FALL 2012

SCHOOL OF INTEGRATIVE BIOLOGY

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

sib.illinois.edu

From the Director

This is my first newsletter as school director and, to be quite honest, there is so much exciting news to report.

Let me start with a few basics. While not without challenges, the school is doing beautifully. First and foremost, the number of School of Integrative Biology (SIB) majors has almost doubled to over 400 in the last three years. The word is out that we provide a coordinated and stimulating curriculum, taught by fantastic faculty and staff who put their students first. The growth of the school creates a vibrant learning environment where students can find like-minded friends to help them pursue their goals. It also poses a challenge. SIB prides itself on its student-centered approach, but bigger classes can put this approach to the test. To meet this challenge, we have begun to transform our teaching approach from traditional lecture to a classroom that highlights active learning, in which students are challenged to solve problems through critical thinking and quantitative analysis. We still lecture to some extent. However, knowledge in biology is growing so rapidly that it is imperative to help students develop learning skills that will enable them to keep abreast of its explosive growth. The National Science Foundation and the National Academy of Sciences recently have recognized that we need to do things differently in the biology classroom.

I am in constant awe of the enormous talent and promise of our undergraduates in the school. Our students continue to earn admission to the nation's top medical schools, professional schools and graduate schools, as well as enter the work force in education, business, and technology. The high caliber and creativity of our students are exemplified by the accomplishments of recent graduate, Josie Chambers, and current student, Muhammed Fazeel. Josie was named a Marshall Scholar for 2011-2012. This enormously prestigious and selective award will fund her graduate studies in conservation biology at both Edinburgh and Cambridge in Great Britain. Fazeel, in addition to exceling with a challenging course load, makes time to exercise his deep passion for entrepreneurship. His new instructional software and his portable heart-monitoring system earned Fazeel the sole undergraduate nomination for the Lemelson-MIT Student Prize for innovation. These are just two of the SIB students working to improve our world.

It is enormously rewarding to report that, in parallel with the growth in our majors, our research portfolio also is experiencing healthy growth. Fueled by hard won, competitive grants, SIB faculty members have substantially increased research support from federal sources and the private sector. New initiatives in the ecology of infectious diseases, bioenergy and sustainability, molecular underpinnings of behavior and development, improved photosynthetic efficiency and food security, just to name a few, are being lead by SIB faculty. Increased funding accelerates the pace of discovery, and opens new opportunities for our graduate and undergraduate students to engage in research that addresses pressing contemporary challenges facing society. Recognizing the centrality of the research experience to biology students, SIB now has a program that places undergraduates in research laboratories in the first semester of their freshman year!

Along with education and research, outreach is the third pillar of the school's mission, and new initiatives in the school are bringing our science to the world. Entomology's Barry Pittendrigh heads the Scientific Animation Without Boarders team; the team produces culturally-sensitive videos that can be viewed on any cell phone in one's native language; the videos provide instruction in, for example, protecting native crops and preventing cholera. Plant biology graduate students have initiated the "Plants iView" program to provide enrichment activities to local middle school students emphasizing plant biology, an aspect of biology often underrepresented in their curriculum. And, if you haven't had a chance to visit the Pollinatarium (www.life.illinois.edu/pollinatarium) yet, please do. This is the first science center in the nation devoted to flowering plants and their pollinators, and it has an active educational program servicing local elementary schools.

Our faculty are the foundation of the school and this past year we welcomed some new faces, recognized incredible accomplishments, and said good bye to a dear friend. Entomology assistant professor Brian Allan has his lab up and going; his research on the ecology of disease transmission bridges ecology, entomology, and human health, and promises to unravel how global change affects the transmission of infectious diseases. Animal Biology assistant professor Zak Cheviron moved into his new lab just this January; Zak studies adaptation and eco-physiological responses to environmental stresses, including the effects of elevation on the respiratory system.

Communication is the thread that weaves the SIB community together. Over the past year we have initiated several new communication efforts through social networking. The SIB LinkedIn Group (www.linkedin.com/groups?gid=1795575&trk=hb_side_g) provides a forum for sharing news, job opportunities, mentoring advice and much more between current students, faculty and alumni. Similarly, the SIB blog (http://blog.sib.illinois.edu) provides breaking news and opportunities. The advising staff hosts a Facebook page (www.facebook.com/pages/UIUC-Integrative-Biology-Academic-Advisors/128680037156) to provide up-to-date information about course offerings, looming deadlines, summer internships. All sites offer subscribers the opportunity to interact directly with the SIB community by posting responses, news, advice, or opportunities. Please consider this an open invitation to members of the SIB community, current and past, to keep up with the school, make new friends online and reconnect with old ones. And, recent graduates, please don't underestimate the value of your experiences. Current students would very much benefit from hearing about your experiences at Illinois as well as the transition to life after SIB.

Going forward, one of our challenges is to increase non-state funding to the school in the form of gifts and donations. Faced with continuing reductions in state support, it is becoming increasingly difficult to fund activities that enrich the undergraduate experience and our research enterprise. We use our gift revenues to support student research and conference travel, special seminars, and to advance and promote our faculty. I very much understand and appreciate the sacrifices by students and parents to make a University of Illinois education possible, so I don't ask lightly. Please give what you can to the SIB Enhancement Fund and ensure that the next generation can take full advantage of the Integrative Biology experience. To give online, go to www.las.illinois.edu/giving and select Integrative Biology from the LAS Department/Unit Annual Funds drop-down menu.

Evan H. DeLucia
Director of the School of Integrative Biology

Zachary Cheviron Joins the Department of Animal Biology

Zachary Cheviron joined the Department of Animal Biology in January 2012 as an assistant professor. Cheviron earned his PhD from Louisiana State University in 2008 and then held posts as a postdoctoral research fellow in the Department of Ecology and Evolutionary Biology at UCLA and then in the School of Biological Sciences at the University of Nebraska, Lincoln. Dr. Cheviron's research is aimed at understanding the physiological and molecular mechanisms that allow species to cope with changes in environmental stress over space and time. He uses integrative gene-to-whole-organism approaches that draw on techniques from physiological ecology to population genetics and functional genomics to address a broad range of topics. These range from mechanistic investigations of physiological adaptation and acclimatization responses to comparative analyses of the importance of environmental gradients in population divergence, speciation, and biodiversity conservation. Perhaps due to a prolonged lack of topographic relief during his childhood in central Illinois, Cheviron developed an early fascination with montane environments, and much of his current work focuses on birds and mammals that are distributed along elevational gradients in the Andes and Rocky Mountains.

Dr. Rebecca Fuller Named Gunsalus Scholar Award

Dr. Rebecca (Becky) Fuller was recently named the Gunsalus Scholar Award for the development of the scholarship and teaching of young faculty members in the physical and life sciences at the University of Illinois. Becky is an evolutionary biologist who studies fish. Her lab has two main research themes. First, Becky and her students study the evolution of color patterns and color vision and the extent to which these vary as a function of the lighting environment. Second, Becky's group studies speciation and the extent to which speciation is propelled via natural selection. She is also interested in developing resources to help teachers effectively teach evolution in the public schools and in increasing public awareness of the taxonomic diversity of fish in Illinois. She is proud to say that she has her office and laboratory in the Shelford Vivarium where all the cool kids hang out.

SIB News By The Numbers

2 SIB scientists chosen to host blogs on Scientific American's new blog network at blogs.scientificamerican.com

102 years since Illinois's entomology department was founded in 1909

$3.1 million awarded by the NSF to plant biology professor Ray Ming for his work on papaya sex determination, with the goal of creating fertile hermaphrodite papaya plants

9 bee species whose active genes were sequenced by a team led by entomology professor Gene Robinson, working with a 1GB sequencing grant from Roche Diagnostic Corp.

42 alumni graduated from the interdisciplinary program in ecology, evolution and conservation biology (PEEC), since it was founded in 2000

30 graduate students whose multifaceted genomics education will be funded by the NSF through an IGERT grant written by SIB faculty Andy Suarez, Carla Caceres and Gene Robinson

15 - 20 students who benefit from the Student Enhancement Fund each year

27 students who have graduated with a Ph.D. in SIB the past two years and have moved on to jobs elsewhere. Congratulations!

