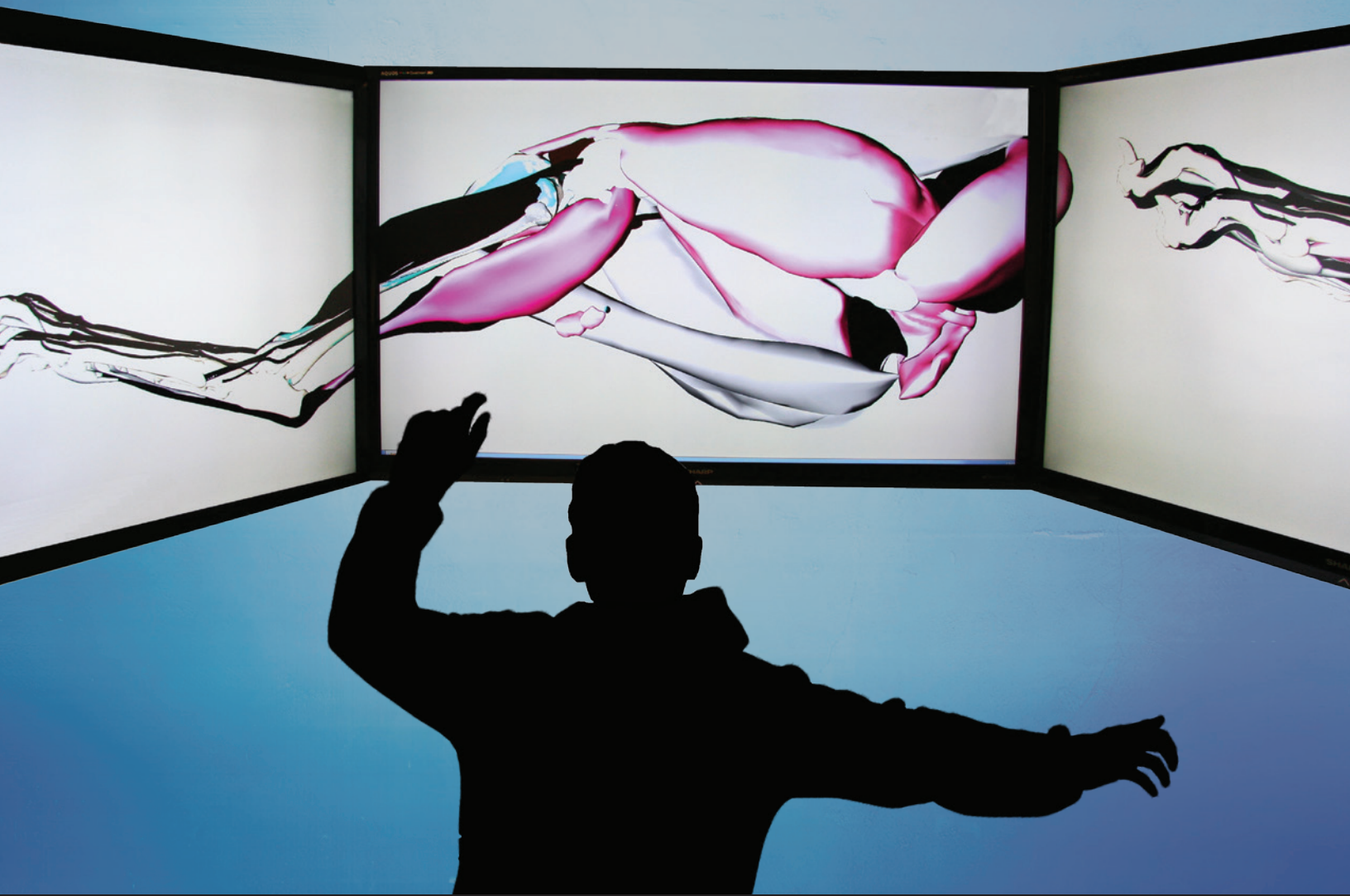


SYNERGY



BECKMAN INSTITUTE
FOR ADVANCED SCIENCE AND TECHNOLOGY

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Virtual Surgery

Using three 90-inch LCD/LED monitors and an Xbox Kinect, researchers at Beckman's Illinois Simulator Laboratory (ISL) can virtually dissect images of body parts using only arm movements. Students and physicians alike will be able to practice and prepare for surgical procedures in a whole new way.



