FALL 2011

BIO@SU

Communications with Alumni and Friends

THE DEPARTMENT OF BIOLOGY AT SYRACUSE UNIVERSITY

Inside

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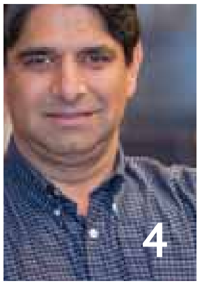


Dean
George M. Langford

Editor
Ernest Hemphill

Copy Editor
Kathleen M. Haley '92

Graphic Design
W. Michael McGrath

Department Chair
Ramesh Raina

Contributors
Samuel Chan, Tess Cherlin, Ghaleb Daouk, Ernest Hemphill, Dawn Higginson, Richard Levy, Ramesh Raina, John Russell, Zaara Sarwar, Kari Segraves, Sarah Wendel, Jason Wiles, Emily Williams

Photography
Steve Sartori
David Revette
Olle Pellmyr

Assistant Dean for Advancement
Karen Weiss Jones

Address Updates
Evelyn Lott *(ealott@syr.edu)*

Syracuse University
Department of Biology
110 Life Sciences Complex
107 College Place
Syracuse NY 13244
315-443-2012
biology.syr.edu

ON THE COVER
Confocal microscope section of developing mouse oocytes labeled by Green Fluorescent Protein (GFP). Nuclei of all cells are shown in red. Oocyte development proceeds through a stage in which oocytes become individualized from cysts of interconnected germ cells.

Note FROM THE EDITOR ERNEST HEMPHILL

In this issue of *BIO@SU* there is a notice that Dick Levy's long-awaited history of biology at Syracuse University will soon be available. Over the last couple of years, I have read early versions of Dick's book and what I learned has influenced my thinking about education, science, and particularly how universities have changed. Natural sciences at SU began with a handful of faculty, one of whom also served as chancellor. All, of course, were men, all were white, and they taught the natural sciences broadly defined: zoology, botany, and geology. We know little about their personal lives, how they developed an interest in science, and even the nature of their research interests. They slightly predated the germ theory of disease; their world didn't include biochemistry, molecular biology, or even knowledge of Mendel's work in genetics. One member of the faculty had a rather peculiar view of evolution and the origin of humans.

Several weeks ago John Russell pointed out to me that with the imminent arrival of several new faculty members the offices and research laboratories of the Life Sciences Complex will have reached their intended capacity. Our current faculty members come from several countries, roughly a third are women, and our graduate and undergraduate students are even more cosmopolitan. Of course, the curriculum of biology today hardly resembles that of 140 years ago. In the current and past issues of *BIO@SU* we have profiled many of our faculty, so our readers know something of their interests and how they became scientists. In this issue, **Sam Chan** tells the story of his odyssey from China to the United States, and **Kari Segraves** tells how she became a biologist and describes her research on the evolution of mutualism. Two graduate students, **Dawn Higginson** and **Zaara Sarwar**, explain their research, their interest in biology, and their plans for the future.

The last several years has seen a surge in the number of SU students choosing to major in biology and biochemistry. Suddenly, the many new teaching laboratories and classrooms in the LSC don't seem quite as plentiful or spacious as they did four years ago. In this issue **Jason Wiles** describes the new introductory biology program and provides a glimpse into a modern lecture format. My Ph.D. mentor frequently argued that biology was a very good choice as a major among the liberal arts—it is a rigorous course of study, it is relevant to the future, and with requirements in other disciplines provides breadth. This year, I have included brief profiles of three graduating seniors, **Sarah Wendel, Emily Williams,** and **Tess Cherlin.** Their undergraduate education and their plans for the future didn't/don't quite fit into the biology curriculum as written on paper. I also call your attention to the painting in Jason Wiles' article that was made by biology/illustration major **Julie Green.** Providing a rigorous and relevant education in a world that is rapidly and unpredictably changing is more of a challenge than the limits of physical space. However, much of that education will come outside of the classroom through research experiences, internships, and travel. Helping students take advantage of these opportunities and locate the finances to participate has become a major focus of the department and the University.

I make my usual appeal to drop a line to me (*hehemphi@syr.edu*) to update what you are doing and where you are living, so that I can put that in "Who What, When, Where" next year. Trust me, your fellow alumni—to say nothing of the faculty—really are interested in what happened after you left our hallowed halls. Sad to say, there are only a handful of the thousands of students I taught whose lives I know anything about in the intervening years. I'm sure that is true of most of my colleagues as well.

Finally, I wish to thank all the contributors to this issue of *BIO@SU*, the help of Scott Erdman in putting this issue together, and Dick Levy for writing the obituaries for two of our former faculty. Deborah Herholtz, Evelyn Lott, and Sally Hallahan provide many of the data on students and their awards, and now that I'm retired my dependence on their efforts is almost total. I am privileged to work with such fine, cheerful, and obliging people.

Letter
FROM THE CHAIR

By John Russell

I wrote my first *Letter from the Chair* in June 1999 full of hope about what would be possible to create in the Department of Biology at Syracuse University. Now seems an appropriate time to review all that has occurred over the past dozen years. Two activities have dominated this period: recruiting new faculty and planning the new Life Sciences Complex. I reviewed my *Letter* from that 1999 edition of *BIO@SU* and saw that I remarked how rare are "the twin opportunities to recruit new faculty and to participate in building new facilities" and how I was looking forward to that twin challenge. I would temper that somewhat egocentric statement today by saying I was looking forward to working with my colleagues in biology and others on the SU campus to address these twin challenges. Certainly much has been accomplished, but it took a wonderful group effort involving a number of people all working to improve SU biology.

There have been many accomplishments the past dozen years. I'll highlight two here. Most obvious is our beautiful new Life Sciences Complex completed and occupied in 2008. Serious planning for this building began in early 2000 and involved meaningful input from everyone who would be involved in using the new building, including faculty, staff, and students. At this point I would be remiss if I did not acknowledge the critical role played by Larry Wolf in the planning and construction of the building. He was appointed by Dean Emerita Cathryn Newton (more about her key role follows) as the project shepherd. In this role, he took part in innumerable meetings and helped forge decisions that had to be made as such a major construction project goes forward. His important role was to make sure that the users needs were always "at the table" as the myriad of decisions about details were being made. Once the architects were identified (Ellenzweig, Boston), his role became absolutely critical. Throughout the planning and construction process, Dean Newton was the staunch champion for the building and for the Department of Biology. She worked tirelessly to make sure we got the building we wanted. She helped keep the number of painful "value engineering" decisions (read "cuts") to a minimum. The Department of Biology owes a great debt to Dean Newton for her support throughout the building process and throughout most of the faculty hiring processes as well.

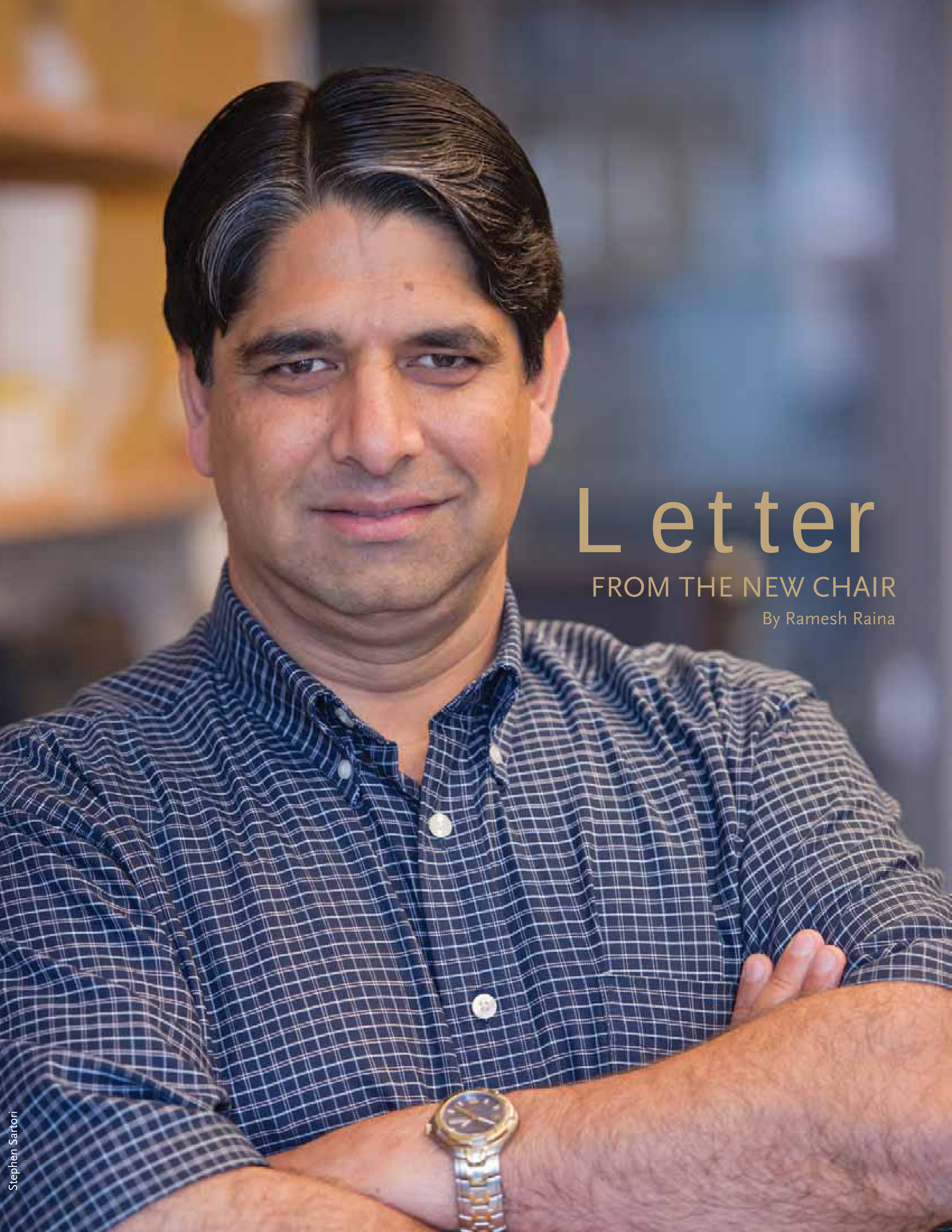
The Life Sciences Complex has 16 teaching laboratories (nine biology, six chemistry, and one jointly shared between biology and chemistry). It has eight classrooms ranging in size from 250-seat capacity to 30-seat capacity. And, of course it has administrative space for the Department of Biology and for the Department of Chemistry. Finally, it has 27 research laboratories plus numerous research support rooms (constant temperature rooms, cell culture facilities, a Confocal Microscope facility, a genomics facility, a plant growth room and a 5,000-square-foot, state-of-the art greenhouse). As this edition of *BIO@SU* goes to press, the vivarium is being finished and will be ready for use in autumn 2011. With the new faculty hires accomplished this year, the research space will be entirely occupied by research-active faculty only three years after it was opened.

For those of you whose time in the department meant using the facilities in venerable Lyman Hall or the vintage 1960s Biological Research Laboratory, let me assure you, the Life Sciences Complex is an enormous improvement! For the first time in the history of the Department of Biology, it allows all of its members to be under one roof. And very importantly, it has made possible the recruitment of outstanding new faculty.

Between the 2000-2001 academic year and the summer of 2011, we will have hired 21 new tenure-track faculty. Most of these hires were to replace faculty who left via retirements or, in a few cases, those who left for other institutions. Of the 19 tenure-track faculty present when I arrived in 1999, ten remain. For the upcoming academic year, we will have at least 28 tenure-track faculty and very possibly 29. It is particularly gratifying that we will have nine women tenure-track colleagues, up from just three in 1999. With the hard work of our faculty, the support of the College of Arts and Sciences, and the reality of the new Life Sciences Complex, all of the new faculty colleagues who have been at Syracuse for at least three years have won federally funded research awards from either the National Science Foundation or National Institutes of Health. This is particularly impressive given the current federal grant-funding rate of around 10 percent. Most of the newcomers are young and their best teaching and research days are still ahead of them.

Between the time of the last edition of *BIO@SU* and the end of the coming academic year we will have welcomed at least seven new colleagues. Dr. Katharine (Kate) Lewis joined us last summer from Cambridge University where she was a Royal Society University Research Fellow. Her research program addresses developmental issues in the spinal cord and, thus, she is our first neuroscientist. Dr. Heather Coleman joined us in March from Queensland University (Australia). Her research addresses important issues related to plant biotechnology, especially issues related to converting plants to fuel. Dr. Sandra Hewett joined us in July as the inaugural Beverly Petterson Bishop Professor of Neuroscience and comes to us from the University of Connecticut Health Center. She will lead the college's new neuroscience initiative working with colleagues at SU as well as at SUNY Upstate Medical University. Her research program, which has enjoyed continuous NIH funding for more than 10 years, focuses on the molecular and biochemical mechanisms by which post-ischemic inflammation contributes to the progression of the neuronal injury that follows stroke. Dr. James Hewett also joined us in July from the University of Connecticut Health Center. His research focuses on central nervous system inflammatory mechanisms activated under pathological conditions, with a particular emphasis on temporal lobe epilepsy. Dr. David Althoff joins us in August. Dr. Althoff was a research assistant professor in the department prior to his appointment as a tenure-track assistant professor. His research program in evolutionary biology will focus on evolutionary ecology of species interactions. In January 2012, we expect two new colleagues to join us. Dr. Jannice Friedman is an evolutionary biologist who will come to us from Duke University, where she has developed a research program that addresses understanding the causes and consequences of the enormous diversity in plant reproductive strategies. Dr. Susan Parks will come to us from Pennsylvania State University, where her research program has focused on the use of sound by the North Atlantic right whale. Dr. Parks' studies on the behavioral aspects of sound production, perceptual abilities, and impacts of noise on acoustic communication have won her a Presidential Early Career Award for Scientists and Engineers. As I'm sure all will agree, this is a most impressive list of new colleagues and we look forward to their arrival. This windfall of new faculty arriving in the upcoming year is due to the great support from Dean George Langford of the College of Arts and Sciences.

Finally, it gives me pleasure, mixed with sadness, to announce that this will be my last *Letter from the Chair* as I stepped down as chair as of June 30, 2011. I look forward to the life of a biology faculty member and, besides teaching, I shall work closely with Dr. Sandra Hewett to build the neuroscience initiative. It has been an incredible 12 years. I sincerely thank everyone who has contributed to the tremendous growth and success of SU biology during that period. It is particularly gratifying to know that the next chair of the department will be my highly esteemed colleague Dr. Ramesh Raina. I know the Department of Biology will be in great hands.



Letter
FROM THE NEW CHAIR

By Ramesh Raina

Stephen Sartori

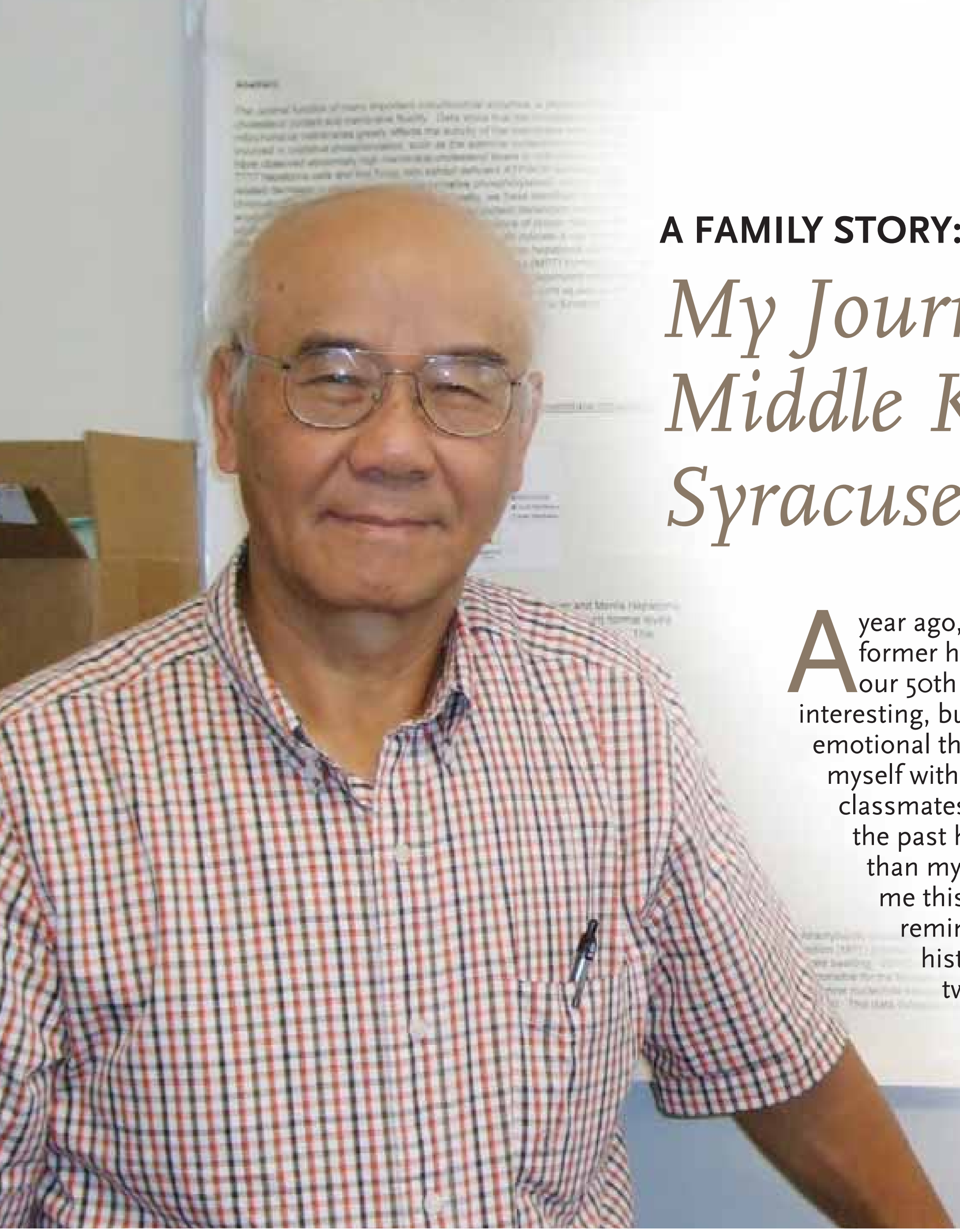
My serious research career began at the start of my Ph.D. program in 1985 in the laboratory of Hiren Das at Jawaharlal Nehru University, New Delhi (India). My project was to understand the molecular mechanisms regulating nitrogen fixation by *Azotobacter vinelandii*, a free-living, nitrogen-fixing bacterium. This experience provided me a solid foundation in molecular biology, and I have perpetuated and molded these skills throughout the rest of my career.