5 undergraduates enrolled in the new individual plan of study in entomology

Program in Ecology, Evolution, and Conservation Biology (PEEC) Student Accomplishments Based on Student Surveys

Since the program was formed in 2000: 18 students have graduated with master's degrees, and 34 students have graduated with Doctorates who are all now post-docs, scientific fellows, or professors.

Since 2006, PEEC students have received: 19 nationally competitive external fellowships, 24 students have been ranked as excellent or outstanding teachers, more than 25 papers have been published by PEEC students, and 10 students have received competitive travel awards.

Since 2009: 15 competitive campus or college fellowships, and 9 national awards have been awarded to PEEC students.

May Berenbaum Wins Tyler Prize

In a ceremony in Los Angeles, entomology professor and department head May Berenbaum was awarded the 2011 Tyler Prize for Environmental Achievement. The prize, which honors "exceptional foresight and dedication in the environmental sciences," is awarded to scientists who have made critical steps towards solving environmental issues. Berenbaum won the award for her research on the genetic relationships between insects and their host plants, as well as for her work on declining bee populations.

Berenbaum joined the Illinois Department of Entomology as an assistant professor in 1980, after earning her PhD in ecology and evolutionary biology from Cornell University. She became a full professor in 1990 and was appointed department head in 1992. Over the course of her career, Berenbaum has garnered a number of prestigious honors. She is a member and national associate of the National Academy of Sciences. In 2009, she won the Public Understanding of Science and Technology Award from the American Association for the Advancement of Science, in recognition of her commitment to increasing science literacy in the general public.

In the past five years alone, Berenbaum has received grants from the National Science Foundation, the U.S. Department of Agriculture, the Almond Board of California, and the Energy Biosciences Institute. In addition to over 200 articles in peer-reviewed journals, Berenbaum has written several popular science books, including *The Earwig's Tail: A Modern Bestiary of Multi-legged Legends and Honey, I'm Homemade*—a honey cookbook that also details the history and science of honey harvesting.

Honey production and bee entomology have been central to Berenbaum's career. Her research became especially relevant in 2006, when scientists started to notice massive disappearances of worker honey bees across North America. Bees were abandoning hives and vanishing, leaving behind the food stores, unhatched eggs, and queen bees that they normally protect at any cost. According to the National Agriculture Statistics Service, the number of hives in the United States dropped by almost half between 1947 and 2007. The phenomenon soon became known as Colony Collapse Disorder, and Berenbaum gained national attention for her work on the subject. She was interviewed by Smithsonian Magazine and National Public Radio, among many other magazines and shows, and she even testified before Congress.

Berenbaum has also undertaken research projects to uncover the reasons behind CCD, including a toxicological study that identified the enzymes honey bees use to metabolize certain pesticides. She crafted a revolutionary research project to recruit citizen scientists to track changes in bee populations nationwide. In the BeeSpotter network that she developed, individuals upload photos of bees, which researchers then identify and enter into the database along with the date and locality information. As photos are submitted and catalogued, scientists gain a more complete sense of bee population changes—giving them the data they need to uncover the reasons behind sudden population declines. Although the exact cause of CCD remains unknown for now, Berenbaum's efforts have brought scientists closer to discovering the explanation.

Department of Entomology head May Berenbaum receives the 2011 Tyler Prize for Environmental Achievement. She was lauded for her expertise on bees and advancing the field of entomology.

Berenbaum's devotion to popularizing insect research is evident on campus, where she has developed several new programs to teach community members about insects. The Insect Fear Film Festival, which she founded in 1984, combines entomology education with insect-related art, snacks, and horror films. Berenbaum also helped found the Pollinatarium—the country's first free-standing science center dedicated to pollination. The Pollinatarium provides a unique space in which visitors can learn about pollination mechanisms and even see a live bee hive. The Department of Entomology runs the Pollinatarium, and sales of Berenbaum's Honey, I'm Homemade go to benefit the center.

Berenbaum has also worked extensively on the chemical relationships between plants and the insects that eat them. With plant biology professor Mary Schuler, Berenbaum is currently studying how insects develop resistance to plant toxins, and how plants develop new toxins to prevent insect consumption. In addition to providing valuable insight into plants' and insects' genetic mechanisms, this research will allow scientists to develop more effective insecticides for use in commercial and public health initiatives.

The Tyler Prize honors Berenbaum's work across these domains. The prize was established by John and Alice Tyler in 1973, just as environmental issues were beginning to gather international attention. Now administered by the University of Southern California, the prize recognizes environmental contributions across a range of disciplines; past winners include Jane Goodall, Jared Diamond, and Paul Ehrlich. Winners are first nominated, then selected by an Executive Committee made up of environmental advocates in academic and public sectors. Berenbaum's nomination process was begun by Gene Robinson, professor of entomology, who emphasized her contributions to scientific research as well as her community engagement. His nomination was supported by Thomas Eisner, a Tyler Prize Laureate and one of Berenbaum's heroes.

To receive the Tyler Prize, Berenbaum traveled to Los Angeles, where the awards were held on April 14 and 15. She delivered a public lecture at the University of Southern California, the institution that runs the prize, on April 14. At a private banquet the next evening, Berenbaum received a $200,000 cash prize and a gold medal, surrounded by the Tyler Prize Committee and important members of the environmental community.

Davis Prize Funds Study in Panama

For the Davis family, giving to School of Integrated Biology is a way to honor their son's memory by encouraging the growth of young scientists.

Robert Davis came to the university from Lincoln-Way East High School in Frankfort, Illinois. As a student in SIB, Robert participated actively in campus life. In addition to his research work, he acted with the What You Will Shakespeare Company and played the flute, bass, and guitar. He also served with the Illinois Emergency Medical Services team and trained new Emergency Medical Technicians. Tragically, Robert passed away of a bacterial infection in 2008. Having completed the major requirements, he received a posthumous degree in Integrative Biology.

In memory of their son, Sue and Kent Davis established the Robert H. Davis Undergraduate Research Prize. The prize honors one student a year who exhibits Robert's academic achievement as well as his passion for extracurricular activities. Like Robert, the awardees combine an interest in science with a desire to live life to the fullest. The prize is intended to help its recipients gain research experience over a summer or a semester.

The Davis family: Kent, Emily, Kate, Robert, and Sue.

This year, the Davis Prize went to Claire Johnson, a senior in the Integrative Biology Honors Program. Johnson, who also attended University Laboratory High School on campus, has participated in several research projects at Illinois. She has worked in Charles Whitfield's lab for two and a half years, using the honey bee as a model system for studying behavioral genetics. She has also conducted research with May Berenbaum on the coevolution of the parsnip webworm and its host plant, as well as with Hugh Robertson on the genetic basis for bumblebee binding proteins. Johnson says of her research experience, "the IB school really helps students to get involved in labs, which is important in figuring out what you want to do in the future."

Johnson has also benefited from the SIB Student Enhancement Fund, which allowed her to participate in a field program in Peru, where she studied the ecology of the Amazon River and monitored many tropical species. These lab and field experiences, as well as SIB courses, have nurtured her interest in ecology.

In addition to her academic achievements, Johnson is an active entomological advocate through her participation in the Club Insecta. As the club's Outreach Coordinator, she helps organize insect-related activities and publicize campus events like the Insect Fear Film Festival. Johnson is also a devoted musician—she plays violin with a local group whose genres include classical, old-time, bluegrass, and Celtic music.

The Davis Prize and the SIB Student Enhancement Fund funded Johnson's participation in the Smithsonian Tropical Research Institute internship program this summer. Based in Panama City, Panama, the STRI runs research programs throughout the tropics, in environments ranging from tree canopies to the ocean depths. For her entomology-based internship, Johnson lived in Gamboa, which allowed her access to the town's large insectary. Johnson began her time in Panama by studying tortoise beetles, weevils, and ants; she also ran a census on stingless bee colonies and observed orchid bees on Barro Colorado Island, a 1,500-hectare island in the middle of the Panama Canal.