Beckman Director Art Kramer announced the five 2014 student awardees, Victoria Cross, Genevieve LaBelle, Qian Yin, Brennan Payne, and Vuong Le, at the first annual student awards reception.

Student Awards Reception

“One of Arnold Beckman’s favorite sayings was ‘excellence in everything.’ In that fine tradition, we’re proud to recognize these five excellent students,” said Art Kramer, director of the Beckman Institute, as he welcomed guests to the Beckman Institute’s first annual student awards reception.

On Saturday, April 26, five students were honored for receiving one of the three annual Beckman student awards. Nadine Barrie Smith Memorial Fellowships were awarded to Ph.D. students Qian Yin and Genevieve LaBelle, the Erik Haferkamp Memorial Award for Undergraduate Research to junior neuroscience major Victoria Cross, and the inaugural Thomas and Margaret Huang Awards for Graduate Research to Ph.D. students Vuong Le and Brennan Payne.

During the reception, the families of Erik Haferkamp and Nadine Barrie Smith, as well as Tom and Margaret Huang and their family were able to meet the awardees, their parents, and their faculty advisors.

“I’m so incredibly honored to get this award,” said Cross, who works in Justin Rhodes’ lab to study the genetic and environmental factors that affect behavior in clownfish. “I know Erik was extremely dedicated to this lab and the field of neuroscience. It was very special to meet his family and learn more about him.”

Erik was a senior undergraduate student in Justin Rhodes’ lab, a budding neuroscientist double-majoring in psychology and molecular and cellular physiology, at the time of his death at age 22 in 2010. His family and friends established a fund in his memory to continue to support undergraduate research in neuroscience at the Beckman Institute.

LaBelle and Yin, recipients of the Nadine Barrie Smith Fellowships, are both graduate students in the field of medical imaging, which honors the legacy of Nadine, who earned all three of her degrees at the University of Illinois—a bachelor’s in computer science, a master’s in electrical engineering, and her

Ph.D. in biophysics. Nadine was well-known for her research in medical imaging and therapeutic ultrasound, and she was also passionate about advancing women in science and engineering. In her memory, her family, including husband and former Beckman researcher Andrew Webb, established the fund to support female graduate students researching in medical imaging.

“Though I never met Nadine, I’ve heard and read many inspiring stories about her. She is a role model to me,” said Yin, who, after her grandfather died of liver cancer, dedicated her career to help develop new biomedical imaging methods to diagnose and treat cancer.

For LaBelle, this fellowship will allow her to stay at Beckman over the summer and research full-time in Brad Sutton’s lab, where she works on improving the speed and quality of magnetic resonance imaging technology.

The Thomas and Margaret Huang Award was created by former students of Tom Huang, an electrical and computer engineering professor who was a founding member of the Beckman Institute and has mentored more than 100 Ph.D. students in his career. The award, given to graduate students in the Human-Computer Intelligent Interaction (HCII) research theme, honors the contributions both he and his wife Margaret have made to society.

Payne will receive his Ph.D. in cognitive science and teaching and learning and then transition immediately into a postdoctoral research position at Beckman because of this award. He will work with Kara Federmeier to advance his studies in understanding cognitive changes associated with aging in older adults.

One of Tom’s students, Vuong Le, also received the award, and will continue as a Ph.D. student in electrical and computer engineering to work on 3D modeling techniques for improved image analysis and understanding.

These three annual awards are supported by generous contributions throughout the year. Those interested in donating may visit beckman.illinois.edu/about/giving.

Nadine Barrie Smith Memorial Fellowship

In honor of Nadine Barrie Smith's life and achievements, Nadine's husband, Andrew Webb, established the Nadine Barrie Smith Memorial Fund that is supported by Nadine's family, friends, and colleagues. The fund provides fellowships to female engineering graduate students who are conducting research in the general field of medical imaging (e.g., ultrasound, optical, magnetic resonance) at the Beckman Institute.

From left to right: Qian Yin, fellowship recipient; Jean Smith, Nadine's mother; Arnette Bosch, Nadine's sister; and Genevieve LaBelle, fellowship recipient. Qian is pursuing a Ph.D. in materials science and engineering and working with Jianjun Cheng and Wawrzyniec Dobrucki from Beckman. Genevieve is pursuing a Ph.D. in computer engineering and works with Brad Sutton in the Magnetic Resonance Functional Imaging Lab.