Following my Ph.D. (1991), I was offered a postdoctoral position in the laboratory of Nina Fedoroff (B.S.'66) at the Carnegie Institute of Washington, Baltimore. I moved to Baltimore in 1992, where I studied epigenetic regulation of maize transposable element *Spm* by DNA methylation. It was an exciting time for *Spm,* as it provided a molecular explanation for the mysteries of the genetics of maize transposable elements for which Barbara McClintock was awarded the 1983 Nobel Prize in Physiology or Medicine. In addition, *Spm* turned out to be a powerful tool for understanding the regulation of gene expression by DNA methylation, an important epigenetic phenomenon associated with a variety of human cancers.

In 1995, I was offered a tenure-track assistant professor position at Penn State University. Though I had not anticipated remaining in the United States, it was an exciting offer, and I decided to move forward with it. In my own lab at Penn State I switched gears completely and started working on understanding the molecular mechanisms regulating plant defense against pathogens in the model plant *Arabidopsis*. Because I had no previous exposure to plant pathology, this switch turned out to be a quite a challenge. However, ultimately, it turned out to be truly exciting, worthwhile, and rewarding venture. My lab also began working on understanding the function of *Arabidopsis* receptor kinases in sensing and responding to environmental stimuli. We continue to work in these areas and the scientific excitement continues to grow with every new finding.

I came to Syracuse University in July of 2003. At that time, the biology department was housed in two buildings: Lyman Hall and the Biological Research Labs (BRL). When I interviewed, I was shown laboratory space on the sixth floor of BRL and the fourth floor of Lyman Hall. The lab in Lyman Hall had no windows, so making the choice proved to be fairly easy and I chose BRL. As a plant biologist, a greenhouse is crucial to my research program. John Russell, the biology chair at that time, showed me the "greenhouse" on the roof of BRL. I was shocked, thinking to myself, *is this what they call a greenhouse?* Clearly, neither the laboratory space nor the greenhouse could be called a modern research facility by any stretch. However, I was told about the plans for the new building with the provision for a modern, state-of-the-art greenhouse, and was even shown initial drawings of the planned new Life Sciences Complex. The plans were impressive, but I knew that such projects always required a great deal of time between making plans and executing them. But one of the most exciting aspects of this offer was the colleagues at SU—their unending positive attitude, enthusiasm, energy, and collegiality. In addition, the administration's commitment to grow the life sciences program at SU was promising. So I took the leap of faith and decided to accept the offer.

So much has changed for our department since then. The administration kept its promise and we now have a new building and a state-of-the-art greenhouse. More importantly, this building has brought the entire biology department under one roof. In addition, the department has grown tremendously, while not necessarily in terms of number of faculty, but certainly in terms of young, research-intensive faculty. This infusion of new blood into the department has resulted in the addition of new directions of research in cutting edge areas of science. In addition, this has allowed us the ability to offer new contemporary courses to our undergraduate and graduate students. None of this would have been possible without the untiring hard work of our faculty, the leadership of our former chair John Russell, and the support of Dean Emerita Cathryn Newton, Dean George Langford and Provost Eric Spina, as well as our alumni, and I am very grateful for that. The biology department is in a strong position to move forward and I look forward to your support in taking the department to new heights.



A FAMILY STORY:

My Journey from the Middle Kingdom to Syracuse and Back

By Samuel Chan

A year ago, I returned to Hong Kong to join my former high school classmates in celebrating our 50th reunion. I expected the trip to be interesting, but I found it to be more powerfully emotional than I anticipated, as I reacquainted myself with the land of my childhood, and met classmates and family friends whose lives over the past half-century had been much different than my own. The experience has haunted me this past year and I find myself frequently reminiscing about my past and my family history, although I have lived more than two-thirds of my adult life in Syracuse and Central New York. This is my story, which I hope some of my former students and acquaintances will find interesting.

For generations, my father's family resided as farmers in the countryside on the northern bank of the Yangtse River, between Nanjing and the coastal city of Shanghai, part of the central region of the "Middle Kingdom" (China). My father was the eldest son in the "eldest son line"—meaning my father, my grandfather, and their male ancestors for many generations were all eldest sons. As such, the meager resources of the family were used to educate my father, with the expectation that he would eventually become the titular head and spokesman for the extended family. My father was sent to Nanjing Central University in the then capital of China to study a newly established curriculum on national policy, focusing on military needs and logistics. Subsequently he was awarded a military rank and served in the Nationalist Government directing regiments of armies resisting the Japanese invasion in the 1930s, and continued in this capacity during the Second World War. Following that war, my father continued working in the Nationalist Government during the Chinese Civil War against the communists.

My mother was from a relatively well-to-do urban family from a town whose name literally translated from the Chinese characters is "Salt City," perhaps a portent of things to come given that I've spent most of my life in another "Salt City." My mother had a better education than most people, especially women, and was a school teacher before she married. By becoming the wife of the eldest son of the Chan family, she effectively became the matriarch of this large clan, with responsibilities for the care of my father's relatives. My mother had both progressive thinking (even some socialist sympathies) and high ideals. She was smart, strong, and morally straight. My older brother, Dan, sister Julia; and I were born prior to the end of WWII, and my younger brother, Moses, was born after, a "baby boomer." In those early years, China was constantly in a state of war, and my parents had to follow the central government and relocate many times to south-eastern seaside and north-western inland cities.

At the end of 1949, when the Nationalist forces had been out-matched and forced to withdraw from the mainland, my father received orders to gather his subordinates and remove important industrial equipment to Hainan Island in the South China Sea, but in the middle of the transportation process, the government changed the strategy and ordered him to ship everything to the ultimate destination: Taiwan. There was much confusion and chaos from these constantly changing instructions. Some Nationalist soldiers and other personnel deserted, even betraying comrades. Still others stole government properties and weapons. My mother and her four young children were sent to Hong Kong some weeks ahead to await my father's arrival from the mainland, and were then intending to continue on to Taiwan. However, when my father finally arrived in Hong Kong on the last train from Canton (Guangzhou), he was greeted with the devastating news that his twin younger brother, who had remained in our original hometown near Nanjing, had been murdered as a replacement for my father who the communists had failed to capture. My uncle had never worked for the Nationalist government. At this most difficult time, emotionally heartbroken, my father nevertheless courageously decided to forsake his previous political life and not to rejoin the government in Taiwan. He and the family remained in a village of the New Territories of Hong Kong, and my siblings and I lived there until leaving for college.

This began a period of great hardship for the family. Hong Kong society was quite different from home, and the Cantonese dialect spoken in this British colony is quite unlike Mandarin Chinese and my family's dialect. Of course, we also had no local acquaintances. Our family had no means to earn a living; in fact, on many occasions we simply did not know from where (and whether) the next meal would come along. Our situation became even more tenuous, but eventually would be profoundly changed, by the religious conversion of my father. He began attending a nearby refugee church (relocated from the mainland) where he heard the Christian Gospel proclaiming a savior who willingly died for others, in contrast to the fate of his twin brother who had died unwillingly in place of my father. This gospel entered into his heart. Now in his late 50s, my father converted to Christianity and also felt called to become a minister; he subsequently enrolled in a Lutheran theological seminary for four years to complete his studies and preparation.

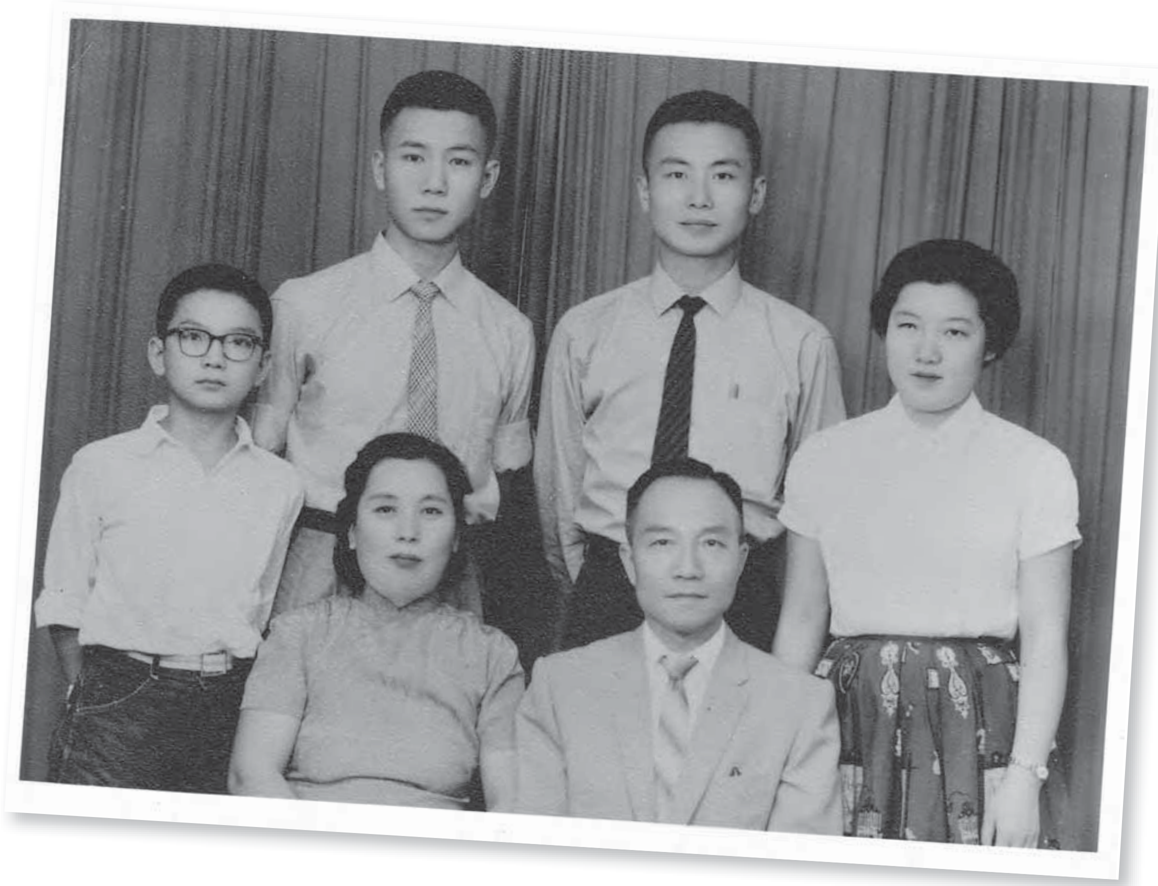
During this period, my mother alone had to hold the family together in this effectively "foreign" society. As noted earlier, my mother was a very capable woman with authority in our family, but now in Hong Kong, she simply had to survive. In the beginning and for a number of difficult years thereafter, she could not understand my father's conversion and complained of irresponsibility on his part. In addition, a major burden on her shoulders was to make sure all four of us children would excel in school; in fact, she was never swayed from her belief that her children were superior. To make the story short, this conversion (including my mother, though at a much later time) changed our whole family, giving us renewed lives with faith, hope, and love.

The family's embrace of Christianity would have another profound effect on my life. At the completion of high school, I was awarded a four-year college scholarship from UBCHEA (United Board of Christian Higher Education in Asia) to study in Japan. With memories still fresh of the atrocities and terrible suffering inflicted by the Japanese on

"We are Christians now; our own sins were forgiven by God, and we should not seek revenge on new generations of Japanese and anyone else not directly responsible for the atrocities inflicted on the Chinese people during the war."

millions of Chinese, few of my peers would consider studying in Japan, and I was strongly discouraged by classmates and teachers from doing so. However, the words of my father who earlier had direct encounters fighting against the Japanese army were, "We are Christians now; our own sins were forgiven by God, and we should not seek revenge on new generations of Japanese and anyone else not directly responsible for the atrocities inflicted on the Chinese people during the war." It was emotional for me, but I took the opportunity and a boat to Japan to study physical organic chemistry at International Christian University in Tokyo under a young Japanese professor, Dr. Hiroshi Minato, who had just come back to Japan from Harvard University. Dr. Minato was very strict and demanding, but he was also a caring Christian. He was kind and respectful to all his students, Japanese and foreigners alike. He changed and influenced my life academically and became my

The Chan family at the time of Sam's graduation from high school. Seated: Sam's mother and father. Standing, left to right: Moses, Sam, Dan, and Julia.



model of a scientist and teacher. After four years under his mentoring, I was recommended to pursue a graduate career in science and medicine in the United States.

I did my graduate study at the University of Rochester Medical School, where for five years I worked on the membrane enzyme complex, cytochrome c oxidase, under Prof. Elmer Stotz. Toward the end of my graduate study, Professor Efraim Racker from Cornell University was invited to the medical school, and gave a series of lectures on the discovery of mitochondrial ATPase and oxidative phosphorylation. When Professor Racker heard my Ph.D. work was on a mitochondrial membrane enzyme, he offered me a postdoctoral research associate position in his famous laboratory. I could not refuse his invitation and moved to Cornell. Three years later after giving a seminar in the newly formed Department of Biology at Syracuse University, I accepted an offer from Prof. Don Lundgren to become a junior faculty member and start my own research laboratory of membrane biochemistry at SU. From that point on, other than my sabbatical semesters at Dartmouth and in Switzerland, I have remained at SU.

Today, my two brothers, our sister, and I are all in the United States. My elder brother Dan Chan was a microbiologist working in Chicago for many years before entering Trinity Theological Seminary, because he promised my father on his death bed he would continue my father's unfinished job on this earth as a church pastor. Dan has since served a large number of Chinese communities in California. My younger brother, Moses Chan, is a prominent physics professor and a member of the National Academy of Sciences, studying low-temperature super-conductivity. My sister, Julia, was the head librarian in the Brooklyn Branch of the Public Library in New York City. We were all taught the traditional Chinese philosophy that the more hardship one endures, the better person one becomes (literal Chinese saying is: the more bitterness one eats, the higher echelon an individual achieves). A simple criterion and aim in life for us is to be able to honor our parents and make them proud.

My parents are now buried on a mountain top cemetery in Hong Kong, resting in peace and with pride. In addition, I believe they would be equally proud of their seven grandchildren; all were born and grew up in the United States. The eldest one is a practicing physician and kidney specialist; another is a young biochemistry professor in

UC San Francisco; three are attorneys working in two of the top patent law firms; and the two others are working in the financial world and the World Bank. Both of my children, Lydia and Albert, graduated from Jamesville-Dewitt High School and then from MIT engineering school.

Looking back, I have been fortunate in having many blessings in life; for example, because my family moved continuously to many parts of China during the war years and I subsequently studied and lived in different societies and countries, I learned several Chinese languages (Mandarin, Cantonese, in additional to my parents' dialects), Japanese and some German. I am capable of doing simultaneous translations (mostly sermons in the church) between the two Chinese languages, Japanese, and English. For example, when Billy Graham gave his Crusade sermons in the Carrier Dome in April 1989, I did the simultaneous translation for the Chinese in the audience.

As my classmates and I gathered for our 50th reunion celebration in Hong Kong, the atmosphere was quite strained and our greetings awkward and formal as we tried to match faces and names from the distant past. But once we became reacquainted, identified one another along with our original nicknames in the local dialect, and joined in warm laughter and feasting on the local favorite dim-sums, it seemed a half century vanished in an instant. I was overwhelmed with the feeling described in the Chinese proverb "fallen leaves longing to return to their roots." I was particularly impressed by my classmates who devoted their lives to building the local community and society. For example, Peter Mak, after serving as head master of the local high school for many years, committed himself to organizing the benevolent society for retired senior citizens. Others had joined together early in their careers to found and build three high schools, and over the years systematically supported the local education programs providing opportunities for all school children.

Returning to Hong Kong after so many years away, I, like most visitors, was overwhelmed with the physical transformation as China becomes a modern industrial state. However, perhaps even more remarkable has been the transformation of the social structure of China under a different political system. My father was born a few minutes before his twin brother and thereby became the eldest son of the eldest son. The advantages and responsibilities of being the eldest son were his, and the fate of his siblings, cousins, and other family members was manual labor tilling the soil. Had that tradition continued one more generation, my elder brother Dan would have inherited the title of "eldest son;" Moses, Julia, and I would have been his subordinates. Instead, the vagaries of war and revolution separated us and many other Chinese of my generation from our homes and traditions.

In the case of the Chan family, the determination, resourcefulness, and shear grit of my mother, along with her faith that all her children were equal and would succeed, resulted in professional careers for all of us.

It has been a year and a half since I returned from the reunion, and I have been reflecting on what I observed in Hong Kong, my past years, and just where I fit into the world order. I was born in China, grew up in Hong Kong, and was educated in Japan and the United States. My students, both undergraduate and graduate, and postdoctoral fellows have come from all over the world. Now, due to the Internet and technological advances, it seems the whole world is at our fingertips. I am no longer a "pure Chinese," nor just a proud naturalized Chinese American, but rather a world citizen.