Johnson's primary project was on the Heliconius butterfly group, which Johnson says worked out well because of her "soft spot for Lepidopterans." Johnson assisted an Arizona State University graduate student who was trying to discover how light affected Heliconius mimicry rings. Heliconius chemically protect themselves against predators by eating passion vines and saving up the cyanide. Such chemically protected species tend to converge on a single warning coloration phenotype to indicate their toxicity. With Heliconius, however, several different mimicry rings can be found. Johnson's experience working with Heliconius was even more exciting because several butterfly genomes are about to be published.

Now beginning her senior year back on campus, Johnson says she is "incredibly grateful" for the prize and for her experience in Panama.

> Like Robert, the awardees combine an interest in science with a desire to live life to the fullest.

International Experiences for SIB Undergraduates

Taiwan. Uganda. Switzerland. Costa Rica. No, this is not a list of destinations for a world tour. It may surprise you to learn that it is instead a list of some of the countries in which SIB undergraduates have conducted summer studies. Yes, that's right – *undergraduates*.

From being admitted to the prestigious and exclusive Organization for Tropical Studies courses in Costa Rica to snagging a World Health Organization United Nations internship in Geneva, Switzerland, our undergraduates are competitive with the best. They conduct real research as well, from the study of growth patterns of tropical trees in Taiwan to investigations of biological anthropology in Uganda.

From the inception of the school, SIB has provided funds to graduate students in support of their further education and research. This support comes from the SIB enhancement fund, which receives its money partly from donations and partly from discretionary SIB funds.

At first, this fund supported only graduate students attending off-campus professional courses, workshops, and some scientific meetings. However, recognizing the need to support undergraduate students as well, in 2007, the SIB executive committee agreed to allow undergraduate students to apply for enhancement fund support for off-campus activities as well. That first year, we awarded nearly $16,000 in such support to undergraduate students alone.

This level of support was clearly not sustainable – we did not receive nearly that much in donations annually, and that figure did not even include support awarded to graduate students. In the years since, support for undergraduate off-campus educational activities has averaged a more manageable $5,500.

Nevertheless, to get to even this amount it is necessary that SIB contribute discretionary funds of its own.

As I was preparing to retire in 2008, it occurred to me that it would be enormously beneficial to SIB and to its undergraduate students if we had an endowment sufficiently large that the income from the endowment could be used specifically to support undergraduate students in their off-campus activities, thereby supplementing the money that donors and SIB put into the enhancement fund.

After I discussed this with my wife, the two of us decided to establish just such an endowment, the *Delcomyn International Study in Biology Award* fund, a fund that would generate income that could be used to support international travel for undergraduates that would help them meet their educational objectives.

We did put in one stipulation – that the fund reach a value of $50,000 before any income could be used from it. Our thinking was that it would be better to wait a few years to build up the fund enough that a reasonable income could be expected annually (about $2,000 on an endowment of $50,000) rather than having only a few hundred dollars to offer students.

Currently, the fund has a value of about $30,000.

If you agree that SIB should do all it can to help enterprising and talented undergraduate students take full advantage of international opportunities for study, you can help.

When you make a donation to SIB, specify that the money should be put into the Delcomyn Fund. The sooner the fund reaches its target level of $50,000, the sooner we can begin assisting additional undergraduates. And even after the fund reaches that level, remember that every additional $10,000 in the fund will generate about $400 in additional income that can be distributed to undergraduates. There are few ways for your gift to have a more lasting impact!

Rare Flower Blooms at the Plant Biology Greenhouse

This summer, from July 15 to 17, the plant biology greenhouse hosted the rare blooming of the titan arum, or corpse flower. The event—which was over a decade in the making—put Illinois on the short list of prestigious institutions that have successfully cultivated this notoriously difficult flower.

A large carnivorous flower, the titan arum only grows in the wild in Sumatra, Indonesia. Its ominous nickname "corpse flower" (bunga bankai in Indonesian) comes from the plant's unique smell of rotting meat. The flower produces the smell to attract flesh-eating insects as pollinators; to spread the odor as far as possible, the plant also heats itself nearly to human body temperature. Because the plant uses so much energy in this process, it can only bloom for 1 to 2 days every two to three years, during which time carrion insects and flesh flies descend upon it.

The plant's blooming is further complicated by its highly specific soil and water requirements. With tropical temperature demands and an underground corm prone to rotting, the titan arum needs constant, attentive care in order to bloom outside Indonesia. For this reason, fewer than 100 titans have ever bloomed in the United States.

Debbie Black, greenhouse manager, led the Illinois cultivation team. Black has cared for the flower since 2001, when Illinois received the titan seed from the University of Wisconsin at Madison. Titans often take many years to reach maturity, so Black expected a long wait from the beginning. In the decade since it was planted, the flower has grown to be nearly five feet tall, with a corm that weighs around 38 pounds. Although enormous in comparison to most flowers, the Illinois titan is actually small for its species: some titans can reach 20 feet in height, and the heaviest corm recorded weighed in at 200 pounds.

The titan showed signs of preparing to bloom in early July, when the flower began to open slightly and emit a faint meaty smell. After growing more than a foot in a matter of weeks, the titan began to open fully on July 15. Black posted constant updates on Facebook and the greenhouse website, allowing far-off fans to track the flower's progress. After concerns that the bright lights would impede the blooming process, the greenhouse team began to extinguish the lights after midnight so that the plant would experience a full night.

Visitors flocked to the greenhouse to see—and smell—the titan in bloom. The greenhouse remained open far past regular hours for the event, with visitors circulating through until 10 p.m. The blooming was also filmed by the History Channel's "Modern Marvels" show, allowing the greenhouse team to share their hard work with a national audience.

Art DeVries Wins Lifetime Achievement Award

At the first-ever International Ice Binding Protein Conference, animal biology professor Art DeVries was awarded the Lifetime Achievement Award. The award honors DeVries's illustrious career working on antifreeze proteins and glycoproteins, which he first discovered in the 1960s. As Jack Duman, DeVries's first graduate student, wrote in a tribute for the conference, DeVries "has contributed more than any other individual to the understanding of AF(G)Ps."

As a graduate student at Stanford, DeVries discovered that Antarctic fishes had special antifreeze proteins that allowed them to thrive in subzero water temperatures. DeVries continued to study these fish at the Scripps Institute of Oceanography, then at the University of Illinois, where he joined the faculty in 1976. His research showed that the antifreeze proteins recognize and bind to ice crystals in the fish's body, inhibiting ice growth even in subfreezing water temperatures.

These discoveries sparked the creation of an entirely new field. Antifreeze proteins have since been discovered in organisms from wolves to fungus; related proteins have even been discovered in desert beetles. Antifreeze proteins also have important commercial applications, particularly in food production. The rapid growth of the antifreeze field prompted the creation of the International Ice Binding Protein Conference.

Held in early August at Queen's University in Ontario, the conference brought together antifreeze protein specialists from around the world. Presentation topics ranged from structural analyses of antifreeze proteins to their usefulness in making ice cream. With four days of events and over 30 speakers, the conference provided a rich environment for collaboration. The conference was partly sponsored by Unilever, which awarded ten International Trainee Travel Fellowships to graduate students and postdoctoral fellows from outside North America.

This honor is far from the first for DeVries. He is a fellow of the American Association for the Advancement of Science and has been a member of the Explorers Club since 1979. He has also won the Felice Ippolito Prize from the Italian National Antarctic Programme and the Accademia Nazionale dei Lincei. DeVries has published over 160 papers, reviews, and chapters, and his work has been included in many general biology and ecology textbooks. Art's research was also recently highlighted as one of the greatest discoveries in evolutionary biology by Sean Carroll in his book *Into the Jungle: Great Adventures in the Search of Evolution.*

In addition to his research on antifreeze proteins, DeVries has worked extensively on more general aspects of Antarctic marine life. During 50 years of traveling to the Antarctic, especially to McMurdo Sound, he has become an expert on the behavior, physiology, and ecology of Antarctic fishes. He even has a fish named after him—the Paraliparis devriesii.

