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SCHOOL OF
BIOLOGICAL SCIENCES NEWS
SPRING 2017

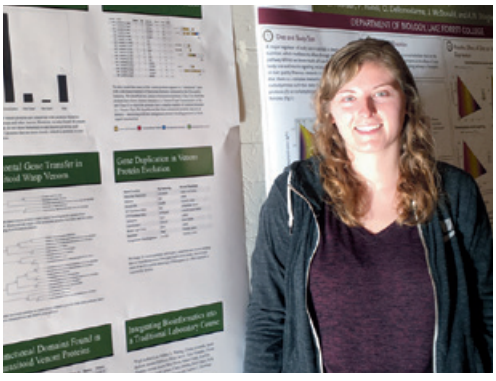
Using inquiry to introduce students to molecular and cell biological research

By Nate Mortimer

Being involved in research can provide a capstone educational experience for biology students, and providing these opportunities for Illinois State University undergraduates is an important priority for the School of Biological Sciences. In the spring 2016 semester, 17 students were afforded just such an opportunity by enrolling in BSC 354 Biotechnology II: Cell Biology Techniques. This course, taught by assistant professor of cellular immunology Nate Mortimer, used an inquiry-based learning approach to introduce students to experimental design and techniques used in molecular and cell biological research.

"My idea for the course was to engage my students in research by teaching them lab skills in the context of an ongoing project focused on a Drosophila model of autoimmunity," Mortimer said. After learning several basic cell biology techniques, the students used these new skills to test a newly discovered mutant allele in a conserved immune gene. Their experiments provided data suggesting that the new allele encodes a gain of function version of the protein, and that this may lead to autoimmunity in the flies. "This molecular finding corresponds with the genetic data that we had previously collected in the lab," Mortimer said. "The students' data are an important step in understanding the function of this mutant protein."

After learning some additional techniques to study the fly immune response, the course continued with an open learning approach, in which the students identified research questions they found interesting and generated hypotheses. "In the course we further developed our critical thinking and problem-solving skills by creating our own experimental plans, analyzing results, and learning how to interpret our experiments," Nicki Wagner said. "I enjoyed how the techniques we learned and mastered in the course were used to answer the questions we had and led us to new discoveries," Ashley Waring said. "The course allowed us to have freedom designing our experiments, which let us to strengthen our ability to thinking like future scientists," Beth Oates said.



Ashley Waring presents at the Midwest *Drosophila* Conference

For this section of the course, the students broadly divided into two groups. The first of these groups was focused on investigating the immune competence of flies with the autoimmune mutation. In preliminary experiments, the autoimmune flies also had higher bacterial loads. "There are a lot of unanswered questions about antibacterial immunity in the context of autoimmune disorders. My students came up with some great ideas, and were able to break into some very interesting new

Continued on Page 2

Director's message

2016 was another exciting year for ISU biology. With our sub-disciplinary sequences (Zoology, Physiology, Neuroscience, and Behavior, Plant Biology, Molecular and Cellular Biology, and Biology Teacher Education) now in full implementation we have seen our numbers of undergraduate majors grow by more than 50 percent from 495 in 2010 to 762 currently! This student population growth brings biology up to the second largest major in the College of Arts and Sciences. Maintaining healthy enrollments is absolutely essential during the state budget turmoil. Approaching nearly two years without a state budget is having substantial debilitating effects on many state institutions, but ISU has been able to weather the storm due to our increased attractiveness to students. Biology is certainly playing its part in keeping ISU strong and successful.

Director Craig Gatto

Another critical component to combating the current fiscal crisis is to seek other sources of revenue. In 2016, biology faculty members were successful in attracting over $2 million dollars in extramural grant support for the various research efforts in the school. Extramurally funded research programs enable our students to actively engage in the scientific process where they can

Continued on Page 2

Director's message *continued from Page 1*

put the problem-solving skills they learn in the classroom toward investigating cutting-edge questions within their areas of interest and gain valuable one-on-one mentoring from their faculty mentors. These efforts have resulted in nearly 70 peer-reviewed publications from biology this year, with almost all of them containing one or more student co-authors. Reflexively, having faculty engaged in current biological investigations keeps them knowledgeable on the most recent advances in science, and they can bring this information back to the classroom. This is critical for providing the best education to our majors because at the current rate of scientific discovery, the information in textbooks is three to four years out of date the day the text is published.

Along these lines, we had two outstanding biology scholars recognized by the University this year. Professor John Sedbrook received the Outstanding College Researcher Award, and Professor Rachel Bowden was named Distinguished Professor, the highest honor a faculty member can be awarded at ISU.

As always, we love to hear from our alumni, so please drop me (or one of your old mentors) an email or like us on Facebook and let us know what you are up to. If your travels happen to bring you near the Bloomington-Normal area, please stop into the school office and say hello.

Wishing you much success,

Craig Gatto, Ph.D.
Director, School of Biological Sciences

School of Biological Sciences News

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Using inquiry *... continued from Page 1*

Nicki Wagner now works at Abbott Laboratories as an assay manufacturing specialist

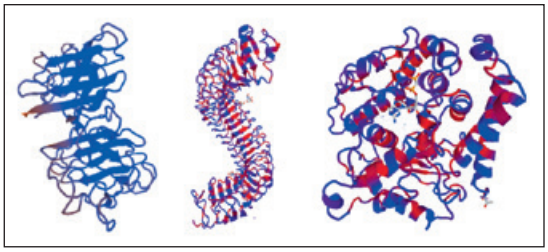
ground," Mortimer said. Within this group Anissa Anast, Kate Genenbacher, and Wagner were interested in identifying of control and autoimmune flies to mount an immune response to bacteria and fungus at different life stages. Finally, Waring, Jamie Young, and Corey Mathis tested ability of the mutant flies to phagocytosize bacteria, a main cellular immune defense against the microbes. "The students were able to accomplish a lot during the class, and their work has motivated a new research direction that I hope to follow up on in future biotech classes," Mortimer said.

The second group investigated a very different aspect of immunity, working to develop a new approach to study immune cell function in vitro. Oates, Gloria Alvarado, Tyler Telander, Nick Rhoades, and Brice Jarvis worked to recapitulate the fly cellular immune response from isolated immune cells. "This has been a long-term goal of my lab, and the students made great progress," Mortimer said. One of the students, Oates, who is now a Ph.D. student at the University of Kentucky, spent the summer working in Mortimer's lab to continue this research. "The approach is not quite there yet, but we got closer than any of the previous attempts. I'm very encouraged that we will get it to work," Mortimer said.

To complement these wet-lab approaches, the students were also introduced to protein bioinformatics. Bioinformatics, a new branch of biology that combines math and computer science skills to analyze biological data, is an increasingly important tool in modern biology. The BSC 354 students learned about homology and sequence alignments, identifying putative functional domains, and 3D protein modeling. They were each given a list of proteins to characterize; these proteins are found in the venom of parasites that infect flies and can manipulate host physiology and immunity. "I think that bioinformatics is a very important skill for the students to learn, and the module was designed to be a fun way to get them involved. It wasn't until I was grading the projects that I realized how exciting the results were," Mortimer said. Several of the students continued to work on the project throughout the summer following the end of the semester to help compile the data. "The results gave us a lot of insight into the function of these parasite virulence factors and also into their evolution," Mortimer said. "Their research has provided one of the first in-depth bioinformatic looks into parasite venoms." A manuscript based on these results is currently being prepared for submission to a genomics journal, and the results are also being presented at two scientific conferences—the Midwest *Drosophila* Conference by Waring, and at the International Plant and Animal Genomes Conference by Mortimer.

Along with these outputs, the course also provided hands-on training and good learning experiences for the students. "It is important to me that we prepare our students for careers in biology. I want Illinois State graduates to be ready for positions in the biotech industry or higher education," Mortimer said. "The course was taught so that we can use the techniques we learned to answer and explore our own research questions. It was a great opportunity," said Ashley Waring, now a biotechnology graduate student in Mortimer's lab. "The experience I gained in biotech went a long way in helping me to land my new position," said Josh Larson, now a research associate at Intrexon Corp. in Maryland. "Just the other day I was using the same techniques we learned in class in my job."

"The way the course allowed us to explore outside of our own research labs has allowed me to have a wider background and more easily adapt to new research as a graduate student," Oates said.



Examples of the students' 3D protein models

"After having taken this course and graduated with a bachelor's degree in molecular and cellular biology, I am able to use the skills I learned in lab every day as assay manufacturing specialist at Abbott," Wagner said.

Overall, Mortimer said "the course was a lot of hard work for everyone, but in the end it was definitely worth it."

In memory

Remembering David Rubin

By Craig Gatto

The ISU School of Biological Sciences lost a dear friend and colleague, Professor David Rubin, in 2016 after fighting his battle with cancer for most the year. David joined the faculty in ISU Biology in 2000 as a comparative physiologist and endocrinologist. He was versatile in the classroom and lectured critical courses that contributed to multiple sequences in the school, including Endocrinology, Physiology, Human Development, Evolution, and Fish Biology. His courses appealed to a wide audience and were almost always filled to the maximum seats allowed. David's research focused on parathyroid hormone (PTH) signaling and the expression and regulation of both the ligands (PTH and similar hormones) and their receptor types. PTH is critical in calcium homeostasis and important in bone growth and development. These investigations led to nearly 30 peer-reviewed publications and about three-quarters of a million dollars in extramural funding for David's laboratory. He was a skilled and diligent mentor to his students and successfully mentored 17 students through completion of their theses. Several of these were undergraduates where Rubin led the school in the most completed honors theses. Many of these students have gone on to successfully pursue graduate or professional degrees. His colleagues in the school send our deepest condolences to his wife Janet and two sons Sam and Ethan. He will be profoundly missed by us all.

David Rubin and Katelyn Genenbacher just after she defended her senior thesis

Remembering Dale E. Birkenholz

By Roger C. Anderson

Dale Birkenholz hiking and birding in Arizona

For Dale's eulogy, I am going to draw heavily on an article I wrote for the ParkLands Foundation Newsletter to honor Dale and note his many contributions to ParkLands. In this article, I indicated that Dale was as close to being our own "Aldo Leopold" as anyone I know or knew. In the forward to Leopold's book, A Sand County Almanac, he wrote "There are some who can live without wild things, and some who cannot. These essays are the delights and dilemmas of one who cannot."