I do admit to having two personality traits probably "inherited" from my parents: first, I am an emotional individual, as my father revealed he was during the most difficult period of his life, and second, I also possess a fiercely competitive nature—particularly revealed in matches of racquet-using sports. I probably learned this competitiveness from my mother while she struggled to survive and overcome extreme hardships in her life. All in all, at this junction of my life, I feel blessed and humble. A country boy from China, the second son of a political refugee who had gone through much hardship in life, I was given ample opportunities to obtain a higher education, to be trained as a scientist, and serve as a professor and mentor to many American and international students from all over the world. I am so thankful to all my former students who studied in my laboratory. Many of them are themselves established professors in important positions here and abroad; still others are in the field of medicine and health-related professions serving others in a different capacity. I was asked recently by some graduating students in my class what I would do if I had a second chance to relive my life again. My answer is the following: Other than some personal failures, and a couple of overly ambitious but futile research projects, I would probably start all over again doing exactly what I have done these past 40-some years.

FACULTY PROFILE:
Kari Segraves

Examine any natural community and you will find a bewildering network of species interactions that range from non-specific, intermittent associations to ones that are profoundly specialized and lasting. As Charles Darwin emphasized in the *Origin of Species*, it is without question that this "entangled bank" of interactions has played a critical role in creating the diversity of species on Earth. The importance of species interactions, however, extends well beyond this scientific perspective. They are part of our everyday lives—from the gut microbes that assist us with digestion to the stimulating effects of caffeine, a chemical byproduct of plant evolution that discourages insect herbivores. My research focuses on the interactions between plants and insects, two species-rich groups that are important both in terms of biodiversity and agriculture.

If someone had told me in my senior year of high school that I would become a biology professor at a highly ranked research university, I would have said that they were crazy. At the time, I was exploring careers in photography or math, and it was purely fortuitous that I decided to round out my senior year with a course in ecology. It wasn't until much later in my career that I began to appreciate the uniqueness of this educational experience, especially for someone growing up in a tiny town in southeastern Washington State. My devoted teacher took us on field trips nearly every day the weather was decent, traveling to the local river in a dilapidated school bus to catch insects, press plants, and seine for fish. In addition to these short trips, we also journeyed on weeklong adventures to Mount St. Helens and the Oregon coast, where we identified countless organisms and observed firsthand many of the concepts discussed in class. It really wasn't until our final trip to the Oregon coast that I realized I wanted biology to be a bigger part of my life. As I stood knee-deep in the cold Pacific waters, I knew that I wanted to learn more about the natural world around me.

I decided to attend Washington State University where I promptly declared biology as my major, and during my sophomore year I started taking upper division biology and other science courses. That year I studied limnology, marine invertebrate ecology, and botany. Much to my surprise, I discovered my favorite classes were botany and chemistry, two seemingly disparate subjects. During my junior year, a friend pointed out that the university housed a biochemistry department where I could pursue both of my interests. So I decided to double-major in biology (ecology and evolution) and biochemistry, with the idea that the latter addition would make me marketable, because at the time I believed that a degree in ecology and evolutionary biology was unlikely to lead to a "real" job. My days were divided between donning my lab coat to study the effects of alcohol on spermatogenesis in rats and taking field trips to northcentral Idaho to survey plant and insect populations.

As I learned more about each of my projects, I found myself gravitating toward my research on the plant *Heuchera*, or alum root. I was investigating a moth (*Greya*) that both feeds on these plants and pollinates them, but what I found particularly intriguing were the genetic features of the plants. Across its relatively small geographic range, we found that the plants varied in chromosome number, with some having the typical diploid set of chromosomes (two of each chromosome) while others were tetraploid (four of each chromosome). On top of this, there was also some evidence for hybridization with another *Heuchera* species. These interesting findings led me to stay at WSU for a master's degree, where I studied how these genetic factors affected the plant's ecological interactions with *Greya* moths and the other insects that visited the flowers. I decided to use a combination of lab and field approaches in my project, employing modern techniques in "molecular ecology" to assess the relatedness of plants and apply this to my field research. I was surprised to learn that in some populations the diploid and tetraploid plants differed slightly in flower shape, whereas in other populations the two chromosomal complements were difficult to distinguish. What was really exciting was the finding that, even when there was no apparent physical difference, both *Greya* and various other insect visitors could distinguish between the two genetic forms. For instance, I found that bumblebee queens preferred to collect nectar from tetraploids whereas the workers of the same species foraged nearly exclusively on diploid plants. So in instances when I was challenged to tell the two types of plants apart even with my molecular toolkit, I found it interesting that the flower visitors possessed an unknown mechanism to distinguish them. Although I enjoyed working in the lab, it was the field research that solidified my desire to continue on with a Ph.D.

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After spending several years working on the *Greya* moths that pollinated and fed on *Heuchera*, I became interested in how mutualistic associations evolve. Mutualisms are interactions between species where both partners benefit from the association. For example, the female moths that forage for nectar on *Heuchera* pollinate the plant and also lay eggs in the flowers. Once the larvae hatch, they feed on a small fraction of the plant's seeds, so both the moth and plant benefit from the interaction. As a master's student I began to focus on how the balance is maintained between partners in a mutualistic association, and why one partner doesn't take advantage of the other such that it gains more from the interaction. For instance, what prevents the moths from laying so many eggs that the larvae consume all of the seeds? In essence, why don't moths cheat?

Given my interest in the evolution of cheating in mutualism, I decided to attend Vanderbilt University for a Ph.D. where I was advised by Olle Pellmyr, a leading researcher studying how mutualisms evolve. He focused on the interaction between yucca plants and yucca moths (*Tegeticula*) as his main study system. I saw many advantages to working with Olle on *Tegeticula* as these moths were familiar because they are close relatives to the *Greya* moths that I studied on *Heuchera*, and the yucca-yucca moth interaction is a textbook example of mutualism. Yuccas, or century plants, feature prominently in desert ecosystems as an important resource for many animals. The plants and their flowers

Yucca aloifolia

Yucca shidigera

Yucca filamentosa

are beautiful and are often cultivated in gardens. Some yuccas are relatively famous; Joshua tree (*Yucca brevifolia*), for example, is both the name of a national park in California and a popular U2 album.

Yuccas are only pollinated by yucca moths, and the relationships between the moth and the plant has become extremely specialized during their evolutionary history. During the day the small white yucca moths benignly rest inside yucca flowers, but at night they become bandits, stealthily flitting from yucca flower to yucca flower to lay eggs and pollinate. The female yucca moths deposit eggs inside of the flowers, hypodermically injecting them into the floral tissue using a modified structure that resembles a needle (similar to the stinger of a wasp). Just after laying an egg, a female will climb to the top of the flower and purposefully pollinate using a bit of pollen that she carries in a ball under her head. Females have specialized mouthparts used for collecting and depositing pollen, and these mouthparts are not found in any other insect. Such active pollination behavior is incredibly rare, as nearly all pollinators accomplish the task by accidentally brushing pollen onto the receptive surfaces of flowers. By purposefully pollinating the flower, the female yucca moth is ensuring a food source for her offspring, since the eggs will eventually hatch into small larvae that feed exclusively on yucca seeds. In the end, the plant generally comes out ahead because the moths pollinate more seeds than the larvae destroy; thus, the plant gains an extremely effective pollinator by giving up a few seeds.

My Ph.D. project focused on how cheaters evolve in mutualistic interactions, and I took advantage of a new discovery that Olle had made while conducting field research in the southwestern United States. When he began working on yucca moths, there were only a few named species, and his observations of the moth *Tegeticula yuccasella* led him to believe this entity was actually a composite of several unrecognized species. A combination of DNA sequence analysis and measurements of the shape and size of the moths showed that Olle was right,

Figure 1: *Tegeticula yuccasella* in a yucca flower. The female in the lower right is laying an egg, and the female on the left is actively pollinating.

and revealed that *T. yuccasella* consisted of at least 14 distinct species. The truly exciting finding was that two of these new species were "cheaters," or moths that avoided pollination and laid eggs directly into developing fruit. Cheaters capitalize on the efforts of the pollinator moths, and their larvae feed on yucca seeds in competition with pollinator moth larvae. In theory, cheaters should overexploit the mutualistic partners by eating all the seeds, and the final result would be extinction of all three species. Yet, a quick look at the evolutionary history of the cheaters shows that they have happily coexisted with the mutualistic moths for upwards of two million years; clearly, cheaters are not destabilizing the mutualism. During the course of my Ph.D. work, I used behavioral studies of the moths, field observations, and molecular analyses of the evolutionary histories of the pollinator and cheater moths to examine how cheaters might have evolved. Although the evidence remains thin, our best guess is that cheaters may come into existence when a mutualistic interaction is more complex than the simple scenario of two interacting partners. That is, in circumstances when multiple pollinator moth species coexist on a single yucca species, there is an evolutionary opportunity for one pollinator species to cheat because the other pollinator is still providing a benefit to the plant. We are still exploring this hypothesis and are learning more about how mutualists can turn to the dark side and become cheaters.

This idea about how community complexity might lead to cheating drew me to think more deeply about how the multitude of interactions present in a community could influence the pair-wise interaction between mutualist partners. We often think of mutualisms as existing in isolation of their surroundings and ignore the effects of other species. Part of the reason for doing so is one of simplification; species often interact with hundreds of other species, and trying to study even just the direct effects of a few interactions can be challenging. For instance, a typical pollination mutualism will involve a focal plant species that has dozens of pollinator species all of which also interact with dozens of other plant species. The picture becomes even more complex when the diverse community of herbivores and predators is added. But one of the great qualities about the yucca study system is its inherent simplicity. In contrast to other mutualisms, the yucca-yucca moth interaction typically has only a single pair of mutualists (one plant and one moth species) and they interact with a small handful of other species—from spiders that sit and await prey in flowers to beetles that feed on yucca flowers.

When I arrived at Syracuse University in 2005, I decided to use the yucca system to ask how community complexity affects the mutualism between the plants and moths. My colleagues and I are focusing on the plant side of the story, trying to understand how all of the direct and indirect interactions with the community impact seed production. At the outset, we thought the results would be straightforward: community members that fed on the plants should harm seed production and those that fed on the herbivores should improve seed production. That's not quite what we found. Instead, we learned that some herbivores could increase seed set. In particular, we found that plants being fed on by a small flower-feeding beetle (*Hymenorus*) produced more seeds than plants lacking the beetle. Although the obvious direct effect of the beetles (destroying floral tissue) is bad for the plants, we found that the beetles also produce a strong indirect effect. Not only do they consume plant tissue but they also incidentally eat yucca moth eggs. By doing so, they are reducing the number of moth larvae feeding within fruit and this increases seed set. So, counter-intuitively, we've shown that a flower-feeding insect can benefit plants.

Our next step in this project involves determining how the community of insects interacting with the plants and moths might influence pollen movement among yuccas. Yucca plants are hermaphrodites—single flowers produce both pollen (sperm) and eggs—meaning that a given plant can pass on its genes by serving as either a mother (producing seeds in fruit) or as a father (siring seeds in fruit of other plants). So far, our analyses have only focused on how well a plant fares as a mother, and does not include the plant's performance as a father. To remedy this, we are currently using molecular tools similar to the ones used in human paternity tests to assess the number of seeds an individual plant has sired. We expect that the male perspective of the plant may differ substantially from the female perspective. For instance, we've shown that the flower-feeding beetles improve seed set from the female perspective, but since these beetles can also quickly consume all of a plant's pollen, we're betting that they decrease the ability of a plant to sire seeds. If the pollen is removed before a moth can collect it, then that plant will not sire any seeds. Consequently, the benefits gained through female reproduction may come at a cost to male reproduction. In the end we hope to paint a full picture of the effects of a number of insects that interact directly and indirectly with yuccas and their pollinator moths to understand more about how these types of mutualisms are shaped in natural communities.

As the yucca project draws to a close, I've decided to return to my work on the *Heuchera* system to learn more about how variation in the number of chromosomes impacts interactions between species. Rather than focusing exclusively on insects, I'm working with the soil fungi that inhabit the roots of *Heuchera*. The interaction between the plants and fungi is thought to be mutualistic as the fungi forage for critical plant nutrients that they then trade with the plant for carbohydrates. I'm interested in the ties between DNA content and the nutrient requirements of plants and how these factors in turn affect interactions with the mutualistic fungi. Since many of our crop plants also have extra sets of chromosomes (e.g., bananas, wheat, and strawberries), knowing more about these interactions that can help plants grow in nutrient-depleted environments may be useful in agriculture. I find it exciting that my research might help us engineer better crops, and I look forward to the discoveries to come.

Figure 2: *Hymenorus densus beetles* feeding on yucca flower

GRADUATE STUDENT PROFILE:

Dawn Higginson

I've learned to be vague when strangers ask me what I do. A blunt reply of "I study sperm" typically results in a stunned or mildly bemused expression and a quietly uttered response of "Oh!" That ends most conversations with non-biologists.

Sperm were discovered in 1677 by Antonie van Leeuwenhoek, a draper by profession and an amateur microscopist. In his spare time, he built simple, single lens microscopes that could magnify objects up to 270x, sufficient to see even some bacteria. In his letter to the Royal Society of London describing his remarkable discovery, he communicated the sensitivity of the topic:

> "And if your Lordship should consider that these observations may disgust or scandalize the learned, I earnestly beg your Lordship to regard them as private and to publish or destroy them as your Lordship see fit."

Fortunately, Leeuwenhoek's work was published and attracted considerable attention from scientists at the time. However, the role of sperm and eggs in the production of new individuals was not understood or widely accepted until the 1880s. Today, it is common knowledge that transfer of paternal DNA through sperm to an unfertilized egg occurs in all sexually reproducing animals.

I first became interested in sperm while working on the evolution of insecticide resistance in the pink bollworm, a pest in cotton fields worldwide. The pink bollworm is a small moth whose caterpillars eat the developing seed heads from which cotton fiber is harvested. In the United States, pink bollworm damage is limited by planting transgenic cotton plants, genetically modified to produce Bt-toxin protein, the gene for which was isolated from the bacterium *Bacillus thuringiensis*. Bt-toxin binds to the gut of caterpillars; the caterpillars stop feeding and eventually die. Outside of legally required "refuges" in which unmodified cotton is planted, virtually all cotton grown currently is transgenic, potentially resulting in intense selection for bollworms resistant to Bt-toxin. After the widespread introduction of Bt cotton to the US agricultural system, the proportion of pink bollworms in Arizona fields resistant to Bt-toxin actually dropped from a surprisingly high level at the time of introduction to undetectable levels. As part of a master's thesis, I was tasked with understanding why resistance to Bt-cotton was not found in the field despite the ease of generating resistant pink bollworm strains in the lab. Experiments conducted by members of my research group at the University of Arizona revealed that resistant moths were less likely to survive the winter than moths susceptible to Bt. Additionally, I found that resistant males sired fewer offspring than susceptible males when competing to fertilize a female's eggs, despite having similar mating frequencies and fertility. While trying to understand this result, I learned that moths and butterflies produce two types of sperm: one type participates in fertilization while the second type contains no DNA. Sperm lacking DNA often makeup more than 90 percent of the total sperm transferred to females. I was completely stunned by this fact. Why spend so much energy making sperm that couldn't fulfill the primary function of fertilization? Follow-up research by my lab group found that resistant males transfer fewer sperm, of both types, to females than do males susceptible to Bt-cotton.

After finishing my M.S. degree at the University of Arizona and a brief hiatus working in a University of Montana lab studying bark beetles (the scourge of western forests, killing whole stands of trees and increasing the likelihood of large-scale wildfires), I still couldn't stop thinking about the bizarre infertile sperm of moths. I found myself borrowing all the sperm-related books from the library and decided that I wanted to investigate the evolution of unusual sperm traits in a depth that only a Ph.D. dissertation would allow. I started looking at grad schools and found the best place in North America, and arguably the world, to pursue my studies was in the lab of Scott Pitnick in the Department of Biology at SU. I applied, was accepted, and spent the next several years happily submerged in the study of how reproductive traits are shaped by selection resulting from male-male competition for mates and female choice of sires.

My doctoral research focused on understanding why sperm that share a common function, fertilization, have such diverse morphology. For example, within insects alone, any one of the four main constituents of sperm—the acrosome, nucleus, mitochondria or flagellum—may be absent or form the most prominent feature of sperm morphology. The answer is, in part, that sperm do much more than just fertilize an egg. In the case of species with internal fertilization (most terrestrial and some aquatic animals), sperm must navigate the often complex chemical and physical environment of the female reproductive tract to locate and fuse with an egg. Sperm also often undergo the final stages of maturation outside of the body of the male that produced them. In addition, sperm typically have to compete with the sperm of rival males within the female while avoiding competition with sibling sperm. The diverse morphology of sperm is believed to reflect adaptations to overcome these many challenges facing sperm.

To test ideas about how sperm morphology evolves, I have focused on diving beetles (Dytiscidae). The group has been around since the time of the dinosaurs, and today there are nearly 4,000 living species. Diving beetles can be found in almost any lake, pond, stream, or puddle worldwide. Prior to my work, the sperm of a handful of closely related species had been examined. From this limited sample, it was evident that the sperm of diving beetles often join together at the head to form a multi-sperm conjugate that swims in a

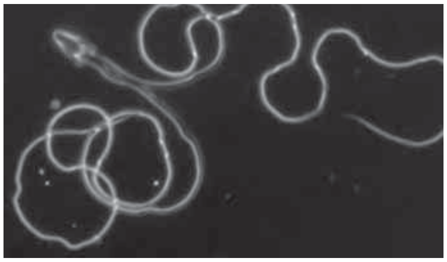


Figure 1: Sperm pairing in *Graphoderus liberus*. The heads of two sperm are tightly joined (upper left) with the flagella free.

coordinated manner before dissociating prior to fertilization. To determine if such conjugates are typical for diving beetles, I characterized the sperm from approximately 140 additional species distributed across the family. From this work, it was evident that most species produce conjugates and that among species, conjugates take one of three forms: 1) aggregates, where variable numbers of sperm align with their heads in register; 2) pairs, where strictly two sperm join with their heads aligned; 3) rouleaux, where the tip of one sperm head slips into a pocket at the base of another to form an orderly stack of sperm (a novel type of conjugate unknown prior to my research). Additionally, males of some species produce two distinct types of sperm that differ in total length or head shape. Unlike moths and butterflies, both sperm morphs contain DNA although it is unknown if both can participate in fertilization. Formation of conjugates and dimorphism sometimes co-occur, resulting in complex conjugates composed of both types of sperm.