Human Modifications to the Environment Can Alter Wildlife

Changes in the environment have many repercussions on human life, but one often overlooked consequence is their impact on the risk of human exposure to infectious disease. Entomology assistant professor Brian Allan investigates these changes in disease transmission, specializing in diseases transmitted by the bites of infected arthropods. For the last four years, Allan has primarily focused on exploring how landscape change has influenced human exposure to pathogens associated with the lone star tick, an emerging vector of several diseases in the U.S.

Human modifications to the environment (such as developing a previously forested area for residential housing) can alter the composition and abundance of wildlife. Because some species of wildlife serve as hosts for ticks and "reservoirs" for pathogens, these species' responses to landscape changes can greatly impact the abundance of ticks and can also increase rates of tick infection with pathogens that are harmful to humans.

Allan's St. Louis-based studies reveal that disease risk is highest in areas of low-density housing, where human land-use transitions from suburban to largely rural. His data suggest that the increased risk is caused by very high densities of white-tailed deer in these "exurban" environments. Deer are not only important hosts for the lone star tick, but they are also reservoirs for pathogens that can cause diseases such as ehrlichiosis. Understanding these increased risks can provide opportunities to intervene and control tick-borne diseases. Allan bases his research out of Washington University's biological field station, the Tyson Research Center, located on

the outskirts of St. Louis. His team includes three technicians, eight undergraduates, and seven high school students.

Beyond the tick populations project, Allan also uses molecular tools to understand the transmission dynamics of vector-borne diseases. At Washington University, he helped develop a new molecular tool that facilitates the identification of host DNA in ticks. Such identification is surprisingly difficult: most American ticks feed on a host once per life-stage and undergo only one generation per year. So when scientists find a tick searching for a new host, the last time it fed on a host was usually eight to twelve months earlier. As a result, any host DNA remaining from the previous blood-meal is highly degraded and difficult to detect.

With some colleagues in molecular biology, Allan developed a highly sensitive tool that amplifies and detects this DNA using very short "host probes." These probes can bind to even highly degraded fragments, allowing scientists to identify them via a technique called reverse line blot hybridization. Allan is currently in the process of establishing these techniques in his Illinois lab, so SIB students interested in the molecular side of ecology research will be able to participate in these techniques in his lab for independent study. Allan also has many opportunities open for students interested in field work.

Allan arrived at Illinois from Washington University in St. Louis, where he conducted his Ph.D. and postdoctoral research. He currently teaches classes on "Ecology and Human Health" (IB 361) and "Biology of Disease Vectors" (IB 481).

Biology Lecturer Tops Twitter List

Mashable.com, the world's largest website whose focus is social media, listed U of I biology lecturer Joanne Manaster as having one of the "25 Twitter Accounts That Will Make You Smarter," where she is counted among the ranks of astrophysicist Neil DeGrasse Tyson, author Gloria Steinem, philanthropist Melinda Gates, TED Talks, MITnews, fact aggregators Google Facts and Mental Floss, and science agencies CERN, NASA, and DARPA.

In the listing, next to a screen shot of one of her tweets, is the description: "Joanne Manaster is a biology expert and all-around science enthusiast. Her informative tweets are fun, inspiring and surprisingly accessible to the average tweeter."

Manaster has been on Twitter for just over four years and has grown her account from zero as an unknown science educator/communicator to someone who is well-respected in the social media and science communication communities, with a following of over 22,000. Twitter is an online social networking service and microblogging site that enables its users to send and read text-based messages of up to 140 characters, known as "tweets."

"I am thrilled and humbled to have been selected for this list." Manaster said. "Through social media, my website, and my blog with *Scientific American*, I have been trying to share science with the general public for several years in a fun, light-hearted, and smart way. Being added to this list is significant to me as it means I'm achieving this goal.

"Unlike many of those on the list who had come to Twitter with celebrity status and had an immediate large following, I am proud of how I have made a name for myself there having started as a relative unknown."

Manaster is an ardent science outreach enthusiast via her video blog, Joanne Loves Science (www.joannelovesscience.com). She examines science in TV, video, and film at her blog for *Scientific American* (http://blogs.scientificamerican.com/psi-vid/tag/the-believers). She encourages the next generation to enjoy science and engineering to young ladies through GAMES (Girls Adventures in Math and Engineering Sciences at the U of I). Follow her tweets at http://twitter.com/sciencegoddess.

GOVINDJEE, MR. PHOTOSYNTHESIS

Photosynthesis is a complex chemical process essential to all aerobic life on our planet. It's also a key component of the plant biology department in the School of Integrative Biology—and a subject that leading researcher Govindjee has studied for more than a half century.

Govindjee, professor emeritus of biochemistry, biophysics, and plant biology, first became interested in photosynthesis as a student at Allahabad University in India. While earning his master's degree there, he began a correspondence with photosynthesis pioneer Robert Emerson. He soon moved to the United States to work under Emerson at the University of Illinois. After earning his PhD in biophysics, under Eugene Rabinowitch, in 1960, he joined the faculty in 1961 and has been a central figure at the university ever since.

Over the course of his career, Govindjee's research has encompassed many aspects of photosynthesis, especially the initial events of the process. In one of his most famous breakthroughs, he discovered that bicarbonate/carbonate not only produces sugar during photosynthesis, but also plays a critical role in photosystem II, providing protons at a key step in photosynthesis.

He has also made important strides in chlorophyll fluorescence and thermoluminescence research. Since he developed a method of measuring the lifetime of fluorescence, which is independent of chlorophyll concentration, scientists have been better able to understand the relationship between chlorophyll and photoprotection.

These discoveries—only a small sampling of Govindjee's work—have led to over 300 research publications, many in leading journals like Nature, Science, and PNAS. As founding editor of the series "Advances in Photosynthesis and Respiration," Govindjee has helped publish thirty three volumes that comprehensively address photosynthesis. Volume 34 (Photosynthesis), in the Series, published in 2012, has been aptly dedicated to him. Furthermore, students continue to turn to Photosynthesis, a book that he co-authored with Eugene Rabinowitch in 1969, for a comprehensive introduction to the subject. He has edited or co-edited many other books, and his three articles for Scientific American helped bring photosynthesis into popular discourse. He edited the journal Photosynthesis Research for over 25 years, creating a space for researchers to share their latest finds with collaborators worldwide.

Govindjee's accomplishments have attracted the attention of many institutions and award bodies. A fellow of the American Association of Advancement of Science as well as the National Academy of Sciences of India, he has also served as the president of the American Society of Photobiology. He is the first recipient of the Lifetime Achievement Award of the Rebeiz Foundation for Basic Biology (2006) and the 2007 recipient of the prestigious Communication Award of the International Society of Photosynthesis Research. He has received accolades from colleagues, some of whom organized a 2008 conference in his honor. "Photosynthesis in the Global Perspective" held in Indore, India, brought researchers from around the world together to present their recent photosynthesis research in the context of global issues. A book Photosynthesis, honoring Govindjee, will be released in 2012 in New Delhi, where he will be a visiting professor.

Closer to home, Govindjee received the Lifetime Alumni Achievement Award from the University of Illinois College of Liberal Arts and Sciences in 2009. The award, granted by the Alumni Association Board of Directors following a written nomination, is a testament to Govindjee's impact on photosynthesis research and his influence on the Illinois community.

These days, Govindjee continues to research and publish despite his retirement. In recent years, he has put out publications in numerous peer-reviewed journals, including three articles in a single 2011 issue of the Journal of Photochemistry and Photobiology. Many of these articles focus on fluorescence lifetime measurements in photosystem II. Govindjee also remains passionate about the history of photosynthesis research, a subject that has interested him since he created the "Historical Corner" section of Photosynthesis Research in 1986. His latest 2011 book The Maximum Quantum Yield Controversy: Otto Warburg and the Midwest Gang deals with the exciting history that took place right on our campus in the Natural History Building. He continues to collaborate with scientists at the university as well as with research groups in Europe and in Asia. (See his web site http://www.life.illinois.edu/govindjee/ for his multifarious activities.)

Mutualists in a Changing Environment

Dr. Heath and graduate student Julia Ossler in Heath lab.