Erik Haferkamp Memorial Award for Undergraduate Research

In honor of Erik Haferkamp's life and achievements, his family, friends, and colleagues established the Erik Haferkamp Memorial Fund, which provides awards to undergraduate students who are conducting research in neuroscience at the Beckman Institute.

From left to right, John Wilson; Beth Haferkamp, Erik's sister; Victoria Cross, award recipient; and Bonnie Haferkamp, Erik's mother. Victoria has been working with Justin Rhodes in his Behavioral Genetics Lab. She is a junior majoring in neuroscience.

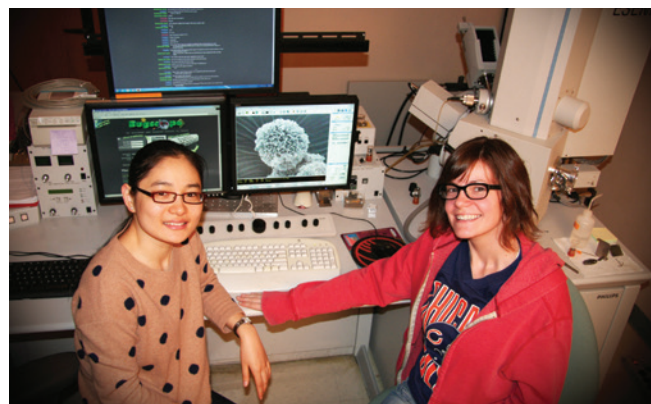
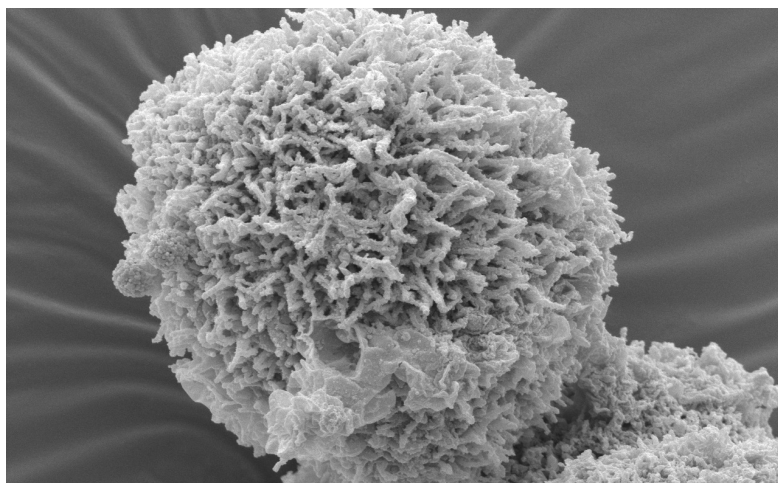


Thomas and Margaret Huang Award for Graduate Research

In honor of Thomas and Margaret Huang's contributions to science, technology, and society, the Thomas and Margaret Huang Fund for Graduate Research was established by the Huang family and their friends and colleagues. The fund provides awards to graduate students who are conducting research in the Human-Computer Intelligent Interaction (HCII) theme at the Beckman Institute.

From left to right: Thomas Huang; Margaret Huang; Vuong Le, award recipient; and Brennan Payne, award recipient. Vuong is pursuing a Ph.D. in electrical and computer engineering under the direction of Thomas Huang, who leads the Image Formation and Processing Group. Brennan will receive his Ph.D. in cognitive science and teaching and learning in this summer. He has been working in the Adult Learning Lab with Elizabeth Stine-Morrow, and plans to work with Kara Federmeier and Stine-Morrow as a postdoctoral student at Beckman.





Jie Sun, Beckman researcher, and Cate Wallace, microscopist, helped conduct a Bugscope session examining zombie cells.

ZOMBIES INVADE BUGSCOPE

Seventh grade science students from Colorado were able to interact with a researcher studying zombie cells in the basement of the Beckman Institute through Bugscope, a unique program that gets students excited about science.

Scott Robinson, manager of the Microscopy Suite at the Beckman Institute, and Cate Wallace, a microscopist in the lab, were hosting a series of Bugscope sessions with 7th grade science students from Mountain Ridge Middle School in Highland Branch, Colorado, when the unexpected happened.

Bugscope, which has just reached its 15-year anniversary, is an outreach effort on behalf of the Microscopy Suite staff that allows students around the world to remotely log into a scanning electron microscope in the basement of the Beckman Institute in order to view insects from their classrooms.