I mapped sperm traits onto phylogenetic trees based on DNA sequence from two mitochondrial and two nuclear genes, which represent evolutionary relationships between species. Next, I evaluated how well different models of sperm evolution fit the observed distribution of sperm traits on the trees. Once I found the most likely model of evolution, I used this model to infer what the sperm of long extinct species of diving beetles might have looked like. I concluded aggregates are the ancestral sperm form in diving beetles and subsequently diversified into pairs or rouleaux. My analyses also revealed that pairing most likely evolved on three separate occasions, that conjugates reverted to their ancestral aggregated condition twice within the lineage with rouleaux, and that sperm dimorphism evolved a minimum of five times in diving beetles, including both species which do and do not form conjugates. From

Figure 2: An aggregate composed of six sperm in *Rhantus consimilis*. The sperm have been DNA-stained making the heads prominent (lower left). Aggregates are composed of variable numbers of sperm within males.

this work it is evident that sperm evolve rapidly but diversification is constrained to particular traits.

Why should diving beetles evolve conjugates to begin with? For diving beetles, like other internally fertilizing species, the female reproductive tract is the selective environment of sperm. I hypothesized that conjugates might allow sperm to maintain positions in the female close to where eggs are released, and thereby increase their probability of being used for fertilization. If this were true, formation of conjugates and aspects of the female reproductive tract would be expected to evolve in a correlated manner. Diving beetles have a conduit-style reproductive tract: sperm enter and travel to the site of storage before exiting through a separate duct to the site of fertilization. I measured the dimensions of the entry duct, storage organ(s) and exit duct of 42 species of diving beetles. Using statistical methods that control for similarity produced by shared evolutionary history, I found that presence of sperm conjugates was correlated with small sperm storage organs and short exit ducts. Furthermore, dimensions of the female reproductive tract changed in advance of sperm conjugation, indicating that sperm evolve in response to selective pressure created by the altered conditions in the female reproductive tract. This prompted me to examine the behavior of the conjugates in the females' reproductive tracts. Conjugates were almost always found with their tips inserted into the exit duct (closest to the site of fertilization) and were able to maintain this preferred position by

Figure 3: Dimorphic sperm and a conjugate of *Hygrotus sayi*. Males produce sperm with checkmark-shaped and filamentous heads (top panel). The tip of one checkmark-shaped head slips into a pocket at the base of another to form orderly stacks called rouleaux to which filamentous sperm heads attach (lower panel). The conjugates are composed of hundreds of sperm and are highly motile. Sperm have been DNA stained and imaged using epifluorescence. Flagella are not visible.

apparently anchoring within the duct.

The few people who aren't deterred by my response "I study sperm" often ask me what is the point of my research and how does it help humans. I sometimes bristle at this question. Is there no intrinsic value to understanding the origins of the tremendous diversity life on this planet and how diversity of forms affect function in their environment? But I know this is insufficient. Instead I explain that despite the discovery of sperm more than 300 years ago, sperm motility (critically important for fertility in humans and many other species), the impact of morphology on sperm function, and the process of fertilization are poorly understood. As with many mammals, otherwise healthy human males often produce a large proportion of sperm with "abnormal" morphology. My work strives to understand why unusual variants in sperm morphology occur and how these variations in form impact the fertility of the males that produce them.

GRADUATE STUDENT PROFILE:

Zaara Sarwar

Growing up in Bangladesh, in a traditional society with conservative values, I have been fortunate to be exposed to a rich diversity of experiences in my academic and social life. This would not have been possible without the encouragement of my family who treasure education above all else.

My mother, a renowned classical musician, exposed my sister and me to the rich heritage of our culture. My father, a scientist and entrepreneur, showed us how with a sound education we could contribute to the development of our society. The achievements of my parents have shown us that we can use our education to help Bangladesh, my home country, to become a more advanced and globalized nation. For instance, my sister who has obtained a master's degree in public administration intends to promote the betterment of Bangladesh through her work in the public sector. As for myself, I have always been interested in the sciences. My interest in the biological sciences dates to reading *The Double Helix* by James Watson. Watson's description of the elucidation of the structure of the DNA molecule and its elegant simplicity in relation to its role as the repository of all genetic information stimulated my interest in molecular biology. This along with strong high school science courses instilled in me a fascination for biochemistry and physical chemistry that facilitate life processes. This led me to earn a B.Sc. in chemistry and mathematics from Queen's University in Canada, following which I decided to further my education by enrolling in the structural biology, biochemistry, and biophysics Ph.D. program at Syracuse University.

At Syracuse University I joined Dr. Anthony Garza's lab where the main focus of research is the mechanisms of bacterial biofilm formation. In nature, and of particular interest to medicine, in many chronic infections bacteria grow as surface-associated communities of cells embedded in an extracellular polymeric matrix. The bacteria in the biofilm often respond collectively to environmental stimuli, sometimes expressing genes or showing pathogenic activities not evident when the cells are growing in isolation or in planktonic culture. In addition, bacteria growing in biofilms are often particularly resistant to host defense mechanisms and conventional therapies with antibiotics.

Recent studies have shown that biofilms in the environment can act as reservoirs for pathogens such as *Vibrio cholerae* and *Shigella spp*. between epidemics. Bacterial biofilms thrive in drinking water and food sources that do not undergo proper sanitation procedures. In fact, poor drinking water quality is one of the primary means of spreading infectious diseases in Bangladesh. Children are especially susceptible to infectious diseases caused by biofilm formation. Moreover, malnutrition of children, which is a common phenomenon in Bangladesh, makes the children even more vulnerable to chronic diseases. I believe that understanding the mechanisms of bacterial biofilm formation, how biofilms are maintained, and how cells communicate within the biofilm are very important. These topics are the subjects of my dissertation research.

In our laboratory, we study the gram-negative soil bacterium *Myxococcus xanthus*. Although not a human pathogen, *M. xanthus* grows in biofilms in which the bacteria act cooperatively in movement and in subduing and digesting bacterial prey which are their source of food. In addition, in response to adverse environmental conditions such as nutrient depletion, *M. xanthus* undergoes a complex life cycle during which bacteria in the biofilm aggregate and form multicellular structures called fruiting bodies (Figure 1).

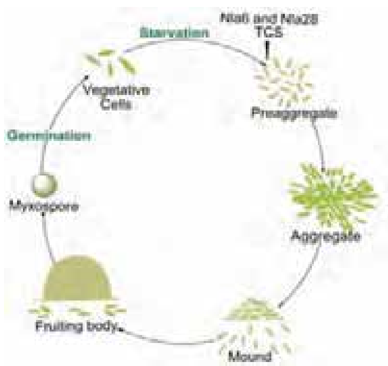


Figure 1: Fruiting body development of *M. xanthus*. Vegetative rod-shaped cells grow in the presence of nutrients. When nutrients are depleted, the cells aggregate and form multicellular fruiting bodies. Individual rod-shaped cells within the fruiting body are transformed into spherical myxospores that are resistant to extreme conditions. The spores germinate into vegetative cells when abundant nutrients are again available.

The social behavior and the complex life cycle of *M. xanthus* make it well suited for studying cellular communication and multicellular developmental processes in bacterial biofilms.

Differential gene expression in response to environmental changes is critical for biofilm formation processes such as fruiting body development in *M. xanthus*. In a number of cellular regulatory systems, detecting changes in the environment and responding by changing gene expression involves "two-component signal transduction systems" (TCS), which in a general form is described in Figure 2. TCSs typically contain a histidine kinase sensor and a response regulator that modulates changes in gene expression. The histidine kinase sensor is autophosphorylated in response to an environmental cue. The phosphate is then transferred to the response regulator, thus activating it. The activated response regulator can then control expression of its target genes. About 20 TCSs that are important for various stages of fruiting body development have been identified in *M. xanthus*. Two key regulators of fruiting body development are the Nla6 and Nla28 TCSs. These TCS genes are expressed during the early stages of fruiting body development. Mutations in these TCS genes result in delayed aggregation and inefficient sporulation. Thus, even though these TCS genes are expressed during the initiation of development, they are important for both aggregation and sporulation, two major stages of fruiting body development. The goal of my project is to identify and characterize the histidine kinase sensor components of the Nla6 and Nla28 TCSs

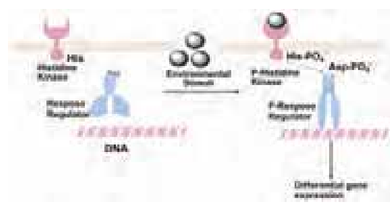


Figure 2: Two-component signal transduction system. The transmitter domain of the histidine kinase is autophosphorylated at a histidine residue in response to changes in environment. The phosphate group is then transferred to an aspartate residue in the receiver domain of the response regulator protein. This activates the response regulator by inducing a conformational change and it can then regulate transcription.

(Nla6S and Nla28S respectively), and to identify the environmental signals that activate these TCSs, thus triggering fruiting body development.

The *nla6S* and *nla28S* genes were initially identified by sequence analysis. These genes were then cloned into expression vectors, and the proteins synthesized in *Escherichia coli* and purified to investigate their *in vitro* activity. Functional histidine kinases are able to hydrolyze ATP and autophosphorylate on a conserved histidine residue. ATP hydrolysis and autophosphorylation experiments showed that both kinases were active *in vitro*.

The next part of my project was to identify the signals that activate the Nla6 and Nla28 TCSs. As both TCSs are expressed during fruiting body initiation they could be involved in sensing nutrient levels and cell density. Since fruiting body development is triggered by nutrient limitation, it is very important for *M. xanthus* to monitor the level of nutrients. In order to investigate whether these TCSs are nutrient sensors, the phenotype of the TCS mutants were studied in the presence and absence of essential nutrients known to trigger fruiting body development. The results of these experiments indicated that these TCSs were not nutrient sensors.

At the onset of fruiting body development *M. xanthus* cells have to determine the cell numbers in their environment, because a certain cell density is required to progress into fruiting body formation. *M. xanthus* accomplishes this by using a signal molecule known as a quorum signal. This process of cell density determination, known as quorum sensing, is used by most bacterial species during multicellular processes such as biofilm formation. Thus, I wanted to investigate whether Nla6 and Nla28 were involved in quorum sensing. Experiments showed that both TCSs are involved in regulating the quorum signal synthetase gene. Also, the quorum signal molecule regulates the expression of the *nla28S* gene. These results together imply the histidine kinases are involved in sensing the quorum signal molecules.

Histidine kinases are widely used by bacteria as sensors to detect a wide range of environmental cues. Although, a lot of work has been done on histidine kinases, not much is known about their sensor activities. This work will provide valuable insight into signal detection by histidine kinases.

UNDERGRADUATE STUDENT PROFILE:

Tess Cherlin

My name is Tess Cherlin, and I am a 10th grade biology teacher at O. Perry Walker High School in New Orleans, Louisiana, by way of Teach for America, a program that gives people the opportunity to go from being an average college graduate to a transformational teacher. I would say I have Syracuse to thank for pursuing my dreams in a far away place; after four years of serious winter, I needed a change. Recently I received a diploma in the mail informing me, reassuring me, that I did graduate from Syracuse University on May 15, 2011, with a bachelor's of science in biochemistry. Phew!

Nevertheless, just two months out and I am missing Syracuse a lot. Although I feel at home in a jazz-filled, semi-tropical, sometimes French-speaking atmosphere, Syracuse is still on my mind. I get nods of approval as I jog through Audubon Park with my bright orange Homecoming 2007 T-shirt. Walking around Tulane's campus, where I am residing until I can move into my shotgun home, I am nostalgic for Hogwarts' look-alike buildings, rather than those covered with lilac. And there are no black squirrels—although there are a plethora of black cats and cockroaches!

The summer heat in New Orleans is something a tad more familiar and comforting. Last year, I was a summer research student at SU funded by the Ruth Meyer Scholarship and the Renée Crown Honors program, which allowed me to continue my research in Dr. Melissa Pepling's lab. My project involved studying infertility using zebrafish as a model organism. Not to say one species' life is worth less than another, but for some reason I felt more comfortable sacrificing fish than mice; the organism my lab most commonly studies. I worked 9 to 5 at SU, gave campus tours on my lunch break, and worked at SUNY Upstate Medical Hospital on Tuesdays and Thursdays in the evenings. I was a busy girl! "Making bank" as they say, and living pretty frugally on the 700 block of Euclid Avenue. My house was big, beautiful, and not air-conditioned. I remember having to wake up at 7 in the morning every day, including weekends, because the sun would almost literally cook me alive. But man did I love summer in Syracuse.

My research focused on determining whether zebrafish ovaries developed similarly to those of *Drosophila*, *Xenopus*, mouse, and human. In animals studied so far, the developing ovary contains structures called germline cysts (clusters of interconnected egg cells), which breakdown into oocytes that become incorporated into primordial follicles. The formation and breakdown of the germline cysts is vital for the reproductive success of a female animal. When these cysts do not breakdown the female is infertile. Today there is a rise in infertility among women, and researching possible causes of this is a particular interest of the Pepling lab. For example, estrogen and estrogen-like molecules have been observed to inhibit the breakdown of germline cysts. There is evidence that women are being exposed to environmental estrogen-like compounds (BPA for example), possibly leading to improper ovary development of their female offspring, a process that is initiated early in fetal development.

Over the course of a year, I learned to dissect zebrafish ovaries out of 2-week-old fish up to adult fish. For a while I was in a rut because I was not able to find any physical structures that resembled the germline cysts I had seen in other animals. But then one day I went to a lecture given by Dr. Joshua Johnson, professor of obstetrics, gynecology, and reproductive sciences at Yale University. The talk was about egg destruction in mammals, but at one point he started speaking about Medaka fish and the germline cysts observed in this fish. I eagerly read everything available on the Medaka and learned that they were quite similar anatomically and morphologically to zebrafish, that is, small bony fishes. I was shocked and excited to see the cyst structures in the Medaka and to realize I had seen comparable structures in my own microscope images of zebrafish. It was not that zebrafish don't have cysts, it was just that I couldn't recognize them. After volumes of articles and making many observations, I was able to make a preliminary conclusion: zebrafish ovaries do contain germline cysts.

With assistance, collaboration, hard work, and a bit of luck, I was able to find my way through an unknown world.

I learned how to read scientific articles and use the information to better my understanding. My peers and supervisors aided me in ways I would never have anticipated for which I am very grateful. Working relentlessly reminded me why I love science so much and where hard work could take me. Finally I used my lucky encounters to my advantage. I could very well have sat and vegetated listening to Joshua Johnson speaking about ovaries while eating some complementary cookies in the back of the Lundgren room. Instead I used the clue he gave me and succeeded in finishing strong with my capstone thesis.

Senior year brought some stresses ranging from deciding what future steps I would take in my life, my zebrafish research, and biochemistry lab with Dr. Chan. Sometimes, what I really wanted to do was lounge about on the Quad, read a book, and drink some People's Place iced coffee. I definitely fell asleep on the green center-point of our campus while reading a particularly long article on *Xenopus* ovarian development. Nonetheless, I learned a lot being a biochemistry student at Syracuse University. Everything I have learned, I want my future students to know. I want to teach so that I can share my knowledge, share my passion, and share the skills, maybe not just biology-related, to help my students succeed.

I decided to apply to and join Teach for America because I wanted to use my degree after college in a way that suits who I am. I have participated in teaching many times throughout my college experience, from tutoring at Nottingham High School, to assistant teaching at a bilingual elementary school in Strasbourg, France, to aiding in an English as a Second Language classroom for immigrant and refugee adults in the Near West Side of Syracuse. Giving others the knowledge that I have is very important to me. Right before senior year I saw a road waiting for me (grad school) and I didn't drive down it. I didn't feel like that was the next step I wanted to take. For me, teaching biology to kids in New Orleans is where I need to be now so I can give my students what I received. The greatest experiences in my life have been my education, and I have pushed to make every experience in my life educational. I will never stop learning and will never stop asking questions and investigating. One day I hope to be a medical anthropologist so that I can bring all of my interests, passions, and skills into one profession. It is my hope to use everything I have learned in my life to build a foundation to do something that doesn't just make me happy, but has the potential of positively affecting many people. I don't see myself being a high school biology teacher for the rest of my life, but I know I will always be a teacher and will always be a student.

UNDERGRADUATE STUDENT PROFILE:

Sarah K. Wendel

There was more than the usual commotion when I arrived in the Meru District Hospital maternity ward in Tanzania on that warm July day in 2010. I had been volunteering in this unit since my arrival in Arusha, in northern Tanzania, four weeks earlier. The dilapidated facility, 10 miles east of Arusha, serves city dwellers, subsistence farmers, and the surrounding semi-nomadic Maasai tribes. Women from the outlying villages had crowded into the small ward that day. They lay head to toe on the three narrow beds in the birthing room. In the postnatal unit, new mothers and their babies were crowded four to a bed. The staff of two midwives was stretched thin.