Heath's work has revealed that the successful trade of mutualist benefits—and therefore the reproductive success of both partners—depends on the synergy between the genes of the plant and the rhizobium.

Mutualisms occur when two species interact in a way that benefits them both. But are mutualist partners always good, or are some individuals in a mutualistic species likely to cheat on their partners? Are cheaters always cheaters, or do their strategies change depending on their partner? How do mutualisms evolve in response to changing environmental conditions? These questions drive the research of Katy D. Heath, assistant professor of plant biology.

Heath studies the interactions between leguminous plants and their mutualistic rhizobial bacteria ("rhizobia"). The legume-rhizobia interaction is a classic example of mutualism: legumes provide rhizobia with energy (carbon) and a place to live; in exchange, rhizobia provide legumes with nitrogen. Legume crops like soybean and alfalfa have a long history in agriculture, where they are often rotated with non-leguminous grasses like corn to improve soil fertility. In natural ecosystems, legumes are often early colonizers of low-quality soils, paving the way for other species, such as prairie grasses. Although the plants are the most visible partners in these exchanges, the beneficial ecosystem also depends on the plants' mutualistic interactions with rhizobia; through symbiosis, these bacteria generate fertilizer for their host legumes and for the entire plant community.

Many important questions surround these essential relationships. A particular puzzle for evolutionary biologists is the longevity of the legume-rhizobium mutualism, which has survived for over 60 million years. Because cheaters enjoy the benefits of mutualism without repaying the favor, they should perform better than their cooperative counterparts (who incur costs of cooperating) and eventually dominate the system. So how have legume-rhizobium mutualisms remained stable for so long?

Heath's research has helped uncover several clues to the persistence of mutualism. Focusing primarily on *Medicago truncatula* (an alfalfa relative) and using traditional genetic approaches, she has documented significant genetic variation in mutualism benefits. Her work has revealed that the successful trade of mutualist benefits—and therefore the reproductive success of both partners—depends on the synergy between the genes of the plant and the rhizobium. This means that an individual rhizobium can be a cheater or a cooperator, all depending on the plant partner with which it interacts. In other words, there is no "best" partner for all genetic variants within a mutualist species.

Heath has also found evidence that the environmental context influences the exchange of benefits between plants and rhizobia. Factors that include the nitrogen environment or the presence of insect herbivores can even change which partner is best for a given rhizobium or plant. This discovery has particular significance in the face of global environmental change, which is dramatically altering the selective environment for species interactions.

Heath has begun investigating the genetic underpinnings of this coevolutionary variation. She has integrated information from natural plant and rhizobium genotypes with the burgeoning resources available for *Medicago* genetics and genomics. Microarray and QTL mapping experiments are identifying genes involved in regulating the trade of fitness benefits between partners, since it is those genes that are most important in the long-term evolutionary stability of legume-rhizobium mutualisms. Future work will continue to study these coevolutionary genetics in natural and managed systems, and will allow Heath to predict how these important mutualisms will evolve in response to global environmental changes like increasing nitrogen deposition, rising temperatures, and rising carbon dioxide.

After earning her BS at the University of Illinois, Heath completed her PhD in plant biology at the University of Minnesota, where she studied the evolution of plant-rhizobium mutualisms. She continued her research as a postdoctoral fellow in ecology and evolutionary biology at the University of Toronto, before joining the Illinois faculty in 2009.

School of Integrative Biology Receives Major NSF Training Grant

The National Science Foundation has awarded the School of Integrative Biology and the Institute for Genomic Biology (IGB) a $3.2 million training grant. NSF's Integrative Graduate Education and Research Traineeship (IGERT) is a highly regarded grant program that was founded in 1998 and has, thus far, provided interdisciplinary research training to approximately 5,000 graduate students.

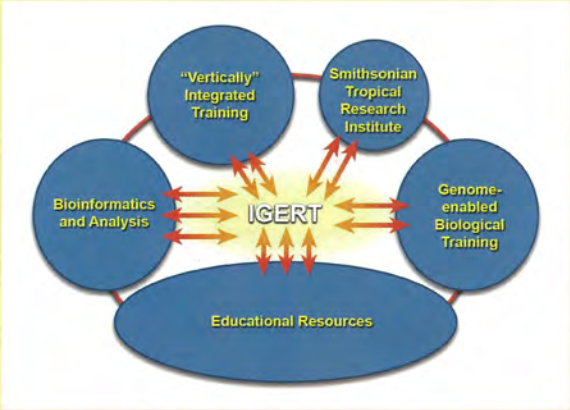
The University of Illinois grant, *Vertically Integrated Training With Genomics* (VInTG), will provide support for as many as 30 graduate students over the next five years. Students will learn ways to both ask and answer the big research questions of the coming decades, says principal investigator Andrew Suarez, associate professor of animal biology and entomology and IGB affiliate.

VInTG will address two "grand challenges" in biology: How do genomes interact with the environment to produce biological diversity? How are biological systems integrated from molecules to ecosystems? Answering these questions will help both science and society determine how to maintain food security under climate change; how to integrate genetics and ecology to study emerging infectious diseases; and how organisms' responses to climate change influence biodiversity and ecosystem function.

"We think this vertically integrated approach will shed light on these kinds of grand challenges," says Suarez.

VInTG will focus on what Suarez calls "back to the future" approaches. Over the past several decades graduate training and scientific research generally has become highly specialized. This approach resulted in major advances, particularly in the genomic and bioinformatics fields. As a result, with hundreds or even thousands of animal and plant genome sequences becoming available, nearly all levels of biological inquiry are becoming "genome-powered." Consequently, Suarez and his co-PIs, Gene Robinson (Department of Entomology), Carla Cáceres (Department of Animal Biology and Program in Ecology, Evolution and Conservation Biology), Sandra Rodriguez-Zas (Department of Animal Sciences), and Owen McMillan (Smithsonian Tropical Research Institute), believe the time is ripe to integrate these fields with a more traditional, taxonomic approach.

Through the grant, graduate students will study an organism or group of organisms from its genome to its evolution, ecology and behavior. This means that graduate students interested in biological fieldwork on a given organism will also learn about genomic tools that are available, and those interested in benchwork and bioinformatics will conduct biological fieldwork in order to put that research in a broader, species-specific context.



With this approach students will have a comprehensive knowledge of their organisms, says Suarez.

"We don't want to train students to generate huge amounts of data without knowing what questions they are really asking," says Suarez. "We want to train field biologists who know how to collect data with the genomic resources available in their mind and to train bench scientists and bio-informaticians to know about their organism."

In addition to being interdisciplinary, the program will have students working in research teams, rather than individual students interacting with individual advisers.

Students are eligible to apply for two years of funding and will take specific classes that emphasize vertical integration.

The Smithsonian Tropical Research Institute (STRI), one of the world's premier tropical research institutes, is a partner in the grant and will host students at their research facility in Panama. Students will have access to STRI's large, diverse and long-term study sites and databanks for a wide variety of organisms and ecosystems in Panama.

This is the third IGERT the University of Illinois has received in the past three years, and the first going to a biology program.

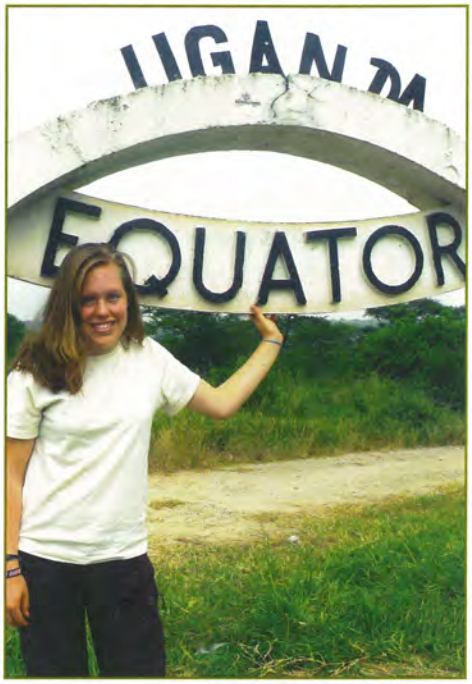
SIB ALUMNA NAMED MARSHALL SCHOLAR

Josie Chambers, a recent graduate of the integrative biology program, was named a 2011-2012 Marshall Scholar. One of 33 students selected from across the nation for the prestigious award, Chambers will receive two years of full funding for graduate study in the United Kingdom.

