions of the community (e.g., detoxification of halogenated hydrocarbons). This project will not only advance knowledge of Dehalococcoides and spirochete biology, but will further improve our predictive ability how microbial communities function and respond to perturbations. The spirochetes that support Dehalococcoides activity share unusual properties compared to traditional spirochetes, some of which can cause disease (e.g., Lyme disease, Leptospirosis, Syphilis). Hence, this research effort also has implications for the medical field by determining the genetic determinants that distinguish pathogenic from benign spirochetes.

Recent SoB awards

Members of the School of Biology have recently received numerous awards! These include:

Justin Burns, Graduate Student, winner of the 2009 SAIC Georgia Tech Student Paper Competition, for his paper "Anaerobic respiration of elemental sulfur and thiosulfate by Shewanella oneidensis MR-1 requires psrA, a homolog of the phsA gene of Salmonella enterica serovar Typhimurium LT2".

Dr. Meghan Duffy, Assistant Professor, awarded the 2010 Faculty Award for Academic Outreach, in recognition of her educational outreach activities at Piedmont Park, aimed at increasing environmental literacy of K-12 students.

Andrey Kislyuk, Graduate Student, recipient of $2000 travel grant at the Georgia Tech Research and Innovation Conference (GTRIC 2010) for his poster "Unsupervised statistical clustering of environmental shotgun sequences."

Dr. Julia Kubanek, Associate Professor, named Tech's 2009 Faculty Woman of Distinction. Dr. Kubanek was chosen for her leadership as a research scientist, professor and mentor.

Dr. Jennifer Leavey, Academic Professional, winner of 2010 CETL Outstanding Undergraduate Educator Award, in recognition of her outstanding contributions to student education at Georgia Tech.

Nicole Mazouchova, Graduate Student, Recipient of $5000 fellowship at the Georgia Tech Research and Innovation Conference (GTRIC 2010) for her poster "Utilization of granular solidification during terrestrial locomotion of hatchling sea turtles".

Samantha Parks, Graduate Student, Poster and Graduate Speaker Awards at the Southeastern Branch Regional American Society of Microbiology Meeting. Samantha won second place for the presentation of her poster "Identification and characterization of denA, a novel HNPA denitrase integral to 3-nitrotyrosine degradation in Variovorax sp. JS669". She also won first place for graduate speaker awards for her talk entitled "Biodegradation of 2-nitropropyl-benzene, a synthetic analog of 1-nitro-2-phenylethane by Burkholderia sp. JS670".

Dr. Sara Thomas, Postdoctoral Researcher, VWR Postdoctoral Award for Scientific Excellence in Experimental Biology. Dr. Thomas was chosen based on the strength of her recent publication, "Diversity and distribution of Anaeromyxobacter strains in a uranium-contaminated subsurface environment with a nonuniform groundwater flow", published in the journal *Applied and Environmental Microbiology* in 2009.

Biology professors get pied for charity

Several Biology faculty got pied for charity on Tuesday, December 1st. The "Pie-a-Professor" event was organized by GT's Student Movement for Real Change (SMRC), and raised funds for the Vumilia Mill Project. (Vumilia means "we persevere" in Swahili.) This project aims to support a camp for refugees displaced by the 2007-2008 election violence in Kenya. SMRC is raising money to build a school, land, and a mill, as well as to provide medical services to camp residents.