Sarah with Maasai children; Meru Mountain in the background

Lesha, a Canadian midwife called me over to a birthing bed. "You have watched long enough," she said. "Can you go solo?" I looked down at the laboring woman. She was petite and pretty, with a broad face and high cheekbones. She appeared to be about the same age as me—and she looked very frightened. Despite my apprehension, I gave her a reassuring smile and took a deep breath. I had watched up to 10 deliveries a day for weeks. But could I do this? I had already watched a woman die in childbirth. I slipped on a pair of gloves. The noise and chaos of the maternity ward receded as I focused on this singular task. Lesha watched as I timed the patient's contractions with my wristwatch and checked to make sure that the baby was head down, feeling for it with my thumb and index finger after gently pushing on her abdomen as it stiffened in a contraction. The patient was fully dilated and in active transition. The head crowned, and as the baby emerged, I gently placed my hands on its shoulders, guiding the small body as it slid out. It was a girl! She gave a good squawk. After clamping and cutting the umbilical word, I cradled the baby, showing her to her mother. *Asante, asante,* she told me repeatedly, her eyes wet with tears. *Thank you.*

Over the next six weeks, I learned other medical skills, such as removing a placenta, giving injections, and changing IVs. I became a trusted member of the

Sarah, other interns and midwife, Safari

OB ward's medical unit. I learned I could function in a hectic environment, where resources were limited and the need was overwhelming. This was why I had come to Africa—to learn, to challenge myself, to make a small difference in the world.

"That's when I feel most alive," Paul Farmer, the renowned doctor and anthropologist, has said, "when I'm helping people." I heard Farmer speak at Syracuse University, and his remarks influenced me deeply. His muscular idealism and his passionate belief that healing constitutes a basic human right spoke to me personally. That is why I have traveled to developing nations to do what I could with my limited skills and have worked abroad and at home in communities of need. It's not that I expect to change the world, but I do expect to make a difference in admittedly challenging situations—whether it is easing misery abroad or going up against a recalcitrant insurance company at home.

In the summer of 2009, I volunteered as a medical intern at a public clinic in Cusco, Peru. While conditions were not as bare as I later encountered in Tanzania, the facility, called Belenpampa, was located in a dilapidated building in the center of the city and provided medical care to the city and outlying areas of Cusco. That lack of equipment was striking. If patients wanted a nurse to use gloves while examining them, they bought them themselves because the clinic could not provide them. I learned technical skills, such as dressing wounds and taking vital signs. The need there was great. When I arrived each morning, 50 people were lined up at the admissions counter.

Closer to home, SU gave me the experience to work in two different laboratories in my undergraduate career. After my freshman year, I earned a summer undergraduate internship program at the National Genome Research Institute at the National Institutes of Health, working in Dr. Eric Green's laboratory on a research project based on comparative genomics with chimpanzee and human X chromosome sequences.

For my Honors thesis and Distinction in Biology, I worked at SUNY Upstate Medical School with Dr. Mary Lou Vallano in the Department of Neuroscience and Physiology. Her current focus is on cerebral vasospasms, which are a narrowing or constriction of brain blood vessels causing reduced blood flow to the brain and the death of neurons. They are often associated with strokes resulting from nutrient deprivation and are a complication of a subarachnoid hemorrhage. Subarachnoid hemorrhages (SAH) make up 7 percent of all strokes but are the most deadly, with more than a 50 percent fatality rate, particularly due to cerebral vasospasm. To date, no therapies have proven to prevent cerebral vasospasm following SAH. As a laboratory, we are looking at the different factors that contribute to cerebral vasospasms and trying to determine if there is anything that can be done to decrease their severity and duration. Specifically, I looked at how to characterize the vasospasm molecularly and if there are indicating features controlling the severity and duration of the vasospasms.

With graduation now over, I am excited to take the next step. I have been awarded an Intramural Research Training Award at NIH with Dr. Tom Quinn, head of the Center for Global Health at Johns Hopkins University and an active member of the National Institute of Infectious Disease and Allergies, and started working there in July. I have learned in an up-close-and-personal way that medicine is not all about gleaming newborn babies and happy patients. It is hard work and long hours. Inspired by Farmer's observation that "no one should have to die of a disease that is treatable," I continue on, eager to undertake the challenge of a career in medicine.

Syracuse has shown me that all these dreams are possible. As Henry David Thoreau once said, "If you have built castles in the air; your work need not be lost; that is where they should be. Now put the foundations under them." Syracuse University has laid the foundation. Now, all I have to do is keep building.

Wendel

UNDERGRADUATE STUDENT PROFILE:

Emily Williams

As a freshman entering the new and exciting world of college, I was undecided on the path of study I wanted to pursue. I had several interests and was eager to explore all of the possibilities offered at Syracuse University. If there was one thing I was confident in, however, it was that I wanted to stay as far away from science as I could. If someone had told me during my first semester at SU that I would be graduating with a degree in biology, I probably would have laughed in their face. I had enough trouble simply accepting the fact that I had been enrolled in the daunting BIO 121, a class that I had chosen as a "back-up" in case the courses that I really wanted to take were full.

A few weeks into my first semester and much to my surprise, there was one course that seemed to strike my interest and stand out from the rest—BIO 121. The more I learned in the class, the more eager I became to learn more. Up until college, I found science to be a collection of boring facts that I was required to memorize. I viewed it more as an inconvenience than anything else. So, why this change in perspective? I believe this shift was entirely due to the style in which science was presented to me. In high school, my science classes were monotonous and dull. In biology class, for example, I was expected to memorize discrete facts and was evaluated based on my ability to recite back these facts. At Syracuse, on the other hand, biology was taught in an enthusiastic manner that tied these facts together into a story, describing the natural world in which we live. Biology was no longer the dull and monotonous field I once knew it to be. For the first time, it seemed completely relevant and absolutely fascinating. I was convinced that I needed to learn more, so the next semester I enrolled in two biology classes. It was these introductory classes at SU that helped me to discover a passion for science and ultimately led me to declare my major in biology.

Not really having a solid plan on where I would go from there, I decided to follow several of my fellow biology classmates in the pre-med route. I completed the pre-med curriculum and spent a lot of my time exploring the medical field at the Syracuse Veteran's Administration Medical Center and Rochester General Hospital. Before I knew it, I was approaching my third year at SU. I was not far into my junior year when I came to the realization that I had enough credits to graduate the following spring, a year earlier than I had anticipated. I seriously began to consider my post-graduation plans. I thought a lot about what led me to major in biology in the first place and came to the conclusion that medicine wasn't what I truly wanted to pursue. Rather, I thought, I'd like to pull from my own experiences in the science classroom (from once struggling to stay awake to learning for the pure enjoyment of it) to promote science literacy and highlight it's relevance in our everyday lives. What I'd really like to do is give students, who may not be overly enthusiastic about learning, an opportunity to view science in the same light I do—with fascination and a yearning to learn more.

After a little investigating, I came across a program offered at Syracuse University that seemed to be just what I was looking for. The School of Education's master of science in science education degree is designed for those, like myself, with a background in science but with little or no experience in education. In addition to the education curriculum, the Department of Science Teaching encourages collaborative projects with the College of Arts and Sciences and SUNY College of Environmental Science and Forestry to effectively prepare students for careers in science teaching. It sounded like a perfect fit.

At the same time, I became aware of another interesting opportunity offered at SU: a one-year Engagement Fellowship giving graduating seniors from all disciplines the opportunity to remain in Syracuse for an additional year. The fellowship provides a tuition scholarship for both graduate coursework and an internship in Central New York, so that students may "thrive personally and professionally, while benefiting the community in several ways."

Hoping that the two programs might complement one another, I applied to both the master's program as well as the engagement fellow's program. To my excitement, I was accepted into both and so I began planning my year of engagement. For the coursework aspect of the fellowship, I intend to take the courses outlined in the master's program. As for the employment, I will be working for Say Yes to Education located in Syracuse. Say Yes is a national, non-profit organization that aims to improve high schools and graduation rates of economically disadvantaged youth in urban communities. Students participating in the program are enabled through tutoring, after-school and summer programming, psychological services, and scholarships. Say Yes also has chapters in New York City, Hartford, and Philadelphia, but Syracuse is the largest initiative, being the first to operate district-wide.

After being accepted into the science education program, I was encouraged to apply for the Robert Noyce Scholars Program. This program, funded by the National Science Foundation, "responds to the critical need for mathematics and science teachers by encouraging talented science, technology, engineering, and mathematics (STEM) students and STEM professionals to pursue teaching careers." In return for this scholarship, I have committed to two years of teaching in a high-need school district upon graduation from the master's program. I look forward to returning to Syracuse in the fall, as well as the many new experiences that will follow.

In Memoriam

ELIAS BALBINDER

Elias with some of his former graduate students and postdoctoral fellows at the silver anniversary of the Adirondacks Molecular Biology and Genetics Conference in 1992. L-R: Meg Dooley (Ph.D. '78), Bob Callahan (Ph.D. '70), Len LaScolea (Ph.D.'73), Chris Cordaro (Ph.D. '69), Elias, Art Blume (Ph.D. '68), Stu Marcus (Ph.D. '72), Colin Stuttard (Postdoc '66-69), Frank Macrina (Ph.D. '72), Pete McCann (Ph.D. '70)

Elias Balbinder passed away on January 3, 2011. He was born in Warsaw, Poland, in 1926. When he was 2 years old, his family sensed the emerging political upheavals in Europe and moved to Argentina, where Elias received his secondary education. He moved to the United States and earned a B.S. in zoology at the University of Michigan in 1949, and a Ph.D. in zoology (genetics) at Indiana University in 1957. He was a postdoctoral fellow at the Carnegie Institution of Washington, Department of Genetics, at Cold Spring Harbor, and at the University of California at San Diego before coming to Syracuse in 1962 as an assistant professor of genetics in the Department of Bacteriology and Botany. He rose to the rank of professor in the Department of Biology before leaving in 1975. Subsequently, he was the head of the Laboratory of Genetics and Carcinogenesis at the AMC Cancer Research Center and Hospital, Lakewood, Colorado, and held a faculty position at the Department of Biochemistry, Biophysics, and Genetics, University of Colorado Health Sciences Center in Denver. Before retiring, he worked for an additional eight years for the U.S. Environmental Protection Agency in Denver in their pesticides program, which deals with matters related to agriculture and public health.

While he was at Syracuse University, Elias conducted research in molecular genetics, funded by NSF and NIH, focusing on the regulation of the tryptophan operon in *Salmonella typhimurium*. He taught courses in bacterial genetics and physiology of bacteria and participated in a course on regulatory control mechanisms, inaugurated in 1965, that was instrumental in introducing the emerging, revolutionary concepts in molecular biology to the scientific community in Syracuse, and that featured four prominent visiting scientists at the cutting edge of their field. Elias played a seminal role as co-founder, in 1967, of the Adirondacks Molecular Biology and Genetics Conference, which provided an informal forum to discuss and debate the emerging concepts of molecular genetics;

the conference continued annually for 25 years. Held in the informal atmosphere of the University's Adirondack conference centers, first at Sagamore and later at Minnowbrook, these meetings were highly stimulatory and useful for over a thousand graduate students, postdocs, and faculty from the northeastern United States and Canada.

The respect and affection generated by his interactions with the numerous graduate students and postdocs Elias mentored at SU is exemplified by the following comments.

"The things I learned from him both as a scientist and a young adult have carried through my adult life and my career at the National Cancer Institute. In addition to being a great scientist Elias was a gentle and caring person who was able to spark the excitement of doing science in me that has lasted to the present. During my own career he has served as a role model in my mentoring of graduate and postdoctoral students." (Bob Callahan, Ph.D. 1970)

"His doctoral graduates not only learned how to be good scientists, they also learned how to think like good scientists. I owe him a huge debt of gratitude for the time, effort, and resources that he invested to make me the man I am today." (David Schwartz, Ph.D. 1979)

"Elias Balbinder was my doctoral dissertation advisor, and no student could have hoped to have a more caring, understanding, and patient mentor. Those characteristics were balanced with a demand for rigorous science and critical thinking. He taught me how to think about research problems and write about results. Writing scientific manuscripts under his guidance was a seminal learning event for me. To this day, I still cannot open a bottle of Lepage's Rubber Cement without the smell reminding me of a worked-over manuscript with page fragments held together by that stuff. For you young readers, "cut-and paste" had a different meaning in 1970! When it came to data management, I vividly recall our bound notebooks and how their distribution was something of a sacred ceremony. How we were to use them was made clear and we never met to talk science in Elias's office without them. Sharing data was yet another example of the scientific culture of the lab. The Balbinder collection of thousands of genetically defined *Salmonella typhimurium* strains was there for use by the scientific community. Requests for mutants seemed to roll in nonstop, and were always honored. Two years ago the NIH published a policy on data sharing in research. Elias knew the right thing to do long before the government stepped in to "help out"!" (Francis L. Macrina, Ph.D. 1972)

Several of his departmental colleagues formed lasting friendships with Elias that continued after his departure from Syracuse. His enthusiasm and caring enriched our lives, and have left a rich store of cherished memories.

H. Richard Levy, Professor Emeritus

ROGER MILKMAN

Roger Milkman, who was on the faculty of the Department of Zoology from 1960 to 1968, died on January 5, 2011. Roger earned his A.B., A.M., and Ph.D. (1956, with P.R. Levine) at Harvard, and did postdoctoral research with Boris Ephrussi at the Sorbonne and CNRS in France. Before coming to Syracuse he was assistant professor of zoology at the University of Michigan and after leaving, he joined the faculty of the biology department at the University of Iowa, where he was active for over 30 years before retiring.

Roger's research interests were broad and interdisciplinary, embracing important issues in population genetics, evolution, embryology, and physiology. His laboratory studies of a polygenic trait in the fruit fly Drosophila (the crossveinless phenotype), and on the molecular genetic evolution of the bacterium *Escherichia coli* are classic, as is his published theoretical work on the forces acting on genetic variation in natural populations. As a scientist, Milkman will be most remembered for his contributions to the selectionist vs. neutralist debate, for his 1978 paper "Selection differentials and selection coefficients" that unified two conceptualizations of selection, and for his development and application of a "clonal frames" theory accounting for the structure of genomic diversity in *E. coli*.

He was a passionate, demanding teacher who used metaphor, song, and limericks to explain complex topics in genetics. Thoru Pederson (B.S. 1963, Ph.D. 1968) recalls taking his first biology course, "Zoology 10," which was taught by Milkman. Pederson writes: "The fall semester of the course was held in Hendricks Chapel due to renovations underway in the classroom building and Dr. Milkman gave his lectures in academic robes, citing the chapel setting as the reason. He was the first science teacher who excited me, and over the years I have realized that he was one of the most superb teachers I have ever had. He launched the course by imitating the strut and squat of a courting herring gull male, the academic robes adding a profile that remains as a photographic image burned into my memory."

Professor Milkman will be remembered for his vigorous engagement of people and ideas. He observed with sharp eyes, ready tongue, and keen wit. He loved his teaching, science, life, classical music, good food, fine wine,

chocolate, languages, instant repartee, and humor. He is survived by his wife of 52 years, Marianne; four children, Ruth, Louise, Janet, and Paul; and six grandchildren.

H. Richard Levy, Professor Emeritus

(Note: Some portions were taken from an obituary by Bertil Hille, the Wayne E. Crill Endowed Professor at the University of Washington Department of Physiology and Biophysics, with input from a number of friends, family, colleagues, and former graduate (Ph.D.) students.)

Faculty News

Michael Cosgrove has been promoted to associate professor with tenure.

Marvin Druger continues his retirement by serving as secretary of the education section of American Association for the Advancement of Science, doing a radio program on WAER (*Science on the Radio*), teaching Freshman Forum, giving campus tours, reviewing grant applications for the National Science Foundation, writing for *55-Plus Magazine*, and promoting four books, including the soon to be released sequel to his *Strange Creatures and Other Poems*, titled *Even Stranger Creatures and Other Poems*. Marvin and his wife, Pat, recently returned from a trip to the Galapagos Islands, where he claims to have interviewed a tortoise that remembers Charles Darwin's visit.

Scott Erdman attended the 26th Fungal Genetics Conference sponsored by the Genetics Society of America and held in Asilomar, California, in March. He presented a poster and a talk entitled "Genome-wide screens using a natural product saponin to identify three PDR pathway target genes, PDR19, PDR20 and PDR21, which influence lipid homeostasis and membrane permeability in *Saccharomyces cerevisiae*." During the past year he continued serving the department as associate chair and director of undergraduate studies.

Jason Fridley's grant proposal "Will climate change alter rates of old field succession across the U.S. eastern deciduous forest? A cross-latitude experimental network." was recently funded. This study involves experiments on tree seedlings trying to "invade" old fields across a climate gradient, with study sites in Syracuse and Florida. Jason spent June conducting research in the United Kingdom and attended a conference on vegetation response to climate change in Lyon, France.

James Hewett was elected to serve on the Council of the American Society for Neurochemistry, and along with **Sandra Hewett**, was recently awarded a grant from the NIH titled: "Constructing a Conditional Slc7a11 (xCT) Null Mouse."

Sandra Hewett the newly arrived inaugural Beverly Petterson Bishop Professor of Neuroscience traveled to Turkey in September to speak at the first Turkish International Stroke Meeting "Novel Therapeutic Strategies and Targets for the Treatment of Stroke" held September 29-October 2, 2011 at Antalya Papillon Ayscha Hotel and Convention Center. The title of her presentation was "The Janus-faced effects of astrocyte IL-1beta signaling: system xc- at the crossroads of protection and injury."

Dean George M. Langford, research associate **Torsten Wollert**, and **Michael Cosgrove**, along with collaborators from Dartmouth College, the Marine Biological Laboratory at Woods Hole, and the McLaughlin Research Institute, report in the *Journal of Biological Chemistry* the discovery of a motor protein (Myo5a) associated with the transport of neuronal synaptic vesicles. In conjunction with another protein called myosin-VA, Myo5a attaches to vesicles containing neurotransmitters and moves them to the cell synapse as part of a "motor cargo" system. The study has implications in understanding malfunctioning transportation systems and the action of neurotoxins that result in insufficient or excessive release of neurotransmitters.

Katherine Lewis gave a talk at a conference organized by the Belgium Society for Cell and Developmental Biology in July in Rochehaut, Belgium, and also attended the International Brain Research Organization Conference in Florence.