Chambers graduated from Illinois summa cum laude in 2010. In addition to her integrative biology major, Chambers minored in anthropology and chemistry. She has previously worked on primate ecology in Costa Rica and Uganda. She has spent this past year in Peru, where she worked with Neotropical Primate Conservation to preserve the habitat of the yellow-tailed woolly monkey. In addition to her studies abroad, Chambers was an active ecological advocate on campus, where she organized a conservation lecture series and developed a community outreach program for environmental education. She also co-founded a campus chapter of Roots and Shoots, a youth-driven environmental program run by the Jane Goodall Institute.

Chambers will use her Marshall Scholarship to begin a career in tropical forest conservation. She will spend this year at the University of Edinburgh, working towards a master's in integrated resource management. Next year, she will pursue a master's in conservation leadership at the University of Cambridge.

Created in 1953, the Marshall Scholarship promotes the ideals of the Marshall Plan by facilitating intercultural understanding between the United States and the United Kingdom. The scholarships, which are funded primarily by the British government, are awarded across academic disciplines to young Americans who exhibit intellectual excellence and strong leadership.



Online Masters of Science in Teaching of Biological Science

The School of Integrative Biology has introduced a new online masters program in the teaching of biological science. The online program, which is specifically designed for certified K-12 teachers, allows its students to earn a masters of science while teaching full-time.

The five online courses, taught by Illinois faculty and experienced instructors, each last ten weeks. The courses present the latest discoveries in subjects like "Human Genome and Bioinformatics" and "Sustainability and Global Change," allowing teachers to bring up-to-date knowledge about current issues into their classrooms. The program also contains education courses in which teachers can learn the latest pedagogical methodologies. In addition, students complete an independent, research-based capstone project that allows them to apply the new skills they've learned.

Each course includes both synchronous components—scheduled sessions in which students can interact with their instructors—and independent work. This structure combines the benefits of real-time teaching with the flexibility unique to online study. Furthermore, because the program is geared towards practicing teachers, much of the coursework can be easily adapted to the classroom.

Interested students should consult the SIB website and contact the online learning team at ibio-online@life.illinois.edu.

Teaching Agriculture and Health Through Cell Phone Animations

Cell phone animations can be watched simultaneously and at the user's convenience in Haiti, India, and Mali.

For years, international development projects have relied on in-person education initiatives, in which educators fly to developing countries to teach new skills. These projects offer invaluable face-to-face contact, and they enable the formation of important human relationships. But such programs are also expensive, and, when logistics or poor funding impede them, many communities are left in the lurch.

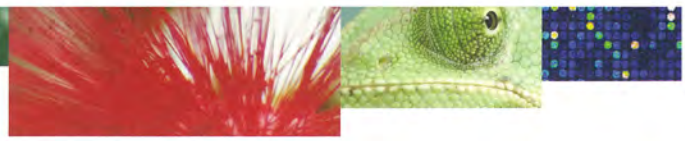
SAWBO's animated videos explain key agricultural and health safety techniques, and are identifiable across cultures.

Enter entomology professor Barry Pittendrigh and the Illinois-based team Scientific Animation Without Borders. SAWBO produces animated videos that explain key agricultural and health safety techniques, like how to boil water or control crop-devouring insects. Because they are animated, these videos are identifiable across cultures, inexpensive to produce, and can be easily adapted across countries. A farmer in West Africa can watch the same video as a farmer in southern India, with the only difference being the language of narration. Currently recorded languages include French and Hausa, and Illinois entomology graduate student Tolulope Agunbiade has also recorded an English version for USAID purposes.

The audio and video presentations are produced in MP3 and MP4 formats, so they can be played on cell phones and solar-powered players, which are becoming increasingly available in developing countries. While traditional development efforts would require educators to travel to each country, the cell phone animations can be watched simultaneously and at the user's convenience in Haiti, India, and Mali.

The SAWBO team combines scientific, digital, and development expertise to make the videos as effective as possible. Other Illinois-based SAWBO collaborators include extension educator Francisco Seufferheld, field extension specialist Julia Bello-Bravo, and graduate students Laura Steele and Tolulope Agunbiade. Pittendrigh has contributed his entomological experience to the videos. One of SAWBO's most successful initiatives focuses on a method of insecticide production. Cowpeas are an essential crop in the agricultural profiles of many African nations, but they are also often attacked and destroyed by insects. In Mali, farmers process the fruits of the neem tree to produce a natural insecticide. One SAWBO video details the insecticide production process, teaching farmers in other countries how to protect the cowpeas and thereby preserve a dietary staple. Other recent videos explain how to boil water to prevent cholera.

Although the project is still in its early stages, it has already attracted important recognition. SAWBO received a grant from USAID, through the Dry Grains Pulses Collaborative Research Support Program, which supports the team's outreach in Mali, Burkina Faso, Niger, Nigeria, and Benin. The materials are made available free of charge on Pittendrigh's website for any educator to download.



Bringing Plant Biology into the Classroom

A group of plant biology graduate students and professors have created Plants iView, a new and exciting outreach opportunity designed to educate middle schoolers about diverse subjects in plant biology. The program was created by the officers of the Plant Biology Association of Graduate Students (PBAGS; Cody Markelz, Rhiannon Peery, Ryan Kelly, Miranda Segura, Sharon Gray, Courtney Leisner, and Becky Slattery) and a handful of professors in Plant Biology (Drs. Andrew Leakey, May Berenbaum, Tom Jacobs and Mary Schuler) and Education (Dr. Barbara Hug).

PBAGS officers recognized that there were not regular outreach opportunities available for students in the department, although such opportunities exist in other departments on campus and other top plant biology programs in the country. Many members of PBAGS were already participating in outreach activities through other organizations and were eager to create one that could overlap with their own research interests. The American Society of Plant Biologists (ASPB) has an education foundation that runs a yearly granting competition for projects that promote the importance of plants to society. Having little grant-writing experience, the PBAGS officers collaborated with professors in Plant Biology and Education to learn critical grant writing skills and broaden the scope of the project by incorporating these professors' research interests into the grant. This format worked extremely well as ideas were slowly pared down from the large list of graduate student ideas.

Plants iView

Starting this November, middle school students involved with the SPLASH afterschool program will participate in six lessons that combine Illinois resources such as the Plant Biology Green House and the Pollinatarium, internet technologies, and iPads. During the lessons, students will learn about the function and importance of plants. Graduate student group leaders will guide lessons such as iSense Plant Biology, where concepts are taught through all five senses, and the carbon metabolism relay race, which actively demonstrates principles of photosynthesis and respiration through physical movement.

After each lesson, middle school student groups will blog about what they have learned. They will also have the opportunity to create short stop-motion videos demonstrating their favorite concepts learned during the six-week session. The goal of this part of the project is to promote "kids teaching kids" how plants work. With the current allocation of funding, the six-week module will be taught once this fall and once in the spring, but the iView team hopes to extend this program through other grants.

A companion website will be created to host the science blogs, videos, and photographs of middle school students' work from the program. The Plants iView website will also serve as a repository for lesson plans, and it will include a section where teachers in other districts can request prepackaged materials for each lesson. Available materials will include a set of videos that show time lapse photography of plants growing under natural conditions and conditions associated with human-induced climate change factors. Parts of the website will be in a "choose your own adventure" format where students and teachers can pick the initial conditions, create predictions, and then run the experiment forward to test these predictions. The web component will allow for broader dissemination of these topics by creating a forum where teachers and students from other schools can post questions and host discussions.

The mission of Plants iView is threefold:

(1) to create a general platform for graduate students and faculty members to communicate research themes to a broader audience on a regular basis;

(2) to provide enrichment activities for plant science education at Urbana Middle School as part of an afterschool program;

(3) to provide online and physical materials for plant biology lessons that meet state and national education standards.