When I think back on my 39 years of friendship with Dale I recall a most remarkable person. Like Aldo Leopold, he was one of those persons who could not live without "wild things." Like Leopold he loved nature and did all he could to understand and preserve the natural world and transferred these strong feelings and commitments to others.

Audience at the celebration of Dale's life

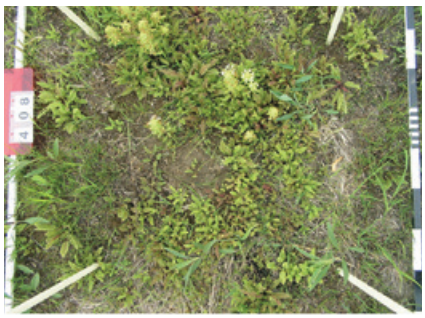
I first met him when I became a professor at Illinois State University in 1976 where he had been on the faculty since 1962. We both taught courses that were related to ecology, and I needed to find field sites where one could take my classes and do research. Dale helped me find them. We visited a diversity of areas including Funks Grove, Weston Cemetery Prairie, Sand Prairie Scrub Oak Nature Preserve,

Continued on Page 4

Borowicz raises funds to examine hemiparasitic effects on prairies

By Amanda Wilson Carter

Vickie Borowicz took advantage of a unique funding opportunity this year to get a research project off the ground. With her collaborator, Steve Juliano, they raised $3,400 on Experiment.com, a crowd-funding platform. Experiment.com utilizes an all-or-nothing form of funding;



Plot sampling at the John English Prairie

if the scientists receive sufficient pledges to reach their grant goals, the project is funded, otherwise no pledges are charged. The advantage of crowd-funding on this platform is that raised grant money goes directly to the scientist, without the overhead fees usually charged by the University (upwards of 50 percent). With their earned funds, the researchers plan to investigate the direct and indirect effect of hemiparasitic plants on prairie communities. Hemiparasites are green plants that tap into the roots of neighboring plants and extract water and minerals from these hosts. Once common, restoration without intense management is challenging. Introducing native parasitic plants may be a tool to reduce aggressive species, and thus to enhance diversity in restored prairies. However, broader effects of hemiparasites on prairies are unknown. The research goal is to evaluate species composition and environmental factors in prairies with native hemiparasites to understand these effects and to provide critical insights to land managers. The funding earned will support a graduate student and undergraduate research assistance over the course of the summer field season.

Vrailas-Mortimer lands an NIH grant to examine mutations related to limb-girdle muscular dystrophies

By Alysia Vrailas-Mortimer

Alysia Vrailas-Mortimer is the recipient of $435,000 grant from the National Institutes Health on "The Role of p38K and Protein Homeostasis in Limb-Girdle Muscular Dystrophies." Limb-Girdle Muscular Dystrophies (LGMD) are caused by mutations in over 30 different genes that result in muscle weakness in the shoulder and hip/leg muscles resulting in impaired movement and potentially the inability to walk. Though so many LGMD genes have been identified, the function of these genes and how they work together to promote muscle health is not well understood. Therefore, Vrailas-Mortimer's lab uses the fruit fly Drosophila melanogaster to help us understand how mutations in the LGMD genes result in muscle weakness and wasting. Many of the genes that cause LGMD are also found in flies and when mutated cause similar symptoms to those observed in people with LGMD. This allows us to test how these genes contribute to LGMD much more easily than in mice or humans. As there is no cure and very limited treatments for LGMD, the Vrailas-Mortimer lab also uses LGMD mutant flies to screen for drug compounds that restore their locomotor functions with the hope that these drugs may someday be used to treat people with LGMD.

Virologist to be hired

By Laura Vogel

The School of Biological Sciences continues to build its reputation for outstanding research programs and to expand its interdisciplinary opportunities for students to be involved in scientific research. This year, we are searching for a new faculty member who specializes in the field of virology. We are seeking a colleague who studies molecular interactions of viruses with their non-human hosts or vectors, including molecular mechanisms of attachment, invasion, replication, persistence, or other virus-host interactions. Our society faces

Remembering *... continued from Page 3*

Breens Woods, Revis Hill Prairie and others. I am a plant ecologist so I knew most of the plants species, but I was amazed to find someone who knew native plants as well as I did and also could identify and knew the natural history of birds, fishes, mammals, and other animals—he was an outstanding naturalist.

He taught the general ecology class, and I taught a course on the ecology and identification of plants. We organized a Saturday joint field trip for the two classes that went to sites in Mason County, Revis Hill Prairie, Sand Prairie Scrub Oak Nature Preserves, and Sand Ridge State Forest. Our students benefitted from Dale's knowledge of natural history, and I benefitted and learned from his unassuming manner. To quote the dictionary: "Some of the most unassuming people are actually the most interesting and powerful of all. They're just decent enough not to display it all the time." And this definition defines Dale.

Dale joined the ParkLands Board in 1978, was president for six years from 1984 to 1992, and was named an Honorary Lifetime Board Director in 2011. He first introduced me to ParkLands in 1978 when he was planting a native prairie community on ParkLands Merwin Preserve, which was our first effort to establish native plant communities on ParkLands. Dale recruited me and Kiwanis Club members to help broadcast seeds of prairie forbs, which he and volunteers had collected locally. The prairie was like most of the restored prairies of the era with a lot of grass and a relatively low abundance of forbs (wildflowers). However, it looked nice when big bluestem and Indian grass reached their maximum height and color in the fall and some of the forbs were in bloom, including stiff goldenrod, New England Aster, and other composites. A later planting, that was carried out by Dale, John English, and me, in the southeast corner of the site had more seeds of prairie forbs and less grass, and it resembles a native prairie more than the earlier planting. The first prescribed burn on ParkLands' property was a burn in the southwest corner of this prairie. Our son John, who was 7 years old at the time, Dale, and I burned the prairie.

Angeleo Capparella speaking at Dale Birkenholz's life celebration

Prior to the planting of the native prairie, ParkLands was not restoring native habitat, but rather wildlife food plots were being established for deer and pheasants, and many non-native trees and shrubs, including the invasive amur honeysuckle and autumn olive, were planted. I asked Dale why were these plantings made, and he said that they planted what they could get from the Illinois Department of Conservation and other sources. Dale lamented that the far northeast corner of the Merwin Preserve was once an open field that he and others would visit in the spring in the evening or early morning to watch and listen to male woodcock peenting, a mating display. The male bird flies high in the sky and makes the peenting sound as they descend to attract females. The site quickly became a forest habitat with honeysuckle understory and non-native trees including tulip poplar, white pine, sweetgum, and river birch, a native species that grows along riverbanks and in wet areas, causing the site to no longer be regularly visited by woodcocks. Today, ParkLands does not do this type of planting on our properties; instead, we now restore native communities, and Dale helped us make this change.

Deer were thought to have been extirpated in Illinois by 1910, and it was a rare experience to see a deer in McLean County in the early in 1960s. Guy Fraker, a Lifetime Honorary Director, made a special effort to see one, and I quote him describing the experience: "In the fall of 1962, I went in before dawn past the bluff to the low ground on the river and sat to watch the day break and hopefully see a deer. Sitting quietly in dawn's light, I shrugged in the chill and a buck snorted about 10 feet behind me. What a thrill!" However, by the late 1980s, it was apparent that white-tailed deer were becoming excessively abundant, even though ParkLands had stopped creating food plots for deer several years earlier. We had great difficulty getting planted tree seedlings to survive. Native wildflowers, seedlings, and small saplings in our wooded areas were being decimated by excessive deer browsing pressure in winter.

In 1994, ParkLands introduced a deer hunting program designed to reduce the size of the deer herd, which involves only killing does. This program was instigated because of damage to ParkLands properties, farmers were complaining because of crop depredation, and there was a high number of deer vehicle collisions on roads adjacent to ParkLands. Dale, like

Leopold, was a hunter and began hunting at an early age, but he was very concerned that the ParkLands membership would be opposed to the hunting program and strongly encouraged that this concern be discussed at our Annual Meeting in 1994 and that we have the membership vote on the deer reduction program. Other board members were also concerned about our membership's reaction to killing deer when our signs at the Merwin Preserve indicated that all plants and animals are protected. However, on pubic field trips, Dale and I had been pointing out the high level of deer damage to native plants. At the Annual Meeting, there was a lively discussion about the deer reduction program, and it appeared that the no votes would dominate. The final tally was 72 "yes" votes for the program and 12 "no" votes. The board had done the right thing in allowing the membership to be involved and expressing its opinions about the deer program. Dale had help move the board in the right direction.

Roger Anderson speaking at Dale Birkenholz's life celebration

ParkLands was a completely volunteer organization until 2002 when we hired our first part-time land steward. We now have a full-time land steward, paid interns, and a part-time administrative director. However, we still strongly need volunteer support, and Dale was one of our most important volunteers, especially before we began to hire people to work for ParkLands. On the Merwin Preserve, he established most of the hiking trails and maintained them by mowing the trails and cutting trees that had fallen over trails. He posted signs, built benches for public use, established bluebird houses in open areas, helped collect and clean seeds of prairie plants, and prepared the Merwin Trail Map. Dale also led numerous public nature walks that included birds and plants. His commitment to public service continued nearly to the end of his life on December 26, 2015. He led the early spring flower walk as late as April of 2014.