Melissa Pepling gave a talk at Utica College in October titled "Estrogen signaling and regulation of primordial follicle formation." She also served on the Cellular, Molecular and Integrative Reproduction NIH study section in February. In July she attended the annual Society for the Study of Reproduction meeting, and chaired a session there. Also attending and giving presentations were her graduate students **Robin Jones** and **Sudipta Dutta** and undergrad **Marta Dzyadyk**.

Scott Pitnick along with graduate students and postdoctoral fellows **Outi Ala-Honkola, Dawn Higginson, Stefan Lüpold, and Mollie Manier** gave research talks at the 2011 Society for the Study of Evolution Conference in Portland, Oregon, and will be giving talks at the Biology of Spermatozoa Conference in England.

Scott Pitnick, John Belote, and **Mollie Manier** had their research on fluorescent *Drosophila* sperm highlighted on NSF's *Science Nation* in August, and were awarded a grant from the National Science Foundation "Genetic and functional analyses of sperm length evolution in *Drosophila*."

Ramesh Raina assumed the position of chair of the Department of Biology in July.

John Russell has stepped down as chair of the Department of Biology after 12 remarkably successful years, but will continue as a member of our faculty. His closing remarks as chair are included in this issue of *BIO@SU* (see page 2).

Kari Segraves has been promoted to associate professor with tenure.

Tom Starmer notes that after many years of waiting for yeast taxonomists to get their "stuff" together, the three-volume *The Yeasts: A Taxonomic Study, 5th ed. Elsevier* (Kurtzman, C.P., J. Fell and T. Boekhout, eds.) has been published. Included in this treatise is a review titled "*Yeast Ecology*" by Tom and his long-time colleague André Lachance.

Jason Wiles presented results of a study on how evolution is viewed and taught in predominantly Islamic nations during the 2011 annual meeting of the American Association for the Advancement of Science in Washington, D.C., on February 18. Jason notes that thoughts about evolution are just as diverse in the

news

Muslim world as in western societies. Thus, the teaching of evolution varies by country and cultural attitudes within these countries. *(Excerpted from Inside SU, February 18, 2011)*

The Department of Biology has welcomed several new faculty colleagues in the past few months and more will arrive in the coming semester. These include **Heather Coleman** (plant biotechnology), **David Althoff** (evolutionary biology), **Jannice Friedman** (evolutionary biology), **Susan Parks** (acoustic communication in whales), **Katherine Lewis** (neurobiology), **James Hewett** (neurobiology), and **Sandra Hewett** as the inaugural Beverly Petterson Bishop Professor of Neuroscience. More information is available on our new colleagues in John Russell's remarks and we hope to provide an extended introduction of these new faculty members in the 2012 edition of *BIO@SU*.

Graduate Activities and Achievements

The following students have defended their master's theses since the last edition of *BIO@SU:*

Xi Chen Thesis: *Controlling bacterial persister cells using antimicrobial peptides with Trp and Arg repeats*. Advisor: Dr. Dacheng Ren (Biomedical and Chemical Engineering)
Current position: Ph.D. student attending New York University.

Zhongan Chen Thesis: *Effects of white-tailed deer on forests on a nitrogen-poor soil in Minnesota*. Advisor: Mark Ritchie

Christopher Duke Thesis: *Potential reproductive benefits of an alternative reproductive tactic in the yellow dung fly Scathophaga stercoraria*. Advisor: Al Uy

Grant W. Gephardt Thesis: *Effects of prenatal exogenous estrogen exposure on male germ cell development and embryonic survival*. Advisor: Melissa Pepling
Current position: sales representative, Life Technologies, Inc.

Rebecca A. Ruppel Thesis: *Using patterns of chromosome inheritance to test the mode of polyploid formation in Heuchera cylindrical*. Advisor: Kari Segraves

The following students have defended their doctoral dissertations since the last edition of *BIO@SU:*

Aditya Dutta Dissertation: *Molecular characterization of genetic components of pathogen defense in Arabidopsis*. Advisor: Ramesh Raina
Current position: Postdoctoral research scientist, Columbia University

A profile of Aditya and his research was included in the 2010 edition of *BIO@SU*.

Dawn M. Higginson Dissertation: *Evolution of sperm conjugation in diving beetles*. Advisor: Scott Pitnick
Current position: Postdoctoral Excellence in Research and Teaching Fellow at the Center for Insect Science, which is a research division within the University of Arizona

A profile of Dawn and her research is included in this issue of *BIO@SU* (see page 14).

Ellen M. Wisner Dissertation: *The consequences of anthropogenic disturbance on communication and the operation of sexual selection in the eastern bluebird (Sialia sialis)*. Advisor: Al Uy
Current position: University Lecturer, New Jersey Institute of Technology

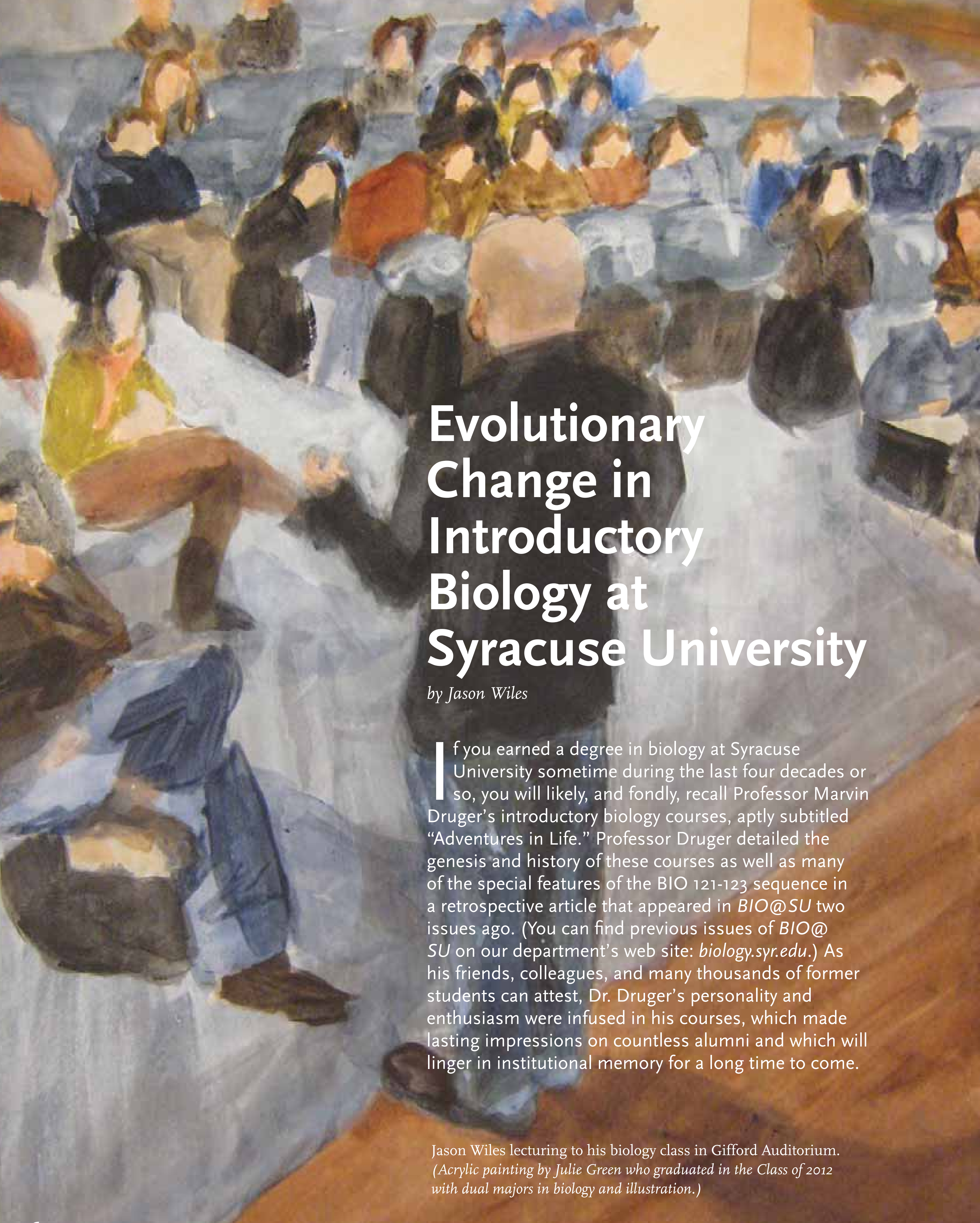
Jorge Hurtado-Gonzales Dissertation: *The maintenance of male color polymorphism in Poecilia parae*. Advisor: Al Uy

A profile of Jorge and his research was included in the 2009 edition of *BIO@SU*.

GRADUATE STUDENT AWARDS AND ACHIEVEMENTS:

Liz Droge-Young was awarded a Rosemary Grant Award for Graduate Student Research from the Society for the Study of Evolution, and also a Direct Travel Grant by the *Journal of Cell Science* and the *Journal of Experimental Biology* to attend the Biology of Spermatozoa Conference in England this autumn.

Dawn Higginson was awarded a three-year NIH/PERT Postdoctoral Fellowship at the University of Arizona.



Evolutionary Change in Introductory Biology at Syracuse University

by Jason Wiles

If you earned a degree in biology at Syracuse University sometime during the last four decades or so, you will likely, and fondly, recall Professor Marvin Druger's introductory biology courses, aptly subtitled "Adventures in Life." Professor Druger detailed the genesis and history of these courses as well as many of the special features of the BIO 121-123 sequence in a retrospective article that appeared in *BIO@SU* two issues ago. (You can find previous issues of *BIO@SU* on our department's web site: *biology.syr.edu*.) As his friends, colleagues, and many thousands of former students can attest, Dr. Druger's personality and enthusiasm were infused in his courses, which made lasting impressions on countless alumni and which will linger in institutional memory for a long time to come.

Jason Wiles lecturing to his biology class in Gifford Auditorium. *(Acrylic painting by Julie Green who graduated in the Class of 2012 with dual majors in biology and illustration.)*

During the few years since the last SU student heard the recorded voice of Dr. Druger sign off from another year of "Adventures" and hung up their headphones in the Lyman Hall laboratory, there have been sweeping changes, not only in the introductory sequence, but also across the entire Department of Biology. In the fall of 2008, the department moved from our former separate locations in Lyman Hall and the Biological Research Laboratories to the Life Sciences Complex (LSC). This remarkable facility united our department in an environment more conducive to cross-disciplinary interaction. Moreover, the LSC adjoins the Center for Science and Technology that houses the offices and research laboratories of the faculty of the Department of Chemistry. This has increased synergy across departments, not only among faculty, but also between graduate and undergraduate students. The teaching facilities for biology and chemistry are now in close proximity, and the Milton Atrium between the two buildings provides a place for students to hang out between classes, work collaboratively, or grab a quick snack or lunch.

The tight and drab space in Lyman Hall devoted to Druger's BIO 121-123 is an unlamented part of our past. Most of the first floor of the research wing of the LSC is devoted to introductory biology, and much of that space is taken up by four large, open, and brightly sun-lit lab spaces in which students work collaboratively in teams of four at benches with the necessary connections including Internet ports. We can comfortably serve 96 students at a time, and with multiple lab sections, almost 900 students in a week.

While I do address a similar breadth of the life sciences that Professor Druger did with his "individualized" approach to general biology, I no longer use the audio-tutorial method of instruction. New and renovated physical facilities allow me to adopt a more interactive approach to instruction in the introductory biology courses, even in large lecture classes. Gifford Auditorium has been renovated, and its presentation technology updated. Overhead projectors have been replaced by multiple displays with a variety of input options, so the power of the Internet and the e-textbook as well as video feeds from microscope or specimen cameras can be seamlessly incorporated with PowerPoint presentations during lectures. Lecture sessions are more interactive as well, and attendance is up thanks to adoption of personal response devices. With their "clickers," students individually respond to questions throughout the lecture, and a survey of their collective response is available in real time. This lends itself well to small group interactions and competitions during class meetings, which is more engaging than entirely instructor-centered lectures. It also gives me a better idea of students' understandings and misconceptions immediately, rather than after the next exam. The lecture material is directly tied to a new catalog of laboratory activities that has been designed to stress team-based inquiry, problem solving, and hands-on experimentation. But those who recall with pangs of nostalgia their experiences with Professor Druger's courses can take heart. I have kept and revised a few of his excellent activities, and yes, students still do fetal pig dissections in the second semester.

While the BIO 121-123 sequence retains the familiar diversity of biological content, the path students take through introductory biology has changed considerably. This has been done partly in recognition of the fact that students entering biology come from very diverse backgrounds in terms of preparation and prior experience. Moreover, I have made changes to accommodate students intending to major in biology: those who need a biology background for nutrition, psychology, and exercise science, and those simply fulfilling science requirements of various colleges within the University. Beginning with basic biochemistry, cell biology, and genetics, students in Biology 121 explore the diversity of organisms within a framework of major themes, including the flow and regulation of energy and information within living systems, and the central and unifying concept of evolution. Upon completion of this course in the fall semester, students intending to major in biology may then go directly into upper-level courses such as Biology 326: Genetics and Biology 327: Cell Biology that build upon the conceptual foundation of the introductory course. Biology 123 continues the exploration of biodiversity, including the anatomies of humans and other animals, plant biology, and ecology, again understood through the lens of evolution, with a focus on how these concepts help us to understand and solve real-world problems. This course may be taken with or without laboratory (Biology 124) at the discretion of the students or as required for various programs.

Students use "clickers" to respond to questions during lectures. Software on the instructor's computer collects and graphically displays results in real time, providing instant feedback on student understanding of concepts.

Regardless, however, of whether they aspire to become physicians, biomedical researchers, or ecologists, or whether they are more interested in politics, business, the humanities, or the arts, we treat all incoming freshmen as "potential" biology majors, or at least as future citizens who need to know about the living world and science in general. To that end, we have been working with the faculty of the Department of Biology and scientists in other fields whose work is connected to ours to incorporate the research of Syracuse University professors into our introductory and other undergraduate biology courses. A specific example of linking courses with faculty research is our new approach to teaching about genetics and developmental processes using zebra fish (*Danio rerio*), the primary model organism of interest to Professor Craig Albertson, Professor Kate

Biology 123 students dissecting fetal pigs in the "Druger Laboratory" named in honor of Marvin Druger.

Lewis, and Ph.D. candidate Nicole Jacobs-McDaniels (profiled in the last issue of *BIO@SU*), who designed these exercises to complement the 123/124 curriculum. Students observe zebra fish embryos in various stages of development and compare differences between the emerging structures in "wild type" fish versus those with a particular mutation. Using techniques like gel electrophoresis with DNA samples from the fish, students also "see" the genetics responsible for the observed phenotypes. Through these types of experiences, not only do our students learn about foundational concepts of biology, but they also learn about current techniques and build skills that will help equip them to engage in independent research with our faculty members.

Aside from the content of the course, the new laboratories and enhanced teaching space and facilities have made it possible to make additions and changes to how the course is taught. For one, TAs are much more connected to what's going on in the labs. Whereas TAs once checked-out audio-tutorial CDs or tapes to students who may have been assigned to any of the other TAs for recitation, our TAs now circulate among the student teams actively engaging them throughout the period. Also, now even the teaching assistants have assistants. Upper-level undergraduates who have been successful in the introductory courses are invited to enroll in Biology 360 as biology laboratory assistants. These budding biologists serve as peer mentors for our freshmen, and they are a tremendous help to the TAs—answering questions from their mentees, maintaining stock solutions and other supplies, serving as another set of safety-minded eyes, and getting a great review of general biology in the process. Historically, graduate TAs had been assigned to recitation periods at various times in the week, separate from the tape labs and hands-on laboratory work. The recitation session has now been incorporated into the lab block. This provides a great deal of flexibility as TAs can run recitations before, during, or after the laboratory according to the nature of the week's procedures.

Another way we have been introducing undergraduates to research in the life sciences is through new iterations of Biology 200: Selected Topics. As in the past, teaching assistants offer sections of this course with topics of particular interest to them. Recent TA-led titles include pathophysiology, medical ecology, and biotechnology and bioethics. In addition, a new title under the BIO 200 banner, Introduction to Biology Research at Syracuse, is offered as a way to introduce promising freshmen to the ongoing investigations of our faculty in the life sciences. Students who have successfully completed Biology 121 and who are interested in careers as scientists are invited to enroll in this course in which they read and produce written responses to our faculty members' primary research articles, are treated to technical presentations from those faculty members and/or postdocs and graduate students, engage in related discussion, and compose reviews of the literature around a topic of scientific inquiry. One of the main goals of the course is to steer talented undergraduates toward opportunities in research that are aligned with their interests and goals and which will be mutually beneficial to the student and their faculty research professor. Qualified students desiring to do so are subsequently being placed in research laboratories at Syracuse, SUNY College of Environmental Science and Forestry, or SUNY Upstate Medical University as a result of their experiences in the new Biology 200. This placement then allows students to develop a thesis as part of the Honors Program and/or the biology degree with distinction.

These changes in the introductory biology courses have been exciting, but we have faced, and continue to face, some real challenges. For example, Professor Druger's 121/123 course was extremely cost effective. In one small lab room with only one demonstration bench, he was able, remarkably, to deliver his course to hundreds of students with very little expense. In our new facilities, which are excellent, we now have 4 spacious laboratories housing 24 student benches, each stocked weekly with the necessary materials. This is much more expensive, and we are often constrained in what we can do by the enormity of the student subscription. With all of the added recurring costs, we have had to make do in some cases with outdated equipment, such as decades-old microscopes, that might otherwise have been replaced. The role of the TA has also changed, and as the job has become more time intensive, our graduate students may find it more difficult to balance their teaching and research.