The iView team hopes that this project will create a "learning is fun" environment for the middle school students and increase their long-term interests in science. The team would like to expand this program to include more lessons, ideas, and student participation. If you would like to get involved, please contact the project manager, Andrew Leakey (leakey@illinois.edu) for more details.

A Long-Term Perspective on Tropical Biodiversity

The extraordinarily high plant diversity of South American tropical forests is an ancient phenomenon. Molecular phylogenetic reconstructions place the origin of neotropical biomes in the mid-Cretaceous (between 112 and 94 million years ago). Species-rich neotropical forests were unequivocally present by the early Eocene (55 million years ago). Despite the increased recognition of the antiquity of tropical diversity, what is not as well understood is the role that climate may have played in shaping the modern diversity of tropical forests. Despite the long-term persistence of these high-diversity biomes, these communities have not been static assemblages through time.

Surangi W. Punyasena, assistant professor in plant biology, with affiliations in the Department of Geography, the Center for Latin American Studies, and the Environmental Change Institute, investigates the effect of climate on tropical forests using the fossil plant record. Her research focuses on the role millennial-scale changes in temperature, precipitation, and carbon dioxide may have played in assembling modern neotropical forests, primarily through the reconstruction of paleoecological and evolutionary trends of individual plant clades from the late Quaternary pollen record (the last 50,000 years).

Paleoecology is a division within paleontology that uses fossil data to study ecological relationships and responses of ancient communities. Because the fossil record allows investigation of diversity changes over hundreds to millions of years, paleoecological analyses complement traditional ecological studies of Neotropical forest composition, abundance, and structure by providing a long-term perspective that would be otherwise unavailable. Paleoecological research allows us to test whether the ecological interactions observed in modern communities are maintained under the very different environmental conditions of the past.

Punyasena takes a multifaceted approach to studying the relationship between plant diversity and climate, investigating both modern biogeographic and fossil diversity patterns in Neotropical vegetation. She has developed and applied models based on modern Neotropical plant distributions to the reconstruction of Quaternary temperatures and precipitation from fossil pollen data. Results corroborate qualitative assessments that even the lowland tropics experience several degrees of cooling during the last ice age, and that long-term aridity characterized the subtropical forests of lowland Bolivia until approximately 3,000 years ago. This discovery

suggests that the moist forests of northeastern Bolivia are relatively recent extensions of Amazonian wet forests and argues for subtropical aridity as a component of South American glacial climate.

Current and former Punyasena lab members.

Although Punyasena's research focuses on the past, aspects of her work are critical to predicting the response of tropical forests to anthropogenic climate forcing. They also have important implications for the development of current conservation strategies. Past changes in temperature, precipitation, and carbon dioxide concentrations provide a natural experiment to test how individual plants may be affected by changing climatic conditions. Changes in abundance and composition are recorded in the fossil pollen record, documenting the relative impact of even small changes in environmental conditions. Pollen is the most ubiquitous and most continuous of the terrestrial fossil records, and despite its modest standing in the popular imagination, leaves the best available record for studying ecological response in terrestrial communities. Developing innovative uses for fossil pollen data is the unifying theme of the many projects currently underway in the Punyasena lab, from better imaging and identification of pollen types to studying short-term variation in tropical pollen production as a result of ENSO (El Niño-Southern Oscillation) climate cycles.

Fossil pollen is also an integral component of biostratigraphic research—the dating and sequencing of rock sections based on its fossil composition. Since arriving at Illinois, Punyasena has expanded her research to investigations of older microfossil material from South America, adapting the quantitative models developed for Quaternary paleoclimate research to biostratigraphic dating. She and her collaborators from the Smithsonian Tropical Research Institute are developing tools to improve dating of Colombian and Venezuelan geologic sequences from the late Cretaceous (85 million years ago) to the present.

Punyasena's first introduction to tropical forest research came as a Fulbright Student Scholar to Sri Lanka, where she studied canopy dynamics in the Sinharaja Forest Reserve, a UNESCO World Heritage site. Punyasena earned her Ph.D. at the University of Chicago in 2007. Before joining the faculty in October 2008, she was a Smithsonian Postdoctoral Fellow at the Smithsonian Tropical Research Institute's Center for Tropical Paleoecology and Archaeology in Panama City, Panama.

NEW GRADUATE PROGRAM IN

Among the new graduate students welcomed into the Department of Plant Biology in Fall 2011 are three who are venturing into a new, 16-month degree program that aims to prepare them specifically for science careers outside of academia. For Grant Hansen, Brandon Jordan and Miranda Morgan, the Professional Science Master's (PSM) in Plant Biology blends graduate studies in plant biotechnology with an accelerated introduction to business basics and a realistic look at needs and trends for jobs in biotechnology-based industries. At colleges and universities nationwide, PSM programs are emerging to offer fast-paced, innovative graduate training for scientists transitioning from the university to careers in industry, government, and non-profit organizations.

The vision for the PSM in plant biology began with SIB Director, Prof. Evan DeLucia, who recognized the growing trend of science graduates to follow career paths away from the university and in 2008 led brainstorming sessions to identify potential PSM program areas in the school. Plant biotechnology quickly emerged as an ideal area and led to the creation of the school's first PSM in the Department of Plant Biology, which enrolled its first cohort in Fall 2011. The Department of Plant Biology recognized the value of adding a PSM degree to its graduate programs, which have long garnered recognition worldwide in the plant sciences. The non-thesis PSM program brings a distinctive curriculum and goals to the existing graduate programs in plant biology, and aims to perpetuate the department's strong reputation for interdisciplinary science and diverse career outcomes for graduates of its programs. Committed to the success of the new program, the department moved quickly to invite PSM students into its graduate student organizations and integrate them into graduate science classes and research labs, embedding these students into the life of the department and the larger graduate community at Illinois.

The plant biology PSM curriculum centers on plant-based biotechnology studies, but also encourages students to tailor their science coursework to match their interests. Embedded within this technical foundation are business classes and opportunities for students to develop the professional skills sought by industries, which include communication, innovative thinking and an appreciation for productive workplace dynamics and management. The science and business elements build developmentally in the program and culminate in the real world experience of a summer internship. The role of industry partners is integral throughout the program, providing students with first-hand perspectives on the jobs and competencies key to today's business world. These links forged between the PSM and industry partners, ensure that the program remains responsive and relevant to the needs of the biotechnology sector of medical, environmental and agricultural industries.

Grant Hansen; BS May 2011; molecular and cellular biology

With his emerging interests in marketing research and consulting careers, **Grant Hansen** is identifying courses that offer theoretical and practical knowledge in the area of information technology, and is implementing these concepts through a student consulting organization that serves small businesses.

With interests in marketing research and consulting, Grant is following the emerging trends that reveal the "new era of how business decisions are made and new opportunities discovered…I am preparing myself for a long-lasting and much needed trade within the bio-based industry."

Brandon Jordan; BS May 2011; molecular and cellular biology

PLANT BIOLOGY

Blending Science and Business for Biotechnology Careers

By merging biotechnology-focused training with business knowledge and professional skills, the PSM equips students for diverse entry points into agricultural, medical and environmental enterprises that may lead to management roles in:

- **Product development and marketing**
- **Public and government relations**
- **Design and implementation of regulatory strategies**
- **Market analysis and feasibility studies**
- **Technology transfer and intellectual property ventures**

Like the thesis-based graduate degrees, the plant biology PSM accepts only a small cohort of students each year, ensuring a closely mentored and individual experience for each. In response to both their in-class and extracurricular experiences during their first semester, Brandon Jordan, Miranda Morgan and Grant Hansen are already refining their professional goals and taking advantage of the flexibility in both coursework and practical experience to make the most of the program.

Even as businesses show promise of economic recovery, a highly competitive job market continues to favor graduates prepared to offer both expertise in the science disciplines and an authentic grasp of how the business world works. The PSM focuses on this landscape of 21st century industry careers that demand highly trained, flexible scientists possessing both technical knowledge and skills broadly applicable to the needs at the interface of science and business.