"I think we had a bit of confusion on the time difference," said the teacher, Myka Nielsen. "It was the end of one of my classes and the beginning of another that I had planned on participating in Bugscope, but a researcher was scheduled to use the microscope." Beckman Postdoctoral Fellow Jie Sun ended up conducting a session around her research into zombie cells.

"It was very spontaneous," said Sun. "But a lot of times, the best thing is something unexpected."

In her work with Eric Jakobsson, part-time faculty member in the Computational Multiscale Nanosystems Group, Sun has been examining zombie cells, synthetic mammalian cells made from silica that are templates of real cells.

"Our collaborators made the zombie cells," said Sun. "We're hoping to functionalize them. We're interested in bottom-up synthetic biology. We want to find biological applications of zombie cells to solve biological questions."

The Bugscope session that followed was a high-energy experience in which the students got to interact with a researcher and her

microscopic samples in real time. And it didn't hurt that the research was being conducted on zombie cells.

"The students are so into zombies, but once they got over the initial excitement about the name, they really got interested in speaking with the researcher," said Nielsen. "The kids were really interested in this because we are currently working on cells, genetics, and DNA. It's fun to get them excited about science in general. I called my administration in and said, 'You've got to see this!'"

Sun, who with the help of the Microscopy Suite staff is still learning how to use the microscope herself, was kept on her toes by the students, who were peppering her with questions about her work and what they were seeing on their computer screens.

"It's rare for me to have a firsthand experience with children," said Sun. "They don't understand the scientific details, but they understand the concepts. They ask very good questions."

"The experience was priceless," said Nielsen. "They'll never be able to get to do something like that again."

Sun, on the other hand, is willing to offer her expertise in the future. "Their questions were surprising and inspiring," she said. "It reminds me why I wanted to do this in the first place."

"We need to give kids experiences that they are passionate and curious about," Sun said.

"You really can't beat a job with benefits like this," said Scott Robinson, who's managed the Microscopy Suite since 2006 and has been involved with Bugscope since its inception. "For over 15 years now, averaging twice a week, we have the best time possible: using a high-resolution scanning electron microscope, an assortment of bugs, and a chat window to capture kids' imaginations."

"We can feel their energy and excitement coming over the web, and we have fun but we also take it seriously. For a finite number of minutes we have the ability to shape kids' impressions of science in a real, unfiltered, and positive way."

Selections from the transcript of
the Bugscope zombie experience:

Student: How did zombie cells even get their name? Can they be used to create zombies or what is their purpose in life?

Bugscope Team: They are not alive, really; they are cells that have been duplicated with very fine silica.

Student: Can zombie cells be used to help save people?

Bugscope Team: Yes!

Student: Do zombie cells reproduce the same way as regular cells do?

Bugscope Team: No, they are not alive so they cannot reproduce.

Student: What is the most interesting thing you have ever found about zombie cells?

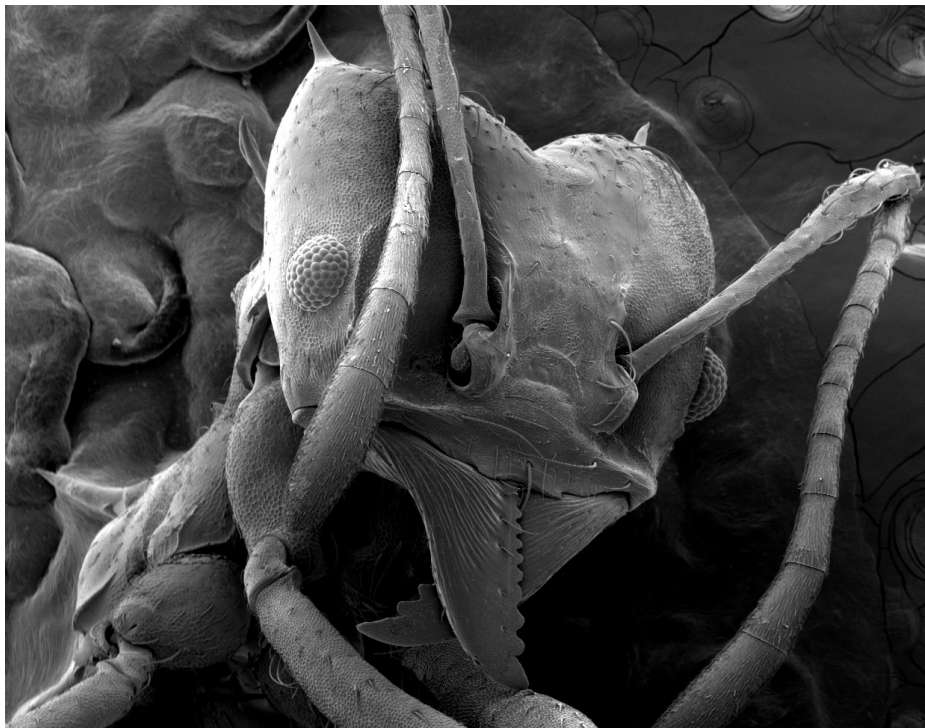
Bugscope Team: I am still discovering it. So far, I found their morphologies fascinating.