One of Dale's greatest assets to ParkLands was his personal treatment of other people. People trusted him and enjoyed being with him, and I can provide you with some examples. When I came to ISU, Ione Rhymer was one of two female faculty members in the Biology Department, and she was not comfortable with all of the faculty, but she liked Dale. To ensure her love for life's simple pleasures could be shared by everyone, Ione Rhymer gave the 15-acre family homestead to Dry Grove Township for the M.J. Rhymer Family Nature Preserve. When ParkLands was asked to help with the Nature Preserve, Dale volunteered to help with the development of the preserve and spent many hours on this project near the end of his life. He was largely responsible for ParkLands obtaining our Bunney (Cecelia Bunney) and Hidden Hills (Frances Woodrum) properties and the largest endowment ParkLands had ever received, the Rhymer Endowment for Woodford County. Dale also personally funded a large endowment for management and restoration of our properties. He was not one of the founders of ParkLands but was a gentle driving force for the growth and development of ParkLands.

And I repeat as I started, he is as close to being our own "Aldo Leopold" as anyone I know or knew.

The 24th North American Prairie Conference hosted by ISU

By Roger C. Anderson

The 24th North American Prairie Conference (2016 NAPC), hosted by The School of Biological Sciences, was held on the Illinois State University campus July 17-21 2016. The motto for the conference, *From Cemetery to National Tallgrass Prairie*, emphasizes that prairies in Illinois range from small remnants in pioneer cemeteries, which have never been plowed and are the best representatives of historic prairie vegetation in Illinois, to landscape scale prairie restorations of thousands of acres, Midewin National Grassland and the Nachusa Grasslands (The Nature Conservancy properties). There is no professional society that organizes the North American Prairie Conference, but rather the conference has been supported by various institutions of higher education. The conferences are typically held biennially, and the 19th, 22nd, and 23rd NAPCs were hosted by the Universities of Wisconsin-Madison, Northern

Continued on Page 6

an ongoing burden of viral diseases such as Zika, Ebola, and HIV, among others where basic research is key to limiting spread and preventing disease. Additionally, this important area of microbiology has provided fundamental insights in genetics and molecular biology which can be applied to other diseases such as cancer. An assistant professor in virology would teach courses including microbiology and virology as well as mentor graduate and undergraduate students in this exciting area of research.

Brockman Alumni Seminar Series in Genetics: Tracy Ivy

By Scott Sakaluk

Tracie Ivy (M.S. '98, Ph.D. '05) gave a seminar entitled "Beetles and Flies: Research at a Small Liberal Arts College" as part of the Alumni Seminar Series

Tracie Ivy with Craig Gatto, Scott Sakulak and Herman Brockman

in Genetics in spring 2016. Tracie is currently an associate professor in the Biology Department at Wofford College. She received her Ph.D. working on the evolution of polyandry in decorated crickets under the supervision of Distinguished Professor Scott Sakaluk. Subsequently, she received an International Postdoctoral Research Fellowship from the National Science Foundation to pursue postdoctoral studies in Switzerland, the first such award to a doctoral student at ISU, and the second NSF grant that Tracie received during her tenure as a doctoral student. Following this post-doctoral fellowship, Tracie took up a second postdoctoral appointment at the University of Rochester, before accepting a faculty position at Wofford College.

Brockman Alumni Seminar Series in Genetics: Glen Borchert

By Erik Larson

Glen Borchert is an invited speaker for the Brockman Alumni Seminar Series in Genetics. Borchert began his scientific career as an undergraduate at the University of Tennessee. In 2006 he earned a Ph.D. in genetics from the University of Iowa, where he contributed to the emerging area of regulatory RNA in the laboratory of Beverly Davidson.

Glen Borchert lunching with graduate students

Upon completing his doctorate, Borchert held two postdoctoral positions, one in the laboratory of Jennifer Doudna at UC Berkeley and the second with Erik Larson at Illinois State University. At Illinois State, Borchert integrated his keen interest in RNA biology with mechanistic studies of mutagenesis and genome biology. He is currently an assistant professor of pharmacology at the University of South Alabama, College of Medicine, and his research program investigates DNA damage and noncoding RNAs. Borchert has received major research grants from the NIH and NSF, and is a 2016 recipient of the Junior Faculty Research Award from the University of South Alabama. Borchert spoke at ISU on October 6, 2016, about his research program.

Graduate student's publication featured on the cover of the *Journal of Experimental Zoology*

By Scott Sakaluk

Meghan S. Strange, M.S. '15, recently published her thesis work in the *Journal of Experimental Zoology* (Strange, M.S., R.M. Bowden, C.F. Thompson, and S.K. Sakaluk. 2016. Pre- and post-natal effects of corticosterone on fitness-related

North American Prairie *... continued from Page 5*

Iowa, and Manitoba, respectively. On a University of Manitoba website, the NAPC is described as having "developed a tradition of excellence in native prairie research, conservation and restoration of one of the world's most productive, yet most endangered, ecosystems." Attendance at the conferences has ranged from 300 to 500, and the 2016 NAPC had 377 in attendance.

"Rainbow Prairie" at Sugar Grove Prairie in Funks Grove. Photograph by Robert Shaw, Wild Perceptions

The 24th NAPC consisted of field trips, contributed oral presentations, posters, breakout discussion groups, plenary speakers, and two Invited oral presentation sessions on landscape scale restorations and grassland birds. Most presenters were from the Midwest, but some were from other areas including Arizona, Delaware, Louisiana, Massachusetts, Oklahoma, and Ontario. A wide range of topics were considered including prairie restorations and reconstructions, fire effects on grassland birds, prairie insects, and other invertebrates, management methods including patch burn grazing, fire season and frequency, prairie mutualists and parasites, pollination, urban prairies, and seeds of prairie plants. The field trip sites included The Nature Conservancy's Nachusa Grassland and the U.S. Forest Service's Midewin National Tallgrass Prairie. These sites were of special interest to this year's conference attendees because they have good quality prairie and recently introduced bison. These introductions mark the first time in the past 200 years that wild bison herds have roamed east of the Mississippi River.

Several faculty members in the School of Biological Sciences assisted with the conference including Charles Thompson and Scott Sakulak who evaluated the suitability of all poster and oral paper presentations for inclusion in the conference. Vickie Borowicz and Diane Byers presented oral papers at the conference and also organized a discussion group on "Managing the Belowground Ecosystem-Prairie Mutualist and Parasites." Angelo Capparella helped edit the conference program and assisted with the Nachusa Grassland field trip. Roger Anderson presented an oral paper, helped lead a field at the ParkLands Foundation's savannas at the Merwin Preserve, and chaired the steering committee. All of these faculty served on the 24th NAPC Steering Committee. Two graduate students, Morgan Walder and Robert W. Phillips presented posters, whose major professors are Borowicz and Byers respectively.

Craig Gatto, director of the School of Biological Sciences, provided support for the conference. Other conference support came from ISU Conferences Services (Tracy Oakley), John Baur, associate vice president for Research and Graduate Studies, provided financial support, and ISU President Larry Dietz welcomed the conference attendees to our campus.

Our conference website is still up (nap2016.IllinoisState.edu/), and you can see more information about the conference on the website.

Report from the Biological Sciences Student Association

By Jennifer Woodworth, President of BSSA

The Biological Sciences Student Association (BSSA) is a student-led organization that provides a social and educational network for students in the School of Biological Sciences. BSSA is open to all students either majoring or minoring in biology. Our organization's mission is to provide students with information about events and research within the department. We also strive to help members play an integrative role as biology students both on campus and within the community. One of our primary objectives is to encourage students to participate in undergraduate research here at ISU. Our meetings often consist of lab tours within the Science Lab Building, in which members get the opportunity to learn about professors' research at Illinois State, as well as observe the various labs in SLB. We also like to provide our members with opportunities to get involved beyond campus. This semester, BSSA participated in several community projects and programs such as volunteering at

Normal's community garden, the Ecology Action Center, and Salvation Army's after-school program. However, one of our proudest accomplishments in fall 2016 was hosting the first annual BSSA Research Symposium in November. With over 25 research posters and several awards for best poster presentation, the symposium was a great success.

BSSA officers and students at the first undergraduate research symposium 2016

The social aspect of BSSA allows students to form connections with peers within their major, form study groups, and encourage one another to participate in activities outside of their classes. Our goal is to make BSSA a useful and fun resource for students looking to make the most of their experience as a biology student here at ISU.

New science-related student organization on campus–Collaborative Science Initiative

By Mary Fischer

We are proud to introduce a new research-based student organization to Illinois State University called the Collaborative Science Initiative (CSI), which was initiated by molecular and cellular biology major Mary Fischer in Professor Nathan T. Mortimer's lab. In addition, Jacob Walker (biochemistry), Seth Breaker (molecular and cellular biology), Karlee Burns (chemistry), and Eileen Whitemiller (zoology) have been instrumental in organizing, promoting, and running CSI in a truly collaborative effort.

CSI provides the unique opportunity for students from all science disciplines to share their research as well as collaborate with other students. This gives students the opportunity to learn about research in various STEM fields and how integrating different points of view can enhance their own research projects. As a major part of research within science and technology revolves around peer collaboration, evaluation, and interdisciplinary corroboration, CSI has organized a research seminar series held bimonthly during the school year. During these seminars individuals present their research and receive feedback on their presentation, as well as answer questions on their project. This format allows for a multi-faceted evaluation of an individual's research with the end result of a better project. For the fall 2016 semester we had fantastic presentations from students working in biology, chemistry, and physics.

The goal of CSI is for undergraduate student researchers to critically think about their own research and to prepare them for the types of situations that they will face after graduation such as interviews for jobs and/or professional/graduate school programs. The hope is that this will prepare current students to be better scientists not only while they are at Illinois State University but also in their respective fields. If you would like to learn more about CSI, please contact Mary Fischer at mfische@IllinoisState.edu.

Bittersweet goodbye to Amrita Puri

By Rebekka Darner Gougis

Amrita Puri joined ISU's Department of Psychology in 2015, with a joint appointment in the School of Biological Sciences. Mita's research expertise is visual perception and cognition, and multisensory integration. In her short time at ISU, she has authored eight publications and taught a graduate seminar in cognitive neuroscience taken by several of our graduate students. During this time, she and her partner, who holds a tenure-track position at the University of Central Arkansas, have been living apart. UCA has offered Mita a tenure-track position, so although we are sad to see her go, we are happy that they have found a solution to the long distance. It has been a true pleasure to have Mita as a colleague during her short time here.