The Professional Science Master's in plant biology is administered jointly with the graduate college and is one of five PSM programs at the University of Illinois. For further information, contact program coordinator:

Dr. Joan Huber
jlhuber1@illinois.edu
(217) 333-5498
www.life.illinois.edu/plantbio/psm

Brandon Jordan is gaining research experience under the direction of Dr. Steven Huber, professor in plant biology, and Dr. Martin Williams, assoc. professor in crop sciences, by applying newly acquired bench skills to studies of a mutant protein synthesized in herbicide-sensitive sweet corn lines. The results may yield insights into basic underlying mechanisms as well as strategies for rapid detection of mutant lines of potential interest to industry. Importantly, his broad graduate scholarship, new skills in the scientific process and industry experience will help Brandon evaluate career options offering both research opportunities that offer the latitude to move into blended roles of science and business.

Citing exploratory motives for choosing a PSM degree, Brandon says, "I needed to answer some key questions for myself regarding what type of career was right for me." He is discovering through the PSM industry partnerships that "while research seminars, graduate courses, and a graduate research project work to expand my scientific knowledge, there is a whole other side of science that deals with the practical application of this knowledge."

Miranda Morgan; BS May 2011; crop sciences, plant biotechnology and molecular biology concentration

Miranda Morgan is building a broad understanding of crop improvement using her coursework and her studies in the lab of Dr. Lisa Ainsworth, assoc. professor in plant biology, where she works to genetically characterize plant lines exhibiting enhanced growth under elevated ozone levels. With interests in public relations in a science-based company, Miranda will be interning with a high-tech agricultural company during summer 2012. Raised on a family farm in southern Illinois, she hopes someday to communicate technical concepts and product information to the public, providing the vital link between farmers and the industries upon which their businesses depend.

In order to decide whether a bench position or customer relations role is right for her, Miranda is exploring both research on the Illinois campus and a communications and marketing summer internship, using the PSM to "experience both sides first-hand and help make a decision."

School of Integrative Biology Seniors Reflect on Their Major

Graduating seniors answered a survey about their experiences in Integrative Biology. Here, in their own words, they recall the most positive aspects of being an IB major at U of I.

"IB Honors. I cannot say enough how incredible this program was for shaping my undergraduate education and turning me from someone who likes biology into someone who cannot wait to contribute to it."

"As an IBH major, the interactions with your professors, the incorporation of scientific thinking as well as an understanding for how research actually works. Also the relationships developed within our small community and the diversity of interests that develop and the combined scientific curiosity."

"Breadth of courses, best teaching on campus, passionate teachers and peers, accessibility of professors, abundance of labs."

"I am happy that 300/400 level classes are smaller, so students were able to form relationships with their professors."

"I really learned a lot, not just about biology but also about its impact on everything and everyone."

"Jumping in the forests and prairie with Professor Carol Augspurger."

"On top of learning all sorts of things about the actual science behind conservation and ecology, I was able to get a lot of hands-on experiences through class work and other experiences. Professors were always readily available to speak with me and were more than willing to hand out information about finding jobs and experience as well as what was needed for grad school."

"I was an IB Honors major and it was the most perfect niche at this school for me."

"My peers helped me all along the way in the program, as well as the most outstanding professors who encouraged us immensely."

"The way it teaches you to think. It does not focus on memorizing facts, but rather applying knowledge to new situations, which is the most valuable skill set to have."

In Memoriam: Dr. Arthur Rainer Zangerl

On December 16, 2011, **Dr. Arthur Rainer Zangerl** died after a valiant 20-month struggle with glioblastoma multiforme, an exceptionally aggressive and almost always fatal form of brain cancer. Art spent his entire academic career at the University of Illinois at Urbana-Champaign. He first came to the University of Illinois as an undergraduate, earning a B.S. degree in biology in 1974 and subsequently entered the PhD program in Plant Biology (then Botany) to work with Fahkri Bazzaz, obtaining his degree in 1981. In 1983 he returned to the University of Illinois to work as a research associate in the laboratory of May Berenbaum; for the next 28 years they had a remarkably productive collaboration that generated dozens of publications and helped to establish the interaction between the parsnip webworm *Depressaria pastinacella* and the wild parsnip *Pastinaca sativa* as a model interaction for the study of chemically mediated coevolution. In addition, Art pursued his own independent research in the area of optimal defense theory and worked with a range of other investigators to make significant advances in this field.

Due to his uncanny insights into experimental design and statistical analysis, his almost unlimited capacity to engineer solutions to seemingly intractable problems, and his inexhaustible generosity and good nature, Art contributed substantially to the research of many faculty and students throughout the School of Integrative Biology. Beyond his formal service on thesis and preliminary examination committees, he also unstintingly offered help to many other students and faculty members whenever it was needed. He was also involved in teaching, giving guest lectures in classes in Honors Biology, Plant Biology, and Entomology, and recently taught Ecological Genetics with Ray Ming.

The high regard in which he was held by his peers was evidenced by the many invitations he received to give lectures at institutions across the country, to participate in international symposia, to serve on grant panels for the National Science Foundation, and to serve on the editorial board of Ecology and Ecological Monographs. With Berenbaum, he was successful in obtaining continuous support for his research from the National Science Foundation. He published over 90 papers (including a 1986 paper in Ecology that received the Mercer Award from the Ecological Society of America) and ten book chapters. His impact on the science of entomology, however, extended well beyond his publication record. His encyclopedic knowledge of biology, his unquenchable scientific curiosity, his tremendous energy and his relentless good humor, even in the face of overwhelming challenges, will continue to inspire his friends and colleagues for years to come. At his suggestion, to remember Art, a fund has been established at the UI Pollinatarium to create the Arthur R. Zangerl Swallowtail Garden, which will feature larval and adult food plants to bring attention to the local swallowtail populations and to help them to thrive.

In Memoriam: Roy J. Barker

Roy J. Barker died January 29, 2012. Dr. Barker was born July 9, 1924, near Norborne, Mo. He grew up on a farm that was plagued with fleas, flies, armyworms, and grasshoppers, providing him plenty of motivation for his future career. An entomology 4-H Club introduced him to the book by C.L. Metcalf and W.P. Flint entitled *Destructive and Useful Insects* (1928). After graduating from high school, he attended the University of Missouri on a Sears-Roebuck Scholarship. His undergraduate career was interrupted by World War II, during which he served in the Army as a cannoneer. After the war, he returned to the University of Missouri and earned a B.S. in agriculture chemisty in 1948. He was unable to obtain admission into the University of Illinois graduate school of chemistry; however, Dr. Clyde W. Kearns, then a professor in the U of I Department of Entomology and a pioneer in the field of insect toxicology, encouraged him to take graduate chemistry courses at U of I anyway and major in entomology. Concentrating his research on the biological magnification of DDT in earthworms, Dr. Barker earned his Ph.D. in entomology from U of I in 1953. While working on his doctoral requirements, he served as an assistant entomologist at U of I and at the Illinois State Natural History Survey.

After earning his doctoral degree, Dr. Barker accepted an entomologist position with E.I. DuPont de Nemours, in Wilmington, Delaware. Two years later, he joined the U.S. Department of Agriculture's Pioneering Lab as a senior insect physiologist, a position he held for the next 10 years. He worked as an entomologist and group leader at the Rohm and Haas Company in Springfield, Pa., from 1963 to 1966 and then finished his career as a research entomologist with the U.S. Department of Agriculture in Tucson, Az., between 1966 and 1979. Over the next decade, he continued to work as a consultant to the pesticide industry through his Pesticide Trouble Shooters business. During his career Dr. Barker's areas of research and specialization included pesticide trouble shooting; insect physiology and biochemistry; and pheromones for pest control.

Dr. Barker and wife, Mary Lou (Criss) Barker, established the C.W. Kearns, C. L. Metcalf, and W.P. Flint Endowed Chair in Insect Toxicology in the U of I Department of Entomology in September 2001. The gift honored the three most influential persons in Dr. Barker's professional career. The generosity of Dr. Roy J. and Mary Lou Barker enabled the Department of Entomology to attract and retain an outstanding faculty member, Dr. Barry Pittendrigh, as the inaugural Chairholder of the C. W. Kearns, C. L. Metcalf and W. P. Flint Endowed Chair in Insect Toxicology.

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