Student: Using the zombie cells you have now, do you think you will be able to recreate a living organism like an animal?

Bugscope Team: Not in the short term. As we are studying life, we understand that life is too complicated to be created from scratch.

Student: Why do you think it is important to learn and know genetics?

Bugscope Team: It ends up being the study of life.



A brief history of Bugscope, as it celebrates 15 years

Within five years of the advent of the very first website (put up by Tim Berners-Lee in 1992), the Imaging Technology Group at the Beckman Institute had developed its first web-based educational outreach project, called Chickscope. Part of a collaboration with Paul Lauterbur, who would win the Nobel Prize for his pioneering work in magnetic resonance imaging (MRI), Chickscope utilized MRI to collect and deliver images of chicks via the web as they developed within their egg shells. A tiny number of classrooms had live access to those images, and the project tallied several thousand dollars in costs.

Having garnered useful information from Chickscope, as well as from the implementation of web-based control of a transmission electron microscope, in 1998 Clint Potter and Bridget Carragher (at that time the co-directors of the Imaging Technology Group), conceived of an affordable, sustainable educational outreach project, to be called Bugscope. With the support of key faculty members at the University of Illinois, they wrote a successful National Science Foundation (NSF) proposal that allowed them to purchase a high-resolution scanning electron microscope. The \$600,000 microscope would be utilized in a wide variety of research at the university as well as providing the basis for Bugscope.

Scott Robinson was hired in November 1998 to help install and operate the new microscope; his other primary task was to serve on the team that would make the Bugscope concept a reality. The team worked quickly, and the first official Bugscope session was held on March 19, 1999, with a local school.

To put things in perspective, when the Bugscope project went online, the web was much more primitive than it is today. Bugscope predates Wikipedia and Facebook, and on the day of the first official Bugscope session, Google had only eight full-time employees.

In the intervening years, the Bugscope interface has been updated three times, but the original spark is still there.

Thriving Atmosphere of Undergraduate Research at Beckman

Research at the Beckman Institute would not be possible without the tremendous work of graduate and undergraduate students at the University of Illinois. Nearly 400 undergraduate students conduct research at the Beckman Institute, and two of them, Andrew Chancellor and Gina Giase, offer a look into their research positions and advice on how to get a position, too.

Chancellor, a senior chemistry major planning to enter the business sector next year, works in Jeff Moore's lab. Giase conducts research in Florin Dolcos' lab, and is a junior molecular and cellular biology and psychology double major with a minor in chemistry, who intends to study neuroimmunology in grad school.

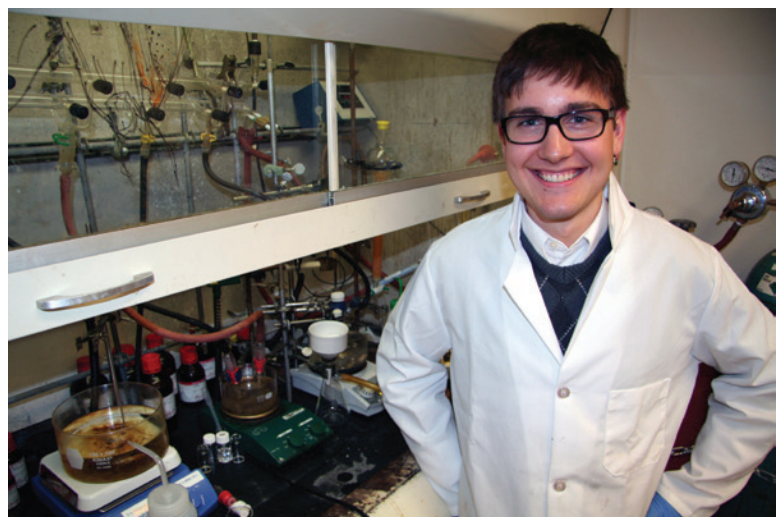
Beckman Institute: What were the steps you took to get a research position at Beckman?