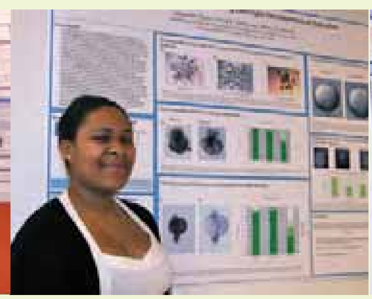
However, with these challenges come opportunities, and we have been making the most of it. All told, we've made great strides, and we are in a wonderful position to continue to improve our students' experiences in introductory biology. And we have an extraordinary environment in which to engage in science education research around our innovations. There are currently several graduate students and faculty members from the Department of Science Teaching who are actively collecting and analyzing data from our students in Bio 121/123/124. Examples of such projects currently underway are lesson study research on how biology graduate students acquire teaching skills; how upper-division undergraduate peer leaders build critical thinking skills and content proficiency through helping freshmen; how online resources can help students understand evolution and its relevance for solving real-world biological problems; and how supplemental instruction may increase retention and achievement among underrepresented populations. Moreover, the progress we make on campus is extended to secondary-level classrooms in more than 20 high schools who offer our general biology curriculum through the Syracuse University Project Advance (SUPA) program.

There is a lot going on in and around introductory biology at Syracuse, but none of it would happen without the coordinated efforts of a large number of individuals working together. I may teach the big lecture sections and direct the program in general, but I could never do it alone. Mary Graziano, laboratory coordinator and lab instructor for 121 and 124, is an indispensable member of our team, and we depend on her to keep the labs running day in and day out. Our graduate TAs, a group of budding professionals who impress me more each year, number in the teens, and we need each and every one of them. Many tens of undergraduate laboratory assistants and peer team leaders serve as aids to the TAs and valued tutors and advisors for their fellow undergraduates. Surabhi Raina teaches evening and summer sections of 121/123/124 for our University College. Nearly 40 high school teachers and several support staff are involved with Syracuse University Project Advance (SUPA) Biology. Our administrative staff in the Department of Biology as well as other faculty members lend their hands and advice. And all of this is managed by the astonishingly capable Beverly Werner, our tireless course coordinator for the introductory sequence. With my stellar support team and hundreds of bright Syracuse University students, we're keeping up the grand tradition of introductory biology that Professor Druger passed down to us. And although the courses will continue to evolve, we're definitely still having "Adventures in Life."

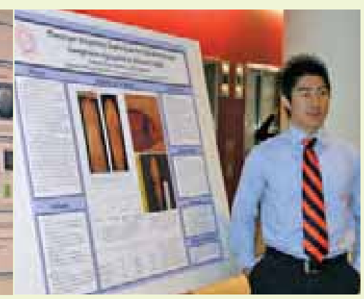
Undergraduate Research Conference

Katelyn Heim and Professor Ralph Slepecky

Kadiah Kamara, Samantha Balakirsky, Sofia Pezoa



JaQuella Taylor



Young Son

The 16th annual Undergraduate Research Conference in conjunction with the Senior Award Ceremony and a poster session was held April 28-29, 2011, in the atrium of the Life Sciences Complex. Posters describing the results of 25 projects and involving 29 undergraduate students were presented. Topics reflected the diversity of research opportunities available for undergraduate research at Syracuse University and neighboring academic institutions. Studies included investigations of the role of specific genes in spinal cord development in zebrafish, light-chain immunoglobulins in chronic leukemia, oocyte development during ovary embryogenesis, *Caenorhabditis elegans* development, moss communities in grasslands, phenotypic integration in cichlids, kin selection, and the characterization of specific genes in senescence in *Arabidopsis.* Mentors for the student participants this year included professors **Fondy**, **Lewis**, **Erdman**, **Maine**, **Pepling**, **Uy**, **Belote**, **Fridley**, **Albertson, Raina**, and **Mathew Maye and James Dabrowiak** (Department of Chemistry). Mentors from other institutions included **Jeffrey Amack**, **Vladimir Sirotkin**, **Michael James**, **Patricia Kane**, and **Andras Perl**, all from SUNY Upstate Medical University; **Rebecca Bader,** Biomaterials Institute; and **Xiao-Jie Yan and Nicholas Chiorazzi** from The Feinstein Institute for Medical Research of North Shore-Long Island Jewish Health System.

Undergraduate Activities and Achievements

THE UNDERGRADUATE CLASS OF 2011

Each spring the Department of Biology celebrates the achievements of graduating biology and biochemistry students on Senior Honors Day. Students are recognized for academic excellence, research accomplishments, or excellence in both academics and research. Several of our seniors, as indicated, also earned degrees with distinction in biology or biochemistry in recognition of their successful completion of a high-quality biology/biochemistry thesis. The Donald G. Lundgren Memorial Award—the department's highest honor for undergraduates—is presented for outstanding scholarship and research. This year's ceremony took place April 29.

ACADEMIC ACHIEVEMENT: **Daniel D. Fernandez, Marisa F. Gobuty, Cassidy S. Henneman, Lua A. Jafari, Sundus S. Mian, Lauren C. Monoxelos, Paige N. Mullins, Aaron J. Roy, Colin P. Shea, Yanina Tovpeko** (also Distinction in Biology), **Jesse S. Turiel, Emily L. Williams, Sarah D. Zuckerman.**

RESEARCH ACHIEVEMENT: **Jennifer E. Benner, Brain R. Birnbaum, Tess A. Cherlin, Moira R. Concannon, Tony H. Gao, Joseph W. Gervasio, Christina I. Giovinazzo, Katelyn M. Heim** (also Distinction in Biology), **Eugenia A. Im** (also Distinction in Biochemistry), **Joanna C. Kurman** (also Distinction in Biology), **Alyssa C. Lau** (also Distinction in Biolochemistry), **Kristina Martimucci** (also Distinction in Biology), **Uchenna J. Mbawui, Lynaya R. Morris, Marisol A. O'Neill** (also Distinction in Biology), **Jennifer Roscoe** (also Distinction in Biology), **Young H. Son** (also Distinction in Biology), **Carey A. Stuart, Viktoriya Zlamanyuk.**

SCHOLARSHIP & RESEARCH ACHIEVEMENT: **Elizabeth F. Barone, Erica J. Brenner, Kyle J. Fahey, Elizabeth A. Gengo, Guang Yu Lee** (also Distinction in Biochemistry), **Qi Wen Li** (also Distinction in Biochemistry) **Jamison D. Patak, Lyuba E. Polinkovsky** (also Distinction in Biology), **Sarah K. Wendel** (also Distinction in Biology).

DONALD G. LUNDGREN MEMORIAL AWARD FOR OUTSTANDING SCHOLARSHIP AND RESEARCH: **Nathaniel J. Miska**, whose research was conducted with Professor Mathew Maye of the Department of Chemistry, was also awarded a Distinction in Biochemistry and graduated with honors from the Renée Crown University Honors Program. His thesis was *Quantum Dot Biofunctionalization.* Nathaniel was also given the Biochemistry Award sponsored by the Department of Chemistry.

UNIVERSITY HONORS: The following biology/biochemistry students were awarded degrees with honors from the Renée Crown University Honors Program. An honors degree requires completion of honors courses and extracurricular activities stressing academics, global awareness, civic engagement, collaboration, and command of language. Students must also complete and defend a capstone project. Those indicated by an asterisk were also awarded a Distinction in Biology or Biochemistry. **Tess Cherlin, Jessica Cho, Julie Green** (a dual major, Julie did her capstone project in art illustration), **Lua Jafari, Qi Li, Kristina Martimucci,* Nathaniel Miska, Lyuba Polinkovsky,* Jennifer Roscoe,* Colin Shea, Carey Stuart, Yanina Tovpeko,* Jesse Turiel** (a dual major, Jesse wrote a thesis in geography), **Sapir Vangruber, Sarah Wendel.***

PHI BETA KAPPA: **Marta N. Dzadyk, Bailey S. Fitzgerald, Marisa F. Gobuty, Sundus S. Mian, Lyuba E. Polinkovsky, Yanina Tovpeko.**

SYRACUSE UNIVERSITY SCHOLARS: Designation as a Syracuse University Scholar is the highest academic honor bestowed at the University. Twelve graduating seniors were named SU Scholars at the May 15 Commencement. This included biology major **Sarah Wendel** and biochemistry major **Qi Wen Li**. A description of Sarah's and Qi's achievements and activities as described in SU News May 9, 2011, is as follows:

Sarah Katherine Jane Wendel, a biology major carrying a Chinese studies minor in the College of Arts and Sciences, is a Remembrance Scholar and participates in the Renée Crown University Honors Program. Also, she is active as a science tutor for undergraduates. Sarah's three study abroad experiences include English language mentoring in Hong Kong and hospital and clinic internships in Cusco, Peru, and Tanzania, Africa. Her work in Peru was supported by a Mark and Pearle Clements Internship Award. Locally, Sarah currently serves as an emergency room observer at Upstate University Hospital, shadowing an attending physician in pediatrics. Sarah also volunteered at Crouse Hospital. She serves on the executive board of Habitat for Humanity's SU chapter and advises students traveling to Hong Kong about aspects of life abroad. Note: A profile of Sarah appears in this issue of *BIO@SU.*

Qi Wen Li, a biochemistry major in the College of Arts and Sciences and a Remembrance Scholar, discovered her passion for scientific research while working in the laboratory group led by Robert Doyle, associate professor of chemistry, with whom she is now a published researcher. A McNair, Ornstein, and Crown Scholar, Qi's research has been supported by the iLEARN program at SU. She undertook summer research at Yale University through a Mark and Pearle Clements Internship Award and pursued research abroad at the Graz University of Technology in Austria as part of the National Science Foundation's International Research Experience for Undergraduates program. Qi plans to continue her studies in a doctoral program in biochemistry and molecular biophysics at the California Institute of Technology.

NEWS OF OTHER UNDERGRADUATES

CROWN, WISE-MARCUS 50-YEAR FRIENDSHIP AWARDS: These awards are competitive grants awarded by the Honors Program to aid students completing their capstone projects. This year's Crown, Wise-Marcus 50-Year Friendship awardees include biology/biochemistry majors **Samantha Balakirsky, Amanda Cole, Marta Dzyadyk, Amari Howard, Vera Osafo, Vivian Yu, and Colin Shea.**

UNDERGRADUATE RESEARCH PROJECTS AND SCHOLARSHIPS: During the past academic year and summer, a total of 31 different student projects of mentored research with faculty members in the department were carried out. Eight students spent their summer doing research in the labs of biology faculty. These students are **Samantha Balakirsky** (Lewis), **Elizabeth Bonarigo** (Erdman/Sirotkin), **Peter Chuckran** (Frank), **Marta Dzyadyk** (Pepling), **Kemardo Henry** (Raina), **Kadiah Kamara** (Lewis), **Sophia Pezoa** (Lewis), and **Ellen Shin** (Garza). Another three undergraduate students from other institutions were part of the Syracuse Biomaterials Institute summer REU program and worked in the labs of department faculty members (Coleman, Erdman, and Pepling). The department acknowledges and thanks the generous and important support of the following funding sources for these projects: **Ruth Meyer Scholars Fund, Renee Crown Honors Program, Lewis Stokes Alliance for Minority Participation, Syracuse Biomaterials Institute, Korczynski-Lundgren Fund,** and the **Levy-Daouk Fund.**

REMEMBRANCE SCHOLASHIPS: Each year Syracuse University awards 35 scholarships in memory of the 35 Syracuse University students lost in the bombing of Pan Am Flight 103 over Lockerbie, Scotland, on December 21, 1988. The scholarships are awarded on the basis of distinguished academic achievement, citizenship, and service to the community. Scholarships for 2011-12 were awarded to biology/biochemistry students **Kadiah Kamara**, **Vera Osafo**, **Margaret Spinosa**, and **Vivian Yu.**

More Graduate Program News

JACK AND PAT BRYAN LIFE SCIENCES LECTURES

In April, Günter Wagner, the Alison Richard Professor of Ecology and Evolutionary Biology at Yale University, presented this year's Jack and Pat Bryan Life Sciences Lectures at Syracuse University. His two lectures were "How Evolution is Cheating Probability," and "Evolution of transcription factor function and the origin of evolutionary novelties"

The lectures were co-presented by the Biology Graduate Student Organization (BGSO) and the Department of Biology. His first lecture was followed by a poster session featuring the work of life sciences graduate students across the University. Students in biology, environmental sciences, biomaterials, exercise sciences, chemistry, physics, and forensic science were invited to submit posters.

Wagner's research is focused on understanding the evolution of complex characters, including questions of how they can evolve by random mutation and selection, the biological nature of character identity and the genetic mechanisms for the origin of novel characters.

The lectures are made possible by a generous gift from Pat Bryan in memory of her husband, Jack, a longtime member of the department's faculty who was deeply committed to graduate education and research.

ANDREW SIEFERT AWARDED NSF GRADUATE RESEARCH FELLOWSHIP TO STUDY PLANT COMMUNITIES

Andrew Siefert, a biology graduate student, received a 2011 National Science Foundation (NSF) Graduate Research Fellowship. Siefert, whose faculty mentor is biology Professor Mark Ritchie, is studying plant diversity and the role it plays in grassland communities.

The oldest fellowship of its kind, the NSF Graduate Research Fellowship recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines, who are pursuing research-based master's and doctoral degrees in the United States and abroad. Students receive an annual stipend, tuition assistance, and a one-time international travel allowance.

Seifert is studying grassland communities at Green Lakes State Park, Fayetteville, N.Y., collecting data on plant traits in response to both naturally and experimentally induced environmental changes. He is also exploring patterns in leaf traits from plant communities collected at inland salt marshes in Central New York and forests in Eastern North America, in collaboration with other researchers, to compare Green Lakes' plant communities with those in different environments. Siefert holds a B.S. in environmental resource management (2007) from Pennsylvania State University, Schreyer Honors College.

Nikhilesh Dhar (Raina) was awarded the "Syracuse University Outstanding TA Award" for 2011. This award selects about 20 TAs from the Graduate School from over 800-plus TAs across the University. This award honors the University's best graduate student teachers.

Jing Dai (Belote), **Nikhilesh Dhar,** and **Pallavi Gupta** (Raina) were awarded teaching mentor appointments with the Graduate School's TA Program for the 2011 summer Teaching Assistant Orientation Program. This appointment is made in recognition of the accomplishments as a graduate student and teaching assistant at Syracuse University. This prestigious award selects top graduate student teachers to staff the annual New TA Orientation Program. These teaching mentors provide training and support for new TAs at the University.

BIOLOGY STAFF:

Deborah Herholtz

It is a fair guess that virtually every biology major since 1991 has met Deborah (Deb) Herholtz the indefatigable undergraduate programs secretary. It is Deb who finds advisors for students, keeps records, helps students with petitions and other paperwork, and tries to answer questions or send students to the persons most likely to be able to help. For absent-minded professors, Deb is the indispensible guide who tries to keep us updated on the ever-changing requirements for various programs, and reminds us of advising schedules and various deadlines for grades and student reports. In her spare time, Deb organizes the graduation reception and helps organize the Senior Honors Day. That is, she does the work and the rest of us take as much of the credit as possible.

Deb was born in Syracuse but spent much of her life and currently lives in Central Square. She is one of those hardy natives who has been here for every snowfall record and commutes through the snowbelt to campus. Deb began working at Syracuse University some 23 years ago in the sociology department before transferring to the Department of Biology almost 20 years ago. In fact, she has been with the department longer than most of the current faculty, and is the person we depend on for an historical perspective on our graduates and the evolution of the curriculum. Deb's ability to identify, locate, and contact students both present and in the past is key to composing relevant segments of *BIO@SU*. When we find ourselves feeling hassled and taking matters too seriously, Deb brings us back to earth with cute pictures and stories of her nieces and nephews, her cats, or an occasional funny item she has spotted on the Internet. Deb is the epitome of the claim that office staff is what makes an organization or a department succeed.

Who, What, When, Where

Peter V.N. Bodine B.S. '80 is a senior director in clinical development and medical affairs operations at the Specialty Care Business Unit of Pfizer in Collegeville, Pa., and serves as chief operating office for eight disease areas. After earning a Ph.D. in biochemistry from Temple University, his career has included a postdoctoral fellowship at the Mayo Clinic, a faculty appointment at Thomas Jefferson University, and positions in discovery research and project management at Wyeth. He and his wife, Judith LaLonde, B.S. in chemistry '82, live in suburban Philadelphia with their three middle school-high school aged sons.

Meg Dooley Ph.D. '78 (with **Elias Balbinder**) is an associate professor at the College of Staten Island/ CUNY.

Garth D. Ehrlich Ph.D. '87 (with **Bernie Poiesz** and **Judi Foster**) is executive director of the Center for Genomic Sciences and Scientific, Governmental, and Regional Affairs Liaison Officer at Allegheny Singer Research Institute in Pittsburgh. He is also professor of microbiology and immunology, professor of otolaryngology-head and neck surgery, and professor and vice chairman of human genetics at Drexel University College of Medicine.

Gretchen Galvin B.S. '08 received an M.S. in medical biology at C.W. Post Campus of Long Island University. She has been accepted into the Class of 2015 at the University of Buffalo School of Dental Medicine.

Tom Grove Ph.D. '76 (with **Richard Levy**) has sold his company, ProteoGenix, and is now semi-retired, doing some consulting, and starting to expand his activities in non-science areas.

Andrew W. Gurman B.S. '73 is a physician in Altoona, Pa., with a practice limited to wrist and hand surgery. He is active in the American Medical Association, where he serves as vice speaker of the House of Delegates and is a member of the board of trustees. Dr. Gurman and his wife have two grown daughters.

Robin Hemphill B.S. '87 is the deputy chief safety officer and director of the Veteran's Administration National Center for Patient Safety. She resides in Ann Arbor, Mich.

William J.M. Hrushesky B.A. '69 recently retired as senior clinical investigator and director of research at the WJB Dorn Department of Veteran's Affairs Medical Center. He continues as research professor at the University of South Carolina's School of Medicine's Department of Cell and Developmental Biology and Anatomy. Dr. Hrushesky's career in medicine has also included tenured professorships at the University of Minnesota and Albany Medical College. He has published more than 761 scientific articles and holds several patents. He is a founder of Medical Chronotherapeutics, which focuses on optimally timing medical preventatives, diagnostics, and treatments relative to rhythmic human biologic time structure. He resides in West Orange, N.J.