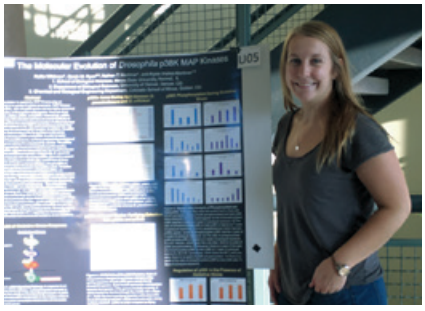
traits and the timing of endogenous corticosterone production in a songbird. J. Exp. Zool. 325A: 347-359). Her study was featured on the journal's cover, with a photograph of her study species, the house wren. Strange tested two hypotheses concerning the fitness-related consequences of experimentally elevated corticosterone (the avian 'stress' hormone) during pre- and post-natal development in house wrens. She also documented the ontogeny of the stress response in nestlings. Her results demonstrate that pre-natal exposure in the egg to maternally derived corticosterone is important in shaping offspring phenotype and has long-term, fitness-related effects.

Strange's study species, the house wren, featured on the cover of *Journal of Experimental Zoology*

Kaitie Wildman receives the Borst Scholarship

By Alysia Vrailas-Mortimer

Kaitie Wildman was the recipient of the 2016 Dr. David W. Borst, Jr. Memorial Endowed Scholarship, which is awarded to an academically outstanding undergraduate student who is also performing research with a faculty mentor. Wildman is a junior biology major and is mentored by Alysia Vrailas-Mortimer and Nathan T. Mortimer on her research project "Regulation of aging and toxin exposure by stress-response



Kaitie Wildman presents her research at the Biological Sciences student Association Research Symposium in November 2016

Continued on Page 8

Wildman *... continued from Page 7*

genes." Wildman is using a combination of bioinformatics, genetics and molecular biology to understand how the stress-response gene p38 MAPK is regulated during times of stress such as aging and exposure to pesticides. She has recently presented her work at the Midwest Drosophila Conference poster session in November and will be giving a talk for the School of Biological Sciences Integrative Biology Seminar series in the spring 2017 semester.

Student Awards

Tak Cheung/Joni St. John General Education 101 Teaching Assistant Awards:
Taylor Joray
Tyler Telander
Morgan Walder
Beth Weber

101 Outstanding Lecture Instructor
Andrew McDevitt

Outstanding Biology Teaching Assistants In memory of Robert and Marion Finn
M.S.–Andrew McDevitt
Ph.D.–Kristin Duffield

Phi Sigma Outstanding M.S. Award
Andrew McDevitt

Phi Sigma Outstanding Ph.D. Award
Amanda Wilson Carter

Charlena Wallen Award
Rachel Mandes

Jack Ward Service Award
Kevin Stanley

Cheung/Brown Publication Award
Suranjana Sen

Robert Gray Ecology Scholarship
Geoff Ower

Rilett Scholarship Awards:
Gloria Alvarado
Alexandra Berroyer
Marissa Cruz
Margaret DeMaegd
Christopher Goldsmith
Andrew McDevitt
Morgan Walder
Jamie Young
Borst Scholarship
Kaitie Wildman

50th Anniversary of our Phi Sigma Biological Sciences Honor Society chapter

By Beth Weber, 2016-2017 president of Phi Sigma Biological Sciences Honor Society, Beta Lambda Chapter

The Phi Sigma Biological Honor Society is a nationally recognized academic organization promoting both academic and research excellence in the field of biological sciences. As the Beta Lambda chapter at Illinois State University, we recognize those who have excelled academically for both graduate and undergraduate (of junior or senior standing) students. Our chapter was founded in 1966 and is still going strong after 50 years of student researchers being involved!

Michael Kavanaugh of University of Montana was the keynote speaker for the 2016 Phi Sigma Research Symposium

The board consists of six graduate students dedicated to the continued excellence of biology in our department and beyond, as well as two faculty advisors to help us achieve this goal. Over the past two years (2015 and 2016), there were 24 newly initiated students, 10 undergraduate and 14 graduate students. Along with maintaining academic success, we strive for our members to achieve with their research as well. We aim to aid in our student-members' success by offering both grants and fellowships on a yearly basis with the expectation they will demonstrate their progress in their research to the department and/or the scientific community within the following year.

During the 2015-2016 year, Phi Sigma made a push for members to become more involved and collaborative within the department. The goal of the current board is to continue this tradition and help foster relations. Phi Sigma sponsors a potluck toward the start of the fall semester to ensure that new and returning graduate students have the chance to mingle with each other and faculty in a low-pressure environment and become accustomed to their new academic home. This is also a time for new students to learn about Phi Sigma and the opportunities offered by our Beta Lambda chapter. This is later followed by an end-of-semester get-together to celebrate a great semester and formally induct new members to the chapter.

Yearly, our Beta Lambda chapter offers competitive grants to our members for internal funding of their research projects. This allows members the opportunity to gain experience in the completion of grant writing for use in scientific research in a true competition where awards are based on the merit of their grants. In the 2015-2016 year, Phi Sigma provided over $10,000 in grant funding for 18 proposals. On top of these grants, Phi Sigma offered fellowships for two M.S. and one Ph.D. student over the summer. The E.L. Mockford and C.F. Thompson Summer Research Fellowships are competitively awarded assistantships for a full-summer salary, supplying winners the fiscal opportunity to solely conduct degree-related research throughout the summer. The three summer 2015 receivers of this fellowship have authored two manuscripts, one in *Hormones and Behavior*, the other in *Evolutionary Biology*, as well as co-authored a manuscript in the *Journal of Zoology*.

Phi Sigma also helps sponsor the weekly seminar series in the Biological Sciences Department, where speakers from across the country, as well as international faculty, are invited to Illinois State to present recent developments in their research. This weekly seminar aims to expand the perspectives of both students and faculty in our department by inviting speakers that either cover a topic of research similar to that of the lab who invited the speaker or speakers who are completely distinct from any research occurring within the department but have the potential fostering for collaboration, future direction, or even exposing students to areas of research that can be attained. Regardless of the seminar topic, it provides a wide range of research interests to bring together our department on a weekly basis for scientific discussion (always followed by adult beverages).

Phi Sigma also hosts and sponsors an annual Research Symposium in the spring, which was successfully held for the 17th consecutive year in 2016. This has become an event greatly looked forward to by faculty and students alike, and we hope to continue this tradition through many milestone years. We give students at ISU a chance to showcase their research with both oral and poster presentations. The 2015-2016 Phi Sigma board did a phenomenal job of expanding the symposium to diversify the research presented and strengthen relations

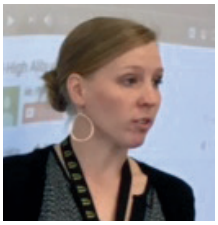
with other biology departments through reaching out and securing presenters from surrounding high schools and colleges. These included Clayton High School, Western Illinois University, and Eastern Illinois University. The 2016-2017 board hopes to continue this effort, as well as expand upon the undergraduate involvement in the symposium.

Each year, internal judges assess the different presentations and award travel grants for the winning presenters at the Research Symposium. The entire day, open to the public, is concluded with a keynote speaker. In 2016, the well-known biochemist and biophysicist Michael Kavanaugh of the University of Montana was the keynote speaker. Kavanaugh presented an enlightening talk on the structural and functional properties of glutamate transport (both membrane bound transporters and channels), which is the primary neurotransmitter involved in mediating excitatory response in neurological pathways of the brain. For 2017, we look forward to a keynote address by Marcella J Kelly of the Department of Fish and Wildlife Conservation at Virginia Tech. Kelly's research focuses on using cutting-edge technology to promote conservation of wildlife species, specifically large cats, through population dynamics focused in an ecological context.

Finishing the school year off strong, Phi Sigma will hold its annual Spring Banquet. An event we host for new member initiation, new board recognition, and a plethora of awards being given for everything from top TA to thank-you awards to faculty expressing appreciation for their investments to departmental improvements. This is a thank you to the entire department: faculty, students, and staff, for another successful year at ISU in the biological sciences. Phi Sigma would like to extend its gratitude for all those current and former members involved in the process of promoting research and academic success. We thank those alumni who have been involved in our traditions and appreciate all they have done, congratulate their success, and look forward to their many future accomplishments.

Mickayla Van Hoveln, (BS, Biology '08, M.S., Biology '10)

Dr. Lucas Armstrong (B.S., Exercise Science '99)



Maggy Proctor (BS, Biology '09, M.A., Education '14)

Todd Katz (B.S., Biology '01)

Distinguished Alumni with their former mentors, Craig Gatto (top left), Rachel Bowden (bottom Left), and Cynthia Moore (bottom middle)

Mickayla Van Hoveln with her former thesis advisor, Vickie Borowicz

Distinguished Alumni visit during Homecoming

By Amanda Wilson Carter

During Homecoming Week, the School hosted a career panel comprised of four distinguished alumni: Mickayla Van Hoveln, Dr. Lucas Armstrong, Maggy Proctor, and Todd Katz. The alumni presented descriptions of their career paths to inform students of the

Continued on Page 10

Undergraduate Researcher
Katelyn Genenbacher

Undergraduate Service Award
Vicki Baran

Undergraduate Teaching Assistant
Bradley Jones

Barb Bathe Award
Christina Jester

Jennifer Grog Student Teaching Award
Zuzana Sulcova

Andrew McDevitt receiving one of his awards from Kevin Stanley

Bradley Jones and Margaret Parker

Kaitie Wildman receiving her Borst Scholarship from Kevin Stanley

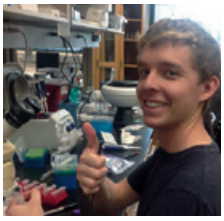
Suranja Sen with her Cheung/ Brown Publication Award

Morgan Walder receiving one of her awards from Kevin Stanley

Graduate of the Vidal-Gadea lab goes to Switzerland to study medicine

By Andrés Vidal-Gadea

Lucas Barickman joined the Vidal-Gadea lab upon inception in January 2015. Over the following year and a half he was an invaluable member of the lab. He used his carpentry skills to build dark rooms and magnetic coils systems and even taught himself how to 3D print in order to manufacture specialized lab equipment. Ever a fearless and positive presence in the lab, Barickman learned immunohistochemistry and went on to make valuable contributions to diverse projects. Most importantly, Barickman discovered the presence of magnetic particles near magnetosensory neuron of the nematode worm *C . elegans*—a milestone in the lab's magnetic orientation project. He also contributed to a project investigating cures for muscular dystrophy: He showed a surprising accumulation of actin filaments in the muscles of worms cured of the disease. Always kind, helpful, and respectful, Barickman helped run a high-school summer boot-camp in Vidal-Gadea's lab where 14 students from across the nation learned and conducted molecular research. Barickman graduated in the spring and is presently in Switzerland to attend medical training. We could not imagine another doctor that we would rather have.



Lucas Barickman graduated in spring 2016 and is now in Switzerland for medical training

Graduate student presents at the 16th Congress of the International Society for Behavioral Ecology

Kristin Duffield presented a portion of her dissertation research in an oral presentation entitled "A dynamic terminal investment threshold in male cricket calling effort" at the 16th Congress of the International Society for Behavioral

Distinguished Alumni *... continued from Page 9*

diversity of employment opportunities available to biology graduates. After earning her master's with Professor Borowicz at ISU, Van Hoveln interned at Monsanto and has worked in several positions throughout the corporation. Presently, she is the varietal crop support lead on projects globally.

Armstrong earned his bachelor's degree at ISU and conducted undergraduate research in Professor Gatto's lab. He returned to Bloomington after medical school and is currently employed as an orthopedic surgeon at McLean County Orthopedics.

Proctor earned her bachelor's degree in biology, teacher education track, and her master's degree in education at ISU. Currently, Proctor is a teacher at University High School where she mentors aspiring teachers who are earning their degrees at ISU.

Katz earned his bachelor's at ISU in biology, teacher education track. He is currently a biology and AP environmental science teacher at Whitney Young Magnet High School in Chicago and recently won the prestigious Golden Apple Award. The alumni were honored with a University-wide luncheon and invited to participate in all Homecoming weekend festivities.

Would you like to return to ISU for Homecoming 2017 and participate in our school's alumni event? If so, please email Diane Byers at dlbyers@IllinoisState.edu to let us know of your interest.

Graduate student research: Joseph Neale

By Joseph Neale

Many of the most effective mosquito control efforts attempt to lower population sizes by killing the aquatic larvae, often with the use of larvicides. However, under certain circumstances, applying mortality to an animal population can produce counterintuitive results, sometimes leading to a population size that is equal to or even greater than the size that would have existed without the applied mortality. This phenomenon is called compensatory mortality, and it occurs with populations that exhibit a highly negative density-dependence, meaning their size and growth rates are regulated by factors that become more intense as the population size increases. A common density-dependent factor is competition for food, where a larger population leads to more competition and an increase in deaths due to starvation. If a proportion of the population is removed by an external source of mortality such as a larvicide, it could lead to no difference in population size over time (compensation) if the larvicide simply removed individuals that would have otherwise starved to death, or it could lead to an increase in population size (overcompensation) if the remaining individuals perform better due to lower food competition.

Joey Neale in Vero Beach, Florida, collecting water from a tree hole, hoping it will contain midge larvae for use as predators in one of his experiments

While compensatory mortality has been demonstrated in laboratory and field studies, the mechanisms behind it remain unclear, and my work aims to elucidate the conditions under which it can occur in four container-dwelling mosquito species. I am attempting to determine what level of external mortality will induce compensation/overcompensation by manually removing different proportions of larvae and rearing the remaining "survivors" to adulthood. My next step will be to expose mosquito larvae to various predators to test for compensatory mortality. These studies will provide a better understanding of a phenomenon that affects a variety of taxa, as well as provide insight for more effective mosquito control efforts.

Graduate student research: Gloria Alvarado

By Gloria Alvarado

In order to preserve the integrity of their genomes, all organisms have developed strategies for correcting DNA damage. If damaged DNA is not repaired, it leads to mutagenesis, which could eventually lead to disease. My project seeks to understand how one type of DNA repair, base excision repair (BER), functions within certain common repeat sequences, commonly found in multicellular eukaryotes. In BER there are many enzymes termed glycosylases that act on DNA base lesions and initiate the repair pathway by removing the damaged base and leaving an abasic site. Uracil found in DNA is one of the most common forms of DNA damage and is repaired through BER with the help of uracil glycosylases. Our genome contains thousands of sequence motifs with tandem repeats of guanine that support the formation of four-stranded DNA structures called G-quadruplex (G4). These structures are highly thermostable and have been shown to be mutagenic but have been retained to help regulate gene expression. I want to know how well uracil is repaired around these G4 structures. Using synthetic oligonucleotides containing a single uracil and designed to form G4, I tested the activity of two major human uracil glycosylases SMUG1 and UDG. I found that there is a dramatic reduction of activity of both SMUG1 and UDG directly adjacent to a G4 structure with a gradual recovery seen the further from G4 the uracil is placed. I intend to follow up on these findings by testing whether the uracil glycosylases can recognize the damage but cannot remove it or if they fail to recognize it all together. I will be showcasing my work on March 8, 2017, during the spring 2017 MCB seminar.

Gloria in her natural environment—a room full of gel boxes

Graduate student research: Kristen Duffield

By Kristen Duffield

The aim of my research is to understand changes in life-history investment when survival is threatened. Specifically, I assessed how decorated cricket males (*Gryllodes sigillatus*) from distinct ages (young and old) manage an investment trade-off between reproductive effort and immune function following the administration of an immune challenge that represents an infection-related survival threat. Five treatments on an increasing spectrum of infection intensity enabled a high-resolution analysis of investment and its context dependence. I analyzed reproductive effort as the time spent performing an acoustic sexual signal and immune function through hemocyte counts and antibacterial lysozyme-like activity.

I found that unmanipulated young males spent more time calling relative to other treatments, while old males called more at high-infection cue doses. These results reveal that calling effort in *G. sigillatus* is dependent on the magnitude of the perceived survival threat but varies according to the intrinsic factor of an individual's age. Immune assays are currently underway for this experiment. To complement these results in males, I am conducting a similar assessment in female *G. sigillatus* by quantifying egg production across age classes following a spectrum of infection-cue treatments. These studies are important contributions to our understanding of life-history strategies and their evolution.

Kristin Duffield presented research from her dissertation during the 16th congress of the International Society for Behavioral Ecology in Exeter, UK

Ecology held this past July in Exeter, U.K. Duffield's dissertation research is co-advised by Ben Sadd and Scott Sakaluk.

From left: two former post-docs from the Sakulak lab, Susan Gershaman (now at The Ohio State University at Marion) and Craig Barnett (now at Kyoto University), Scott Sakulak, and Kristin Duffield enjoying refreshments at a venerable old English pub.

Student Notables

Borowicz Lab

Morgan Walder presented a poster this summer entitled "Take-over on the tallgrass prairie: How *Lespedeza cuneata* establishes dominance" at the Botanical Society of America meeting in Savannah, Georgia, and the North American Prairie Conference, held at ISU.

Bowden Lab

Student-led publications (*indicates student in the lab)

Carter*, A. W., R. T. Paitz, K. E. McGhee, and R. M. Bowden. 2016. Turtle hatchlings show behavioral types that are robust to developmental manipulations. *Physiology & Behavior* 155:46-55.

Treidel*, L. A., A. W. Carter*, and R. M. Bowden. 2016. Temperature experienced during incubation affects antioxidant capacity but not oxidative damage in hatchling red-eared slider turtles (*Trachemys scripta elegans). Journal of Experimental Biology* 219:561-570.

Student presentations

Amanda Wilson Carter (Ph.D. candidate) presented "Can yolk estrogens affect sex determination when incubation temperatures fluctuate in a species with TSD?" (Carter, AW, Bowden, RM, and Paitz, RT) at the Society for Integrative and Comparative Biology meeting in Portland, Oregon, (January 2016). She also presented "Can yolk estrogens compound conservation concerns of reptiles?" (Carter, AW, Bowden, RM,

Continued on Page 12

Student presentations *... continued from Page 11*

and Paitz, RT) at the Illinois Lakes Management Association Annual Meeting in Springfield (2016).

Haley Nichols (undergraduate) presented "Seasonal variation in the production of behavioral ty es in Trachemys scripta" (Nichols, H, Carter AW, and Bowden, RM) at the Animal Behavior Conference at Indiana University in Bloomington, Indiana, (March 2016).

Byers Lab

Robert Philips (M.S. student) presented a poster "Competitive ability of *Chamaecrista fasciculata* from sand vs. tallgrass prairies" at the Botany 2016 meeting in Savannah, Georgia. He also presented this poster at the North American Prairie Conference in Normal.

Student awards and grants

Amanda Wilson Carter (Ph.D. candidate) received a research grant from the American Society of Ichthyology and Herpetology. She was also named Ph.D. student of the year for the School of Biological Sciences, which will be awarded to her at the 2017 Spring Banquet.

Haley Nichols (undergraduate) won third place for undergraduate presentations at the Animal Behavior Conference at Indiana University in Bloomington, Indiana, (March 2016).

Casto Lab

Cody Scholtens (M.S. student) received a grant-in-aid of research from Sigma Xi, the scientific research society. He received this funding for his grant proposal titled "Mesolimbic dopamine, and its role in social behavior."

Aderinsola Odetunde (M.S. student) received a research grant from the Illinois Ornithological Society (IOS) for her grant proposal titled "Effects of blood loss and mite infestation on nestling developmental trade-offs and parental provisioning." In addition to the grant funding, she has been invited to write an article related to her research for the quarterly journal of the IOS, *Meadowlark*.

Undergraduate student research: Amanda Klingler

By Amanda Klingler

> *"In the end, we will conserve only what we love, we will love only what we understand, and we will understand only what we are taught."*—Baba Dioum

These words embody my passion for conservation and science education and are the driving force behind everything I do, including my decision to participate in my current research. I am an undergraduate freshman majoring in zoology. I am conducting research on the instructional activities completed by biology majors in our school's evolution course. As part of this project, I am evaluating the students' written work and identifying scientific conceptions and misconceptions, as well as the patterns of conceptual change that take place throughout the course. Ultimately, my analysis will help to determine whether the instructional methods used in this course were effective in helping students understand evolution accurately, including overcoming common misconceptions about how evolutionary mechanisms apply to human evolution. An accurate understanding of evolution is vital to being a practicing biologist. Identifying misconceptions students hold when entering an evolution course will help better structure those courses to meet the students where they are at and increase instructional effectiveness.

My interest in this research stems for my past work and my career goals. I have always had an interest in the misconceptions people have regarding science in general, and evolution is the Holy Grail. Over the past four years I have been working in conservation education at Brookfield Zoo both as a volunteer and intern. My goal is to complete the zoology and conservation biology sequences and eventually pursue a master's degree in education. I want to spend my career working for an organization such as a zoo in conservation education.

Undergraduate student research: Darren Will

By Darren Will

Darren Will at his wren study site

I recently graduated from ISU in December with a Bachelor of Science in biology, with a zoology concentration. For my honors senior thesis, I performed an experimental study on the behavioral plasticity of provisioning by house wrens (*Troglodytes aedon*) within the avian ecology lab of Charlie Thompson and Scott Sakaluk. I compared provisioning (the procurement and delivery of food items to 4- or 5-day-old nestlings) between nest boxes with standard-sized entrances and those with experimentally enlarged entrance holes. Data were collected during the field season of 2015 and involved videotaping parental provisioning at the two types of nest cavity treatments. Previous research had shown that nestboxes with large entrances are less desirable as nesting sites, presumably because of an increased threat of nest depredation, as they are settled later than standard-entrance boxes, and it takes longer for males to obtain mates at the large-entrance boxes. This suggests that the males at these sites are less attractive to females. Therefore, I predicted that males at boxes that had large entrances would invest more in parental care (i.e., those that succeeded in finding a mate would provision their offspring at a higher rate) than males at nestboxes with standard entrances because this increased parental investment would offset the disadvantage of nesting in large-entrance boxes. As predicted, I found that males at large-entrance boxes provisioned at higher rates than males at the standard-entrance boxes. Thus, males at large-hole boxes likely perceive themselves as less attractive, and in consequence, they increase their parental provisioning in response to having fewer opportunities for reproductive success. The associated manuscript has been published in the *Journal of Zoology*.

Being interested in a multiplicity of biological areas, I am looking to continue graduate-level education. In the meantime, I am applying for work in laboratory positions. I hope to conduct interdisciplinary research in translational science, centered on immunology and

regenerative medicine. My goal is to understand the underlying mechanisms of immune function, including the role of neuroendocrine modulation in immune responses. I have an interest in autoimmunological connective tissue disease, as well as engineering solutions to restore or replace damaged tissue.

Undergraduate student research: Pravleen Bains

By Pravleen Bains

Pravleen Bains from the Vogel lab completed the STEP-UP research program at the National Institute of Diabetes and Digestive and Kidney Diseases

I have been actively involved with research at ISU in the lab of Laura Vogel for the past two and half years working on my senior thesis on aging and antibody production. Last summer I had the opportunity to be involved with the STEP-UP research program through the National Institution of Health, specifically through the National Institute of Diabetes and Digestive and Kidney Diseases. The goal of this program is to allow students to choose from 200 different research institutions throughout the nation where they have the opportunity to conduct various types of research. I chose to go to Yale University and conduct research under Peter Aronson. Not only was I exposed to nine weeks full of rigorous research, but I also attended Renal Rounds and multiple mentor lectures where different principal investigators would share their research with the students in the program. I personally enjoyed Renal Rounds so much, that every week I would look forward to Friday mornings. Each week we were visited by well-respected speakers from medicine who would discuss their ideas and stir up intellectual conversation between the audience and the presenter.

Aronson's lab focuses on roles of genes in the kidney. I focused on the Ksp-Cadherin protein. Cadherin proteins are involved in cell-cell adhesion and tissue development. Cadherin-16 or Ksp-cadherin is a kidney-specific cadherin of unknown function. Two other proteins of significance are NHE3 and A6. NHE3 is a sodium/hydrogen exchanger that mediates reabsorption of sodium and bicarbonate in the proximal tubule. A6 mediates oxalate exchanger in the proximal tubule. Previous work in Aronson's lab found increased protein expression of NHE3 and SLC26A6 in Ksp-cadherin knockout (KO) mice.

Thus, in Aronson's laboratory, I explored two main questions 1) Does Ksp-cadherin KO cause a change in the levels of NHE3 and SLC26A6 proteins at the transcriptional level (mRNA alterations)? 2) Does acidosis upregulate mRNA encoding these transporters, while the effect is modified by knockout of Ksp-cadherin? We were interested in determining the function of Ksp-cadherin. With that information, we could test more transporters to see if Ksp-cadherin only affects acid-based transporters or if it has more of a global function in the kidney. I presented my research at NIH headquarters in front my fellow scholars and judges. Presenting my research was very nerve-wracking since I knew a lot of the judges were successful doctors themselves and were required to ask challenging questions. I was able to successfully answer the questions that were asked and able to go into detail of my project with confidence. I have learned so much this summer. I have grown not only as a student but as a scientist. I immersed myself in a rigorous lab and even though at first I doubted my abilities, I am beyond happy that I could get past my insecurities and thrive. This experience has brought new confidence to my project working with Professor Vogel in my home lab at ISU. I plan on re-applying to this program as a second-year fellow and hopefully will be able to conduct research for NASA this upcoming summer.

Gatto Lab

Kevin Stanley has had his first manuscript from his dissertation work accepted in the *Biophysical Journal*. It was chosen for a "New & Notable" article in the issue.

Gougis Lab

Andrew McDevitt (M.S. student) presented "Self-determination theory as a lens for promoting scientific identity and retention: A pilot study" at the 2016 Annual Meeting for the National Association for Research in Science Teaching in Baltimore. McDevitt graduated in spring 2016 and is now pursuing his Ph.D. in biology and the University of Colorado-Denver.

Janet Stomberg (M.S. student) co-authored the poster "How do science graduate students benefit from conducting educational research?" at the 2016 Annual Meeting for the National Association for Research in Science Teaching. Stomberg graduated in summer 2016 and is now teaching biology at Illinois College.

Kara Baldwin (Ph.D. student) presented "Noyce teacher candidates: Initial pedagogical orientations towards science teaching" at the 2016 Noyce Summit in Washington, DC.

Hammond Lab

Tejas Patel received the Robert G. Bone Scholarship, which is the highest university-wide honor given to undergraduate students. Patel was also a co-author on a manuscript published in the August issue of the *Genetics Society of American* journal, *G3,* entitled "A meiotic drive element in the maize pathogen *Fusarium verticillioides* is located within a 102-kb region of chromosome V." Patel is currently applying to medical schools.

Larson Lab

Rob Larson (M.S. student) will be attending the Chicago College of Osteopathic Medicine at Midwestern University in the fall of 2017.

Mortimer Lab

Ashley Waring (M.S. student) presented the poster "Bioinformatic Analysis of Parasitoid Wasp Venom" at the recent

Continued on Page 14

Mortimer Lab *... continued from Page 13*

Midwest *Drosophila* Conference in Monticello. This work was based on research conducted in the BSC 354 Biotech 2 laboratory course in spring 2016 (see cover story).

Josh Hill (M.S. student) presented the poster "A *Drosophila* Model of Bacteremia," based on his research characterizing bacterial infections in *Drosophila melanogaster,* at the Midwest *Drosophila* Conference.

Jordann Trainor (undergraduate) presented the poster "Characterization of *Asobara sicarius,* a Novel *Drosophila*-infecting Parasitic Wasp," which summarized her research into this new parasite species at the Midwest *Drosophila* Conference.

Brooklynne Thielen and Xavier Hernandez (undergraduates) also presented a poster based on their research into autoimmunity entitled "Modelling Autoimmune Disorders in Drosophila: A Genetic Modifier Screen" at the Midwest *Drosophila* Conference.

Xavier Hernandez received a Student Travel Award from the Council on Undergraduate Research to support his attendance to the Midwest *Drosophila* Conference.

Undergraduate students **Mary Fischer** and **Victoria DeMichel** contributed to the presented work and are co-authors on the presentation "Autoimmunity and Immune Recognition in the Drosophila melanogaster tuSz Mutant," which Mortimer presented at the 2016 North American Comparative Immunology Workshop in Charlottetown, Canada.

Pooja Kadaba Ranganath (M.S. student) was awarded the Gold Medal as top student in immunology from her undergraduate university, the PES Institute of Technology.

Puri Lab

Sarah Caputo (undergraduate) presented "State Anxiety and Perception of Average Emotion in Groups of Faces" at the Vision Science Society meeting.

Master's students **Alex Dayer** and **Kassandra Lee** co-presented their poster "Does Holistic Crowding of Faces Depend on Task Demands?" at the Vision Science

A snapshot of *Discovery Academy*, a middle school STEM camp funded by ISU's Noyce Scholarship Program

By Kara Baldwin, Noyce Graduate Assistant

On a hot and steamy June day, laughter and shouts abound. On this particular day, 60 middle school students (6-8th graders), 15 undergraduate interns, a graduate student, a school teacher, and a biology professor walk through a stream near Bolingbrook High School in Bolingbrook. Lily Cache Creek, an urban waterway, with plenty of urban problems: plastic grocery bags, car parts, and decomposing Flaming Hot Cheeto bags. However, on this day, the goal went beyond these surface observations, instead focusing on the macroinvertebrates that call Lily Cache Creek home.

With kick nets, buckets, plastic bags, and glass vials, middle schoolers walked along the creek, making observations about the riparian areas and predicting the health of the stream. Then, it was time to enter the water. Most middle schoolers jumped right in, wading through the shallow creek, placing aquatic insect nets, and kicking up the benthic layer (as shown by their instructor). A cloud of silt and sand entered their nets. As they picked up the net carefully, the students looked for small invertebrates wiggling on the netting. When a creature is found, the students plucked up the writhing creatures and placed them in a clear dishpan on the creek bank. Other students, wanting to stay dry, labeled glass vials and filled them full of water to test back at the school.

"What's that?!" one student yelled, as the teacher walked slowly through the stream toward them.

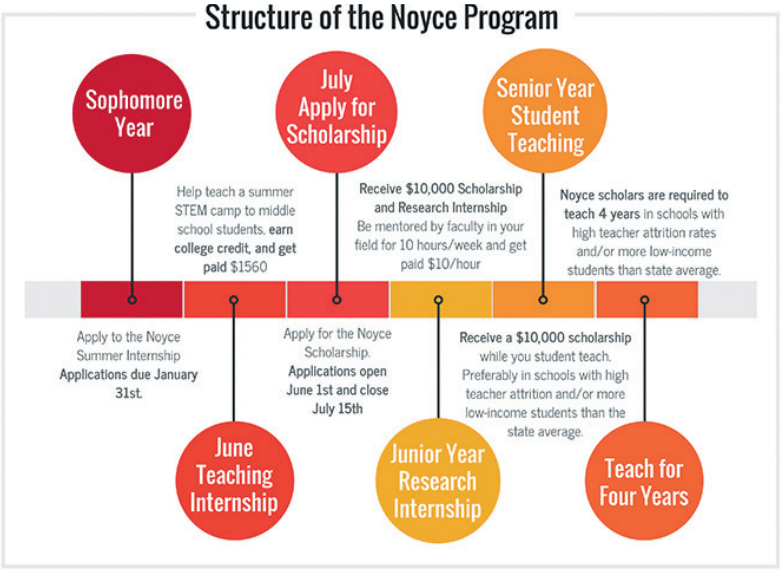
"A leech," the teacher responded.

"EEW, WE FOUND A LEECH!" the middle schooler yelled, as others nearby walked toward the net. With some encouragement, the student quickly placed the leech in the bucket along the stream bank.

Some students became preoccupied as they attempted to catch a frog. A different group caught a toad, showing it off to the other students with excitement and smiles. The toad was given a name, "Teddy," and released back near the stream safely away from curious students. After exploring, all the participants are pulled out of the water, old saturated sneakers squish water out with every step on dry land.

The participants gather around their buckets to identify their findings: sow bugs, snails, crayfish, and other macro-invertebrates. They circle diagrams on their data sheets, finish writing observations in their journals, and continue their hike along the river to lunch. Later, these participants, with the help of their teacher-interns, will calculate the biotic index and test water samples in order to determine the relative health of the stream.

This was just one snapshot from the two-week Science, Technology, Engineering, and Math (STEM) camp entitled Discovery Academy. This National Science Foundation grant-funded program prepares pre-service STEM teachers for teaching in communities that have high poverty or teacher attrition. Toward this goal, the grant funds Discovery Academy to provide a training ground for these pre-service teachers, in addition to encouraging middle school students to learn more about STEM careers. The week was packed with hands-on activities that challenged middle school students' ideas about math and science while also challenging the pre-service teachers' notions of what exciting, effective science instruction looks like. The week's activities included building water bottle rocket launches, competing in engineering design challenges, evaluating their role in ecosystems, and learning how to use technology to build apps, websites, and games. In addition to plenty of STEM activities, middle school students also considered careers in STEM by exploring careers online, meeting technology experts, engineers, and scientists, such as our own Andres Vidal-Gadea. On the last day, campers presented their college and career plans to their parents, school administrators, and community members at Discovery Showcase. Congressman Bill Foster, the only scientist in the U.S. Congress, was the keynote speaker.



Undergraduate interns were guides to the students, mentoring them along the way. But this internship was more than just a summer job; it was a way to expose potential STEM teachers to the ups, downs, joys, and challenges of teaching. The interns guided activities and worked as a team as they experienced inquiry-based learning activities. These future teachers experienced inquiry learning and the flexibility needed in a summer camp environment, as well as their future classrooms. They connected with their middle school students, learned their students' needs and interests, and built relationships. Most importantly, these interns got a taste of teaching. The camp was an opportunity to see if a career in teaching is a fit for their personalities and life goals before jumping into Illinois State University's teacher-certification program.

The interns who decided to pursue STEM education after the Discovery Academy are now recipients of the Noyce Scholarship, a research internship, and induction support through their first year teaching. The Noyce program strives to place quality STEM teachers into public schools across Illinois and build confident, new teachers that will stay in the profession long-term. It all begins with a camp, laughing, exploring, and learning in a suburban stream.

Vidal-Gadea Lab receives NIH grant to investigate Duchenne muscular dystrophy

By Andrés Vidal-Gadea

Assistant Professor of Molecular Neuroethology Andrés Vidal-Gadea received a $403,109 grant from the National Institutes of Health (NIH) to investigate the molecular and genetic mechanisms responsible for muscular degeneration (and protection) in Duchenne muscular dystrophy (DMD).

Duchenne muscular dystrophy is a genetic disorder affecting the third largest human gene which encodes a protein (dystrophin) necessary for muscle function and survival. One of every 3,500 males is born carrying mutations that lead to this lethal disease. There is presently no cure for DMD.

After realizing that a tiny nematode worm (*C. elegans*) could be used to study DMD, Vidal-Gadea conducted a genetic screen where he mutated worms afflicted by muscular dystrophy. His team went on to isolate eight mutants that, in addition to DMD, they also had new mutations that allowed them to overcome the muscular decay and loss of motion characteristic of muscular dystrophy.

This three-year grant will allow the Vidal-Gadea lab to identify the mutations responsible for the recovery observed in these animals. Because *C. elegans* shares nearly two-thirds of its 19,000-plus genes with humans, Vidal-Gadea's team expects that at least some of these

Continued on Page 16

Society meeting.

Sakaluk Lab

E. Keith Bowers (M.S. '11, Ph.D. '14, post-doc 2014-2016) received the 2016 John Maynard Smith Prize from the European Society for Evolutionary Biology. Quoted from their web site: "Every year the European Society for Evolutionary Biology distinguishes an outstanding young evolutionary biologist with the John Maynard Smith Prize. The prize is named after John Maynard Smith (1920–2004), eminent evolutionary biologist and author of many books on evolution, both for scientists and the general public." Bowers' prize will be celebrated at the next ESEB Congress in Groningen, The Netherlands, where he will give the John Maynard Smith Prize Lecture. Bowers is now an assistant professor of evolutionary and physiological ecology in the Department of Biological Sciences, University of Memphis. His web site is **www.ekbowers.com.**

Meghan Strange (M.S. 2015) accepted the position of clinical research coordinator assistant at PMG Research in Champaign. In 2016, she published an article based on her master's thesis, "Pre- and post-natal effects of corticosterone on fitness-related traits and the timing of endogenous corticosterone production in a songbird" in the *Journal of Experimental Zoology.*

Stein Lab

Carola Städele (Ph.D. '15, post-doc '15) received the Young Investigator Award from the International Society for Neuroethology. This prestigious award recognizes doctoral graduate students and early post-doctoral fellows who have shown outstanding promise and have already made a significant research contribution in the field of neuroethology. Städele presented her research findings about how the nervous system copes with detrimental temperature effects in a symposium at the 2016 Congress of Neuroethology in Montevideo, Uruguay. Her newest study on how neurons communicate was recently featured on the cover of the Journal of Neuroscience. Städele has now accepted a post-doc

Continued on Page 16

Stein Lab *... continued from Page 15*

position at the University of California, Los Angeles.

Margaret DeMaegd (M.S. student), **Marissa Cruz** (M.S. student), **Carola Städele** (post-doc) and **Rosangela Follmann** (post-doc) presented posters and research seminars at the Meeting of the Society for Neuroscience in San Diego. DeMaegd presented a poster and an oral data blitz at the Action Selection in the Animal Kingdom Conference at Janelia Research Campus.

Vrailas-Mortimer Lab

Kaitie Wildman (undergraduate co-mentored with N. Mortimer) was the winner of the first annual Biological Sciences Student Association Research Symposium for her poster "The Molecular Evolution of Drosophila p38 MAP Kinases."

Megan Knoernschild and **Kristyn Bossle** (undergraduates) presented their poster "Parkin and PINK1 interact with the CASA complex to regulate mitophagy and locomotor behaviors" at the 2016 Midwest Drosophila Conference in Monticello. Both students were also honored at the 2016 Reggies for their high academic performance while competing as student athletes on the women's gymnastics team.

Michael Almassey (M.S. student) presented his poster "p38 MAPK Regulates Oxidatively Induced Protein Aggregation" at the 2016 Midwest Drosophila Conference in Monticello.

Loren Roustio (undergraduate) will attend Saint Louis University School of Medicine in fall 2017.

Morgan McCall (class of 2014, co-mentored with Nate Mortimer) is now pursing her DMD degree at the College of Dental Medicine-Illinois at Midwestern University.

Vidal-Gadea Lab *... continued from Page 15*

mutants will point to pathways conserved with humans which could be targeted in individuals with the disease.

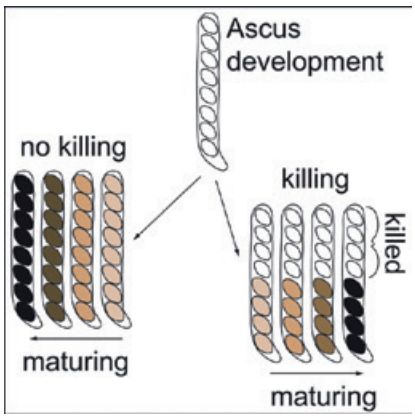
In addition to helping understand the molecular underpinnings of this terrible disease, funding by the NIH will also contribute to the training of graduate, undergraduate, and high-school researchers presently endeavoring in every aspect of the research. Students are presently working on a manuscript describing the beneficial and detrimental effects of various forms of exercise on dystrophic musculature. The work will help guide physicians, parents, and patients considering strategies to mitigate the effects of the disease.

The experimental amenability of these tiny worms make them ideal not only for the study of genetic disorders but also for the training of students at every level of their scientific careers.

Hammond Lab receives an NSF grant to investigate spore killing

By Tom Hammond

The Hammond Lab received a $264,646 award from the National Science Foundation to study a phenomenon called spore killing in fungi. Many fungi produce spores as part of their life cycle. These propagules can help fungi spread to new environments and survive harsh environmental conditions. Some fungal spores are drought resistant, others are cold tolerant, and some can even resist the high temperatures of a forest fire. The Hammond lab is interested in a special type of spore produced during sexual reproduction by the ascomycete fungus *Neurospora crassa*. If this organism sounds familiar to our alumni, it may be because it was the favored model organism of retired ISU Distinguished Professor Herman Brockman. *Neurospora* fungi require two parents for sexual reproduction and sexual reproduction produces many offspring, each containing a mixture of genes from both parents. Each offspring begins life as a small spore called an ascospore, and offspring are produced in groups of eight within a special spore sac called an ascus. The eight ascospores in an ascus are considered to be siblings.



This image distinguishes between killing and non-killing phenotypes in spore saces (asci) of the fungus *Neurosposa crassa*. The Hammond Lab has been awarded an NSF grant to identify the causes and consequences of spore killing fungi

In 1979, scientists who were analyzing isolates from a world-wide collection of *Neurospora* fungi identified pairs of *Neurospora* parents that do not produce asci with eight viable ascospores. Instead, they produce asci with four viable and four inviable ascospores. The viable and inviable ascospores are easy to identify because the former are darkly-pigmented while the latter are translucent. Researchers quickly determined that the surviving ascospores inherit an undetermined spore-killing gene from the spore killer parent and that ascospores failing to inherit this spore-killing gene are killed by an undetermined mechanism.

In their grant proposal entitled, "How do spore killers kill spores? Elucidating the mechanism of meiotic drive by spore killing in *Neurospora* fungi," Hammond proposes to identify the spore-killing gene and determine how it functions. Hammond states: "The spore-killing gene has evolved a mechanism to ensure it is passed to every living member of the next generation. This is a remarkable feat." He adds that, "if we can identify the spore-killing gene and determine how it works, we may be able to develop it into a technology to control pathogenic fungi." One such fungus is called *Fusarium verticillioides*, a particularly troublesome organism for Illinois corn producers. While the project is likely to be difficult, Hammond lab members Nicholas Rhoads, Dilini Ralalage, and Pennapa Manitchotpisit are making rapid progress toward identification of the spore-killer gene. Hammond also credits

the successful proposal to a couple of ISU alumni, Austin Harvey and Kevin Sharp, who helped the Hammond Lab get the project off the ground. "We would not have been successful without the contributions of Austin and Kevin who joined my laboratory as volunteer research assistants shortly after my arrival at ISU in 2012."

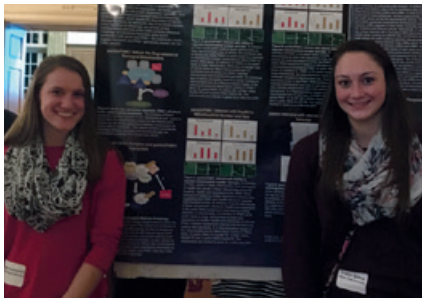
Post-doc secures two NIH grants to study environmental estrogens and stress hormones

By Ryan Paitz

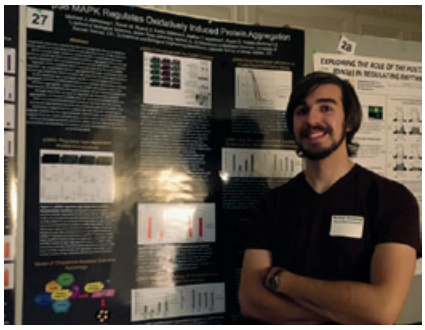
Steroids are important signals used by the body to coordinate complex processes with reproduction being one of the most important of these processes. Because of this, steroid levels are typically elevated during reproduction. For example, estrogen levels rise during pregnancy with levels at the end of pregnancy being higher than any other point during a female's lifespan. Despite this, a lot of attention has been paid to the idea that developing offspring are very sensitive to chemicals in the environment that might act like steroids, especially estrogens. These so called "environmental estrogens" can come from a variety of sources such as agricultural chemicals and plastics and cause long-term negative effects. Luckily developing embryos possess some ability to protect themselves from both natural estrogens from mom and environmental estrogens by metabolizing these chemicals and converting them to inactive compounds. While this has been known to happen in vertebrates, like humans, that are live-bearing and have a placenta, we recently discovered that embryos developing within eggs also have the ability to metabolize estrogens during development. For embryos within eggs, these maternal steroids are present in the yolk when the egg is laid and subsequently metabolized during development. Remarkably, developing turtle embryos convert maternal estradiol from the yolk to the same compound (estrone sulfate) that human fetuses convert maternal estradiol into. This finding allows us to use turtles to test how environmental estrogens might influence how embryos are able to regulate their exposure to maternal estradiol, and this concept serves as the foundation for a grant that was recently funded by National Institutes of Health (Principal investigator: Bowden, Co-investigator: Paitz). Specifically, this project investigates how a common environmental estrogen found in plastics, bisphenol-A (BPA), affects the ability of developing turtle embryos to protect themselves from maternal estradiol. One of the major findings thus far is that BPA inhibits the embryos ability to metabolize maternal estradiol, which subsequently leads to more of this estradiol reaching the embryo during development. This suggests that some "environmental estrogens" may be producing their effects by allowing more maternal estrogens to reach the developing embryo.

While estrogens are one class of steroids that are important during reproduction, another class of steroids that are vital during this time are glucocorticoids. These steroids, more commonly referred to as "stress steroids" because their production is increased during stressful situations, are also capable of moving from mom to offspring and producing long-term negative effects. When females experience stressful conditions during reproduction, it has long been known that this can have detrimental effects on her offspring and increased embryonic exposure to maternal glucocorticoids has been implicated as a primary mediator of these effects. But just as is seen with estrogens, developing embryos possess some ability to protect themselves from these steroids by metabolizing them to an inactive compound. Using Japanese quail as a study system, we have recently discovered that developing embryos regulate their exposure to maternal glucocorticoids in the yolk by metabolizing them to an inactive compound. However, when glucocorticoids levels in the yolk are too high, the embryo is not able to metabolize all of the steroid, and this results in increased embryonic exposure to maternal glucocorticoids. This elevated exposure elicits long-term effects similar to what is seen after humans experience elevated glucocorticoid levels. One of the primary effects is that exposed embryos have altered production of stress steroids when they are exposed to stress later in life. The National Institutes of Health recently funded a project (Principal investigator: Haussmann of Bucknell University, Co-investigator: Paitz) to examine how exposure to elevated glucocorticoids during embryonic development influences how individuals respond to stress later in life, which in turn might influence disease susceptibility and ultimately life span.

Brooklynne Thielen presents her poster at the Midwest *Drosophila* Conference



Megan Knoernschild and Kristyn Bossle present their poster at the Midwest *Drosophilia* Conference



Michael Almassey presents his poster at the Midwest *Drosophilia* Conference

Robert Philips and Morgan Walder hiking in the North Carolina mountains on their way to present their posters at Botany 2016 meetings

Upcoming events

The annual Phi Sigma Research Symposium will take place on March 24, 2017, in the Circus Room of the Bone Student Center. If you would like to attend, please email Greg Tito at gtito@IllinoisState.edu to let us know you will be attending.

Would you like to return to ISU for Homecoming 2017 and participate in our School's alumni event? If so, please email Diane Byers at dlbyers@IllinoisState.edu to let us know of your interest.

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Homecoming.IllinoisState.edu

School's First Female Distinguished Professor Named

By Amanda Wilson Carter

Professor Rachel Bowden was honored with the title of Distinguished Professor in February 2017, the most prestigious title that can be earned by faculty at the University. Annually, up to two faculty from across the University are selected for the award based on excellence in teaching and scholarship. Bowden is the School of Biological Sciences' 12th Distinguished Professor and the school's first female honoree. She has brought in over $1 million in grants for her research investigating maternal hormone effects on sex ratios in the red-eared slider turtle, and she has been funded continuously since 2002 from sources like the National Science Foundation and the National Institutes of Health. Bowden's research has culminated in over 50 peer-reviewed publications in prestigious journals and over 25 invited seminars. She has mentored 12 graduate students and 15 undergraduate students and has published over 25 articles with her students. In addition to research, Bowden has remained active in both internal and external service. She has served on the Undergraduate Studies Committee, the Curriculum Committee, and as the Director of the Behavior, Ecology, Evolution, and Systematics sequence for undergraduate majors. She is on the editorial board at the *Journal of Experimental Zoology Part A: Ecological Genetics and Zoology*, is highly involved with the Society of Integrative and Comparative Biology, and has served as a grant review panel member for the National Science Foundation.

Attendees and presenters at the 17th Annual Phi Sigma Research Symposium

Faculty wait for graduation ceremonies to start, including Distinguished Professor Juliano and our newest Distinguished Professor Rachel Bowden

Patrick Murphy at commemoration of the 230-year-old red oak that unfortunately had to be removed this winter

Winners of the presentation awards at the 17th Annual Phi Sigma Research Symposium

Michael Almassey, *right,* with 2016 graduates. Almassey is continuing work toward his master's degree at Illinois State

Fall 2016 symposium of the Integrative Plant Biology and Biofuel group

Faculty and graduate students—fall 2016

Kerrigan Tobin, M.S. student and winner of the best holiday sweater

Graduate students relaxing at the 2016 Phi Sigma fall picnic

Camila Junco Vidal-Herbez (aka Mila) was born in Bloomington, to Erin M. Herbez and Andrés Vidal-Gadea on January 4, 2017. Both mother and daughter fared well. Pictured are images of Day 1 and two-week-old Mila displaying typical diurnal (A), and nocturnal (B) behaviors respectively

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