Andrew Chancellor: When I was a sophomore, I went to a chemistry seminar, and the professor said, if you aren't doing undergraduate research, you're missing a huge chunk of the undergraduate experience. So over winter break, I decided to research lab options. There definitely was a feeling that I wasn't prepared enough academically, but once I got over that hump, I researched labs and there happened to be an opening in Professor Moore's lab. He connected me with a visiting researcher in his lab, and I just got started. Once you're in a lab, you can ask graduate students if they need an undergraduate, so when the researcher left, I was able to go to a graduate student I knew in the same lab who needed an undergrad.

Gina Giase: As a freshman, I found out there was an undergraduate neuroscience society, so I went to a meeting and someone from Diane Beck's lab came in and they were looking for undergraduate researchers. I didn't get that position, but there was another graduate student from the lab who wanted undergrads, so I joined up with her. After she graduated, I had the opportunity to look elsewhere. I saw the Dolcos lab was hiring, but by the time I emailed them, they had already gotten all of their research assistants and weren't looking, but I guess since I seemed so enthusiastic about their research when I was emailing them and interviewing with them, they just decided to bring me on and see if I was good at my job. A year later, I'm still here!

BI: What do you do in the lab?

AC: Right now, I'm working with a system called ionic molecular glass, a glassy substance that is made out of organic molecules with charges. One goal that is under investigation is to make the glassy solid out of these organic molecules so that it isn't soluble with water—when you spray water on it, it doesn't wash



Andrew Chancellor

Year: Senior

Working in the lab of: Jeff Moore

Major: Chemistry

High School: Guilford High School, Rockford, IL

Future plans: Engineer/Scientist at UOP Honeywell

Best part of lab experience: Learning lab techniques and creating successful reactions.

or dissolve away. It could then be applied to outside surfaces, like windows, so it's protected when it rains.

GG: In the beginning, I was head of subject coordinating, so I'd recruit, screen, and run subjects for the various experiments. I also started shadowing to run subjects in the magnetic resonance imaging (MRI) so I could potentially be running them in the MRI on my own.

Then, as I'm approaching senior year, I switched gears to do my own research to write my senior thesis. We're using autobiographical memories to see how emotion and cognition affect your working memory. I'm going to be working through this entire project and then write a paper on it.

BI: What have you learned in the lab that you couldn't have learned in a classroom?

AC: There are so many problem-solving aspects in research in general because you're kind of working with materials and chemicals that no one has really experimented with. So there's that opportunity to see how chemists actually think and solve problems no else has before. That just doesn't come by reading a textbook. The lab has given me practical experience to problem solve, and that has prepared me for my future job.



Gina Giase

Year: Junior

Working in the lab of: Florin Dolcos

Major: Molecular and cellular biology and psychology

High School: St. Charles North High School, St. Charles, IL

Future plans: Apply for grad school in neuroimmunology

Best part of lab experience: “Working alongside the grad students in the lab has been my favorite part of this whole experience.”

GG: Research here has taught me that not everything is perfect: data doesn’t always match up to how you think it’ll be. This is real life, so what you might be thinking is the real answer might not be right at all.

I’m also learning a lot about scientific papers—both how to write them, and how to read them. They weren’t really accessible before, but now I feel really comfortable with them, especially reading papers and gleaning the most important information.

BI: What do you like about working at Beckman?

AC: Beckman is cool because there are so many different things going on. Even going to seminars, it’s really fun because you get to see what other people are doing it and connect it with what you’re doing as best as you can. Even if I don’t understand it fully, it inspires me to continue on with my research.

As far as my research, I got my dream lab. There is awesome research going on at Beckman in general, and my main interest is organic chemistry, and that’s what I’m doing now.

GG: Because I started working here freshman year and I had a little bit of gap between switching labs, it felt weird not being at Beckman. Beckman is a home away from home—it’s such a supportive and comfortable environment.

Also, it’s great with my interests to work here because Beckman has a strong foundation in neuroscience with the capabilities of using the MRI. It adds the extra component of imaging on top of typical psychology behavioral studies.

BI: What has surprised you about working here?

AC: When I first started working, I was surprised to find the simplest thing of pouring solution into a vial was tricky at first. Yes, I had the dexterity to pour a liquid into a vial, but I was kind of nervous because I’d never really done it before and the chemicals could have melted my skin. But eventually I became comfortable with it. It’s amazing how independent I’ve become. Now I can just walk in the lab, and understand exactly what I need to do when I come in.

GG: I didn’t think about it beforehand, but I’ve learned how to correspond professionally, especially in emails. It’s not something

I noticed until I started with the participant coordination. The impression you give through an email—and seeing what it’s like when people don’t send professional emails back—is way more important than I realized. I never thought that kind of stuff matters—but it does.

BI: What advice do you have for undergrads looking to get a research position?

AC: When you’re looking for position, find the labs that seem really exciting because you want to invest your time in something you care about. Then you have to put yourself out there. When you email professors inquiring about research positions, make sure to add a couple of lines about the specific research from their lab to show you’re interested in their work and you’ve done your homework in finding out what their lab is all about.

GG: Definitely think about what you’re interested in, and look up professors that match that, either in subject or if they’re doing some technique you’d like to learn. Email professors, talk to them because even if they don’t have openings, they could make an exception, like me, or they could call you up later down the road. Persistence is key if you want to get that dream undergrad lab position.

BI: Any final thoughts?

AC: Trying to phrase how important this experience has been to me and my future career is tough—I can’t phrase it well enough because it’s been so important. It’s been a game changer. It’s opened opportunities just by opening my mind to what is out there. Beckman is important because you can see what possibilities are out there that you wouldn’t be able to see otherwise.

GG: It’s amazing preparation for my future. In grad school and in my future career, I’m going to be doing research, so learning how to do everything couldn’t be more beneficial.

Changing the scientific world, one Citizen Scientist at a time

by Claire Sturgeon and August Cassens

Sallie Miller is not one to sit still. After her retirement from various positions in the healthcare industry, Miller took the opportunity to invest her time, efforts, and expertise in volunteering.

During tax season, Miller volunteers as an AARP tax aide. Other days, she helps with the State Health Insurance Program (SHIP) to assist people when they have Medicare questions. She's also on the YWCA board, Presence Life Connections Board, and the American Association of University Women (AAUW) Illinois Board. She participates in a tutoring program called Project READ through Parkland College, and is a Court Appointed Special Advocate (CASA) volunteer.

And then, for one afternoon a week, Miller is also a citizen scientist through the Osher Lifelong Learning Institute (OLLI), a member-driven learning community for people over the age of 50.

OLLI citizen scientists are matched with scientists at Illinois based on their knowledge, skills, and interests. They volunteer in a lab for several hours every week, oftentimes being delegated their own task to manage for the lab.

"What we appreciate about this program is that it allows our members to explore new areas and make important contributions even after their own careers may be behind

them," said Christine Catanzarite, OLLI director. "That's a valuable lesson about the importance of lifelong learning."

The Citizen Scientist Program started in 2009 and has grown to include 15 citizen scientists who are involved in a variety of disciplines and subject areas, from entomology to neurology. Past participants include retired teachers, bankers, gardeners, scientists, and others.

"In a sense, they were all self selected because they all wanted to do something scientific and be part of the scientific community," said Geena Skariah, who helped manage the fledgling program for two years. "Their personalities may range from very talkative to very friendly to absolutely quiet people, but they all find their own niche in each lab."

Miller found her niche at the Beckman Institute volunteering for Susan Schantz, who heads the Children's Environmental Health and Disease Prevention Research Center, which studies whether chemicals in plastics and personal care products alter child development, cognition, or other behaviors.

In the lab, she assists with calling and recruiting participants and inputting data—a vital task for the center as they're working to test more than 600 mothers and babies. As all scientists know, there's a lot that goes on behind the scenes to make

science happen, and Miller makes sure this work gets done.

"I like that I can help them in the process of answering some important questions about the role of chemicals in childhood development," she said. "I like learning about what kind of research is being done, and interacting with the lab members and the other citizen scientists in the lab."

There are six citizen scientists in the Schantz lab, and they are trained in their specific areas by lab members.