Michael M. Krinsky, B.A.'70 has been inaugurated as the 173rd president of the Connecticut State Medical Society. Previously he had served as president and councilor of the Hartford County Medical Association, the largest county organization in Connecticut, and as vice-speaker of the House of Delegates of the state medical society as well as its vice-president. He is in the private practice of neurology in Bloomfield and Vernon, CT. He founded the practice in 1979 and remains clinically active. He received his MD degree at Columbia University College of Physicians and Surgeons in 1974. He has served as an assistant clinical professor of neurology at the University of CT School of Medicine and on numerous hospital and voluntary agency committees in addition to his work with the medical society. He founded the neurology and movement disorders clinic at the Hebrew Home and Hospital in West Hartford, CT, and served as the medical director and neurology consultant at the regional Easter Seals Center. He and his wife Marcia are the parents of three grown children and three grandchildren.

Jeffrey P. Levine B.S. '83 is professor and director of Women's Health Programs in the Department of Family and Community Medicine at the University of Medicine and Dentistry of New Jersey - Robert Wood Johnson Medical School. "Dr. Jeff" lives in Hillsborough, N.J., with his wife, four daughters, and a menagerie of adopted pets.

Malavi Madireddi Ph.D. '96 (with **David Allis**) is principal scientist, Discovery Biology-Metabolic Diseases at Bristol Myers Squib, Princeton, N.J.

Stuart Marcus Ph.D. '72 (with **Elias Balbinder**) is chief medical officer at DUSA Pharmaceuticals, Inc., in Wilmington, Mass.

Joseph Parise B.S '92 is the assistant chief of service in radiology at the Tampa Florida VA Hospital. He and his wife Dominique have four children. Dr. Parise notes that he would love to hear from some of his fellow alumni from '90-'94. His e-mail address is: *jparise@tampabay.rr.com*

Traycie West Pinkoski B.S. '88 has recently moved to Vicenza, Italy, for a three-year assignment with the U.S. Navy.

Shoba Ragunathan M.S. '93 works for Pfizer in Pearl River, N.Y.

B. Todd Schaeffer B.S. '77 is an endoscopic surgeon of the nose, sinuses, neck, and skull base. Dr. Schaeffer serves as assistant clinical professor of otolaryngology at Mount Sinai School of Medicine and associate chair of the dept. of otolaryngology at North Shore University Hospital in Manhasset, N.Y. He recalls fondly bringing home fruit flies on spring break to continue his freshman biology experiments, and listening to Marvin Druger on reel-to-reel tapes—innovative teaching and perhaps a harbinger of online courses.

David Schwartz Ph.D. '79 is a senior faculty member at Houston Community College SW in Houston, Texas.

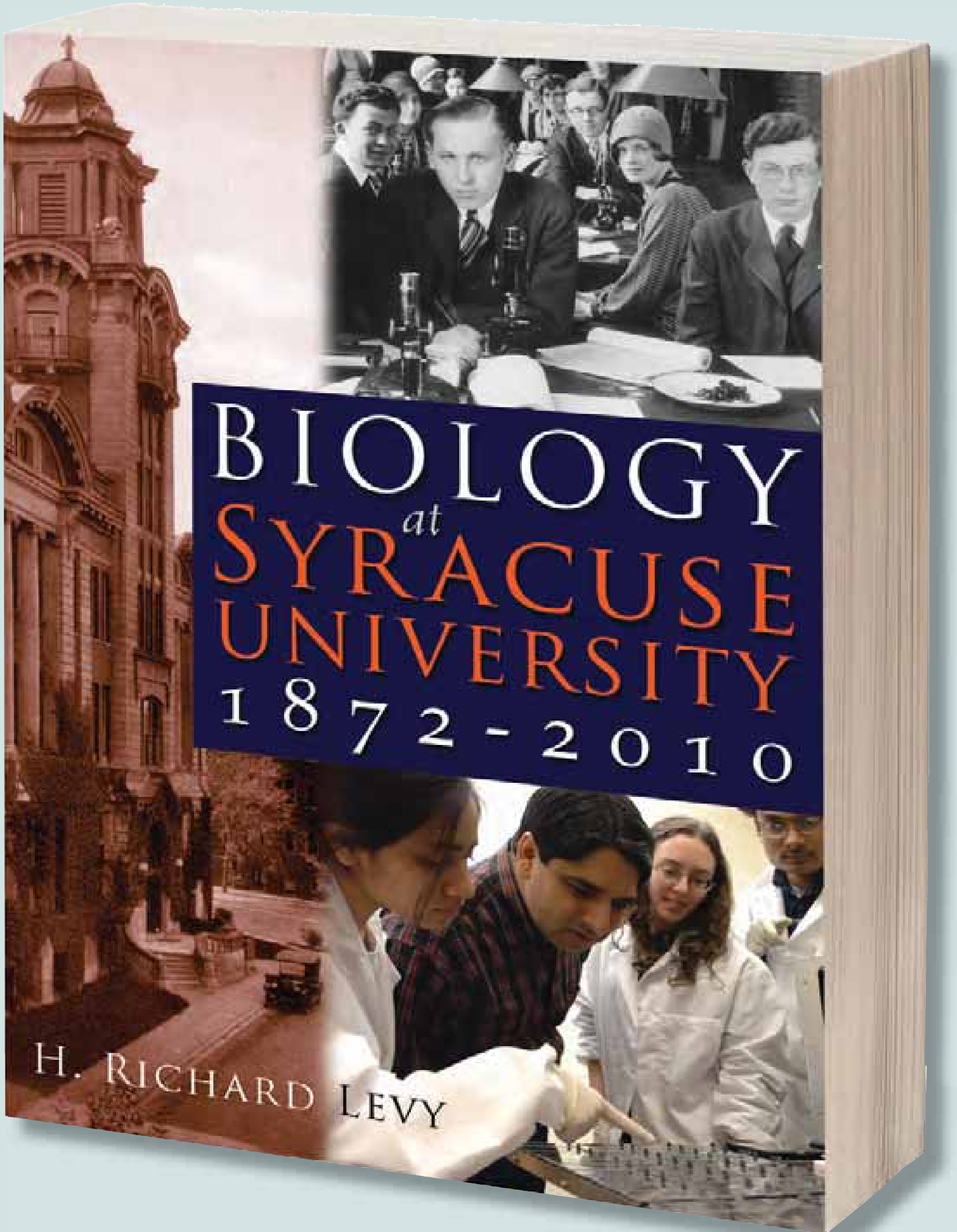
Rion G. Taylor Ph.D. '08 (with **Roy Welch**) has taken a position as assistant professor of biology at MidAmerica Nazarene University in Olathe, Kansas.

Spiro Tzetzis B.S. '91 is the newly appointed medical director for the Department of Health Services at his alma mater, Syracuse University.

Jerry Winkelstein B.S. '61 is now retired from a long career in medicine that included medical school at Albert Einstein College of Medicine, residency in pediatrics, and service as a pediatrician in an Eskimo village. He spent much of his career on the faculty of Johns Hopkins School of Medicine with clinical responsibilities in caring for patients with genetically determined deficiencies, and conducting research focusing on the biology, biochemistry, and molecular genetics of the complement system. Dr. Winkelstein majored in the old zoology department and acknowledges the influence of the faculty, particularly Seymour Gelfant, in instilling a love for research and laboratory work.

PLEASE SEND UPDATES ON YOUR ACTIVITIES TO:

hehemphi@syr.edu **or**
Ernest Hemphill
Room 114
Life Sciences Complex
107 College Place
Syracuse NY 13244



Publication of Dick Levy's book on the history of the Department of Biology is scheduled for early summer 2012. The book is tentatively priced at $29.95. You can reserve your copy by e-mailing Dick at *hrlevy@syr.edu*. We will contact you with exact details once the book is published.

2011-2012 Biology Giving Focus — Undergraduate Studies

The faculty of the Department of Biology takes our mandate of educating the next generation of life scientists extremely seriously. As we move forward and continue to recruit more outstanding undergraduates to our programs, we are experiencing increased demands from these talented students to engage in special opportunities such as faculty mentored research experiences. Providing such opportunities for students has been a hallmark of our educational approach in the Department of Biology and its predecessors for almost a century. Each year a growing number of students participate in research and many of these projects form the core of theses produced by students in the Honors Program or the degree with distinction in biology or biochemistry options. Among the many students participating in research this past academic year, 27 seniors were recognized for research or scholarship and research at Senior Honors Day. Undergraduates have often been coauthors on papers published in peer-reviewed journals and also have presented posters at national meetings of various scientific organizations. We are, of course, extremely proud of these accomplishments of our students and faculty mentors.

The advantages for students to work in the research laboratories are many. For those considering a graduate study in the life sciences, it is an important window into the nature of research and commitment necessary to complete a graduate or professional degree in a specific area of biology. Students intending to pursue careers in teaching also find the opportunity to actually do science and engage with peers doing laboratory or field work gives them a perspective on science that goes far beyond learning biology and teaching methods in the classroom. However, in talking to students and alumni it is clear that the major benefit is simply the opportunity to meet faculty individually in an environment quite different than the classroom, to say nothing of working with postdoctoral fellows and graduate students all focused on doing experimental work.

Funding of the undergraduate research experiences has always been through many sources. Through the Honors Program (Crown-Wise Scholars), Ruth Meyer Scholarships, Korczynski-Lundgren Fund, and the Levy-Daouk Fund, we are able to provide funds for faculty-mentored projects during the academic year and summer stipends to a small number of students engaged in extended projects. With the current interest in our programs and given the amount of support available from these sources, our funds are presently inadequate to meet our current needs. We are, therefore, turning to our alumni and friends for help in supporting this program. Gifts specified for undergraduate studies this year will be added to the Levy-Daouk endowment funds to help increase our annual funds returned from this account and available for the purpose of supporting undergraduate research. Please consider a gift of whatever amount you feel appropriate to help us continue offering these important experiences to as many of our students as possible.

To provide your financial support to Biology Undergraduate Studies, please send your gift via the enclosed reply card envelope. For more information about giving to the Department of Biology and the College, contact Karen Weiss Jones, assistant dean for advancement, at 315-443-2028 or *kmweissj@syr.edu*.

Dr. Ghaleb Daouk '79 on Giving to Biology and the College of Arts and Sciences

My start in the biomedical sciences came as an undergraduate at SU in the Department of Biology. I had the privilege to carry out an undergraduate research project with H. Richard Levy, professor and chair emeritus of biology. The opportunity to work closely with an outstanding faculty member and human being, Dick Levy, and the chance to get engaged directly in research discoveries, instead of just learning about them in textbooks, further fueled my interests in basic research, and led me into medical school and first-rate research universities such as at MIT, for which I have been ever grateful. Recognizing the importance that such experiences have for students, I have always felt it important to give back to the department and the college. I strongly encourage you to consider a gift to the Department of Biology or the College via the appeal made in this issue of *BIO@SU*.

Ghaleb Daouk graduated from SU's College of Arts and Sciences magna cum laude with a bachelor's degree in biology. He earned an M.D. degree from the American University of Beirut, and a master's degree in management of technology from the MIT Sloan School of Management. His post-doctoral research in molecular biology at MIT was followed by his clinical training in pediatric and renal medicine at Massachusetts General Hospital/Harvard Medical School, where he served on its faculty for 11 years before moving to Children's Hospital Boston. There he currently holds patient care, teaching, and several administrative responsibilities. He is also a co-founder together with his wife, Dr. Rima Kaddurah-Daouk, of a Palo Alto-based biotechnology company, Avicena.

Ghaleb is currently a member of SU College of Arts and Sciences Board of Visitors and he chaired its life sciences sub-committee during the construction of the Life Sciences building. He also chairs the SU biology alumni board. In 2000, he established the Daouk-Levy undergraduate studentship fund in biology in honor of his mentor, former SU biology chair H. Richard Levy. He also established the Ghaleb and Rima Daouk Visiting Professorship in the Life Sciences at SU, which will be inaugurated in fall of 2011 with public and research lectures by distinguished SU alumnus Thoru Pederson '63, G'68 (B.S., Ph.D.), Vitold Arnett Professor of Cell Biology, University of Massachusetts School of Medicine.

GIVING TO BIOLOGY AT SU:

In this issue of *BIO@SU* we are continuing our appeal to our many alumni and friends for your help in supporting the programs of the Department of Biology. In these times of fiscal austerity throughout the country, it should come as no surprise that our teaching and research needs have outpaced direct University funding. Whether you donate regularly to SU or are considering a first time gift, we hope that you will consider designating your contribution to support biology at SU. Your support will directly benefit the quality of our teaching programs and research.

Our needs are diverse and encompass all aspects of our program, so we have decided to concentrate our efforts on three areas. Your donation to the Biology Gift Fund can be designated for use in one of the following ways.

Emeritus Chairs Program

Honors the efforts of previous Biology Department Chairs John M. Russell, H. Richard Levy, David Sullivan and Judith Foster and provides the Biology Department Chair with flexibility to meet critical needs, such as one-time purchases of major scientific equipment, support for new course development and rewarding outstanding achievements of biology faculty and instructors in teaching and research.

Undergraduate Programs

Supports opportunities for undergraduates to participate in field study and unique research opportunities in class, with faculty members and summer research projects. Supports improvements in undergraduate teaching facilities and equipment in laboratories, independent research opportunities, travel to research meetings and the development of new courses addressing the most contemporary issues in biology.

Graduate Programs

Supports opportunities for graduate students to travel to national and international meetings, participate in advanced courses at major research facilities, and rewards outstanding students in the program with research fellowships.

With your help, we can ensure that biology faculty and students have the resources they need to excel. A pledge form and return envelope are enclosed for your convenience. Your support will be greatly appreciated.

For more information about giving to the Department of Biology and the College of Arts and Sciences, contact Karen Weiss Jones, assistant dean for advancement, at 315-443-2028 or *kmweissj@syr.edu*.

SYRACUSE UNIVERSITY
Department of Biology
Life Sciences Complex
107 College Place
Syracuse, NY 13244

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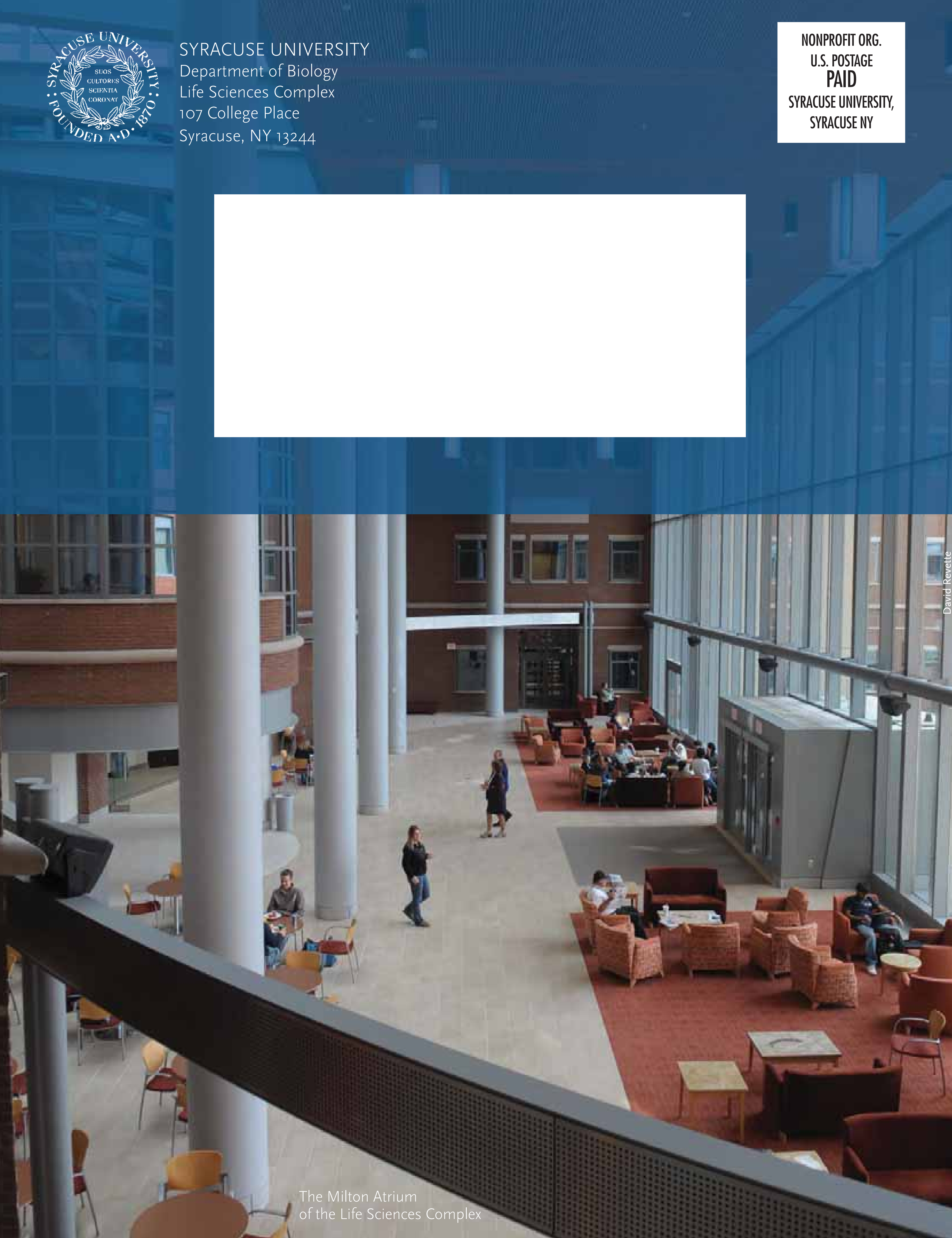

David Revette

The Milton Atrium
of the Life Sciences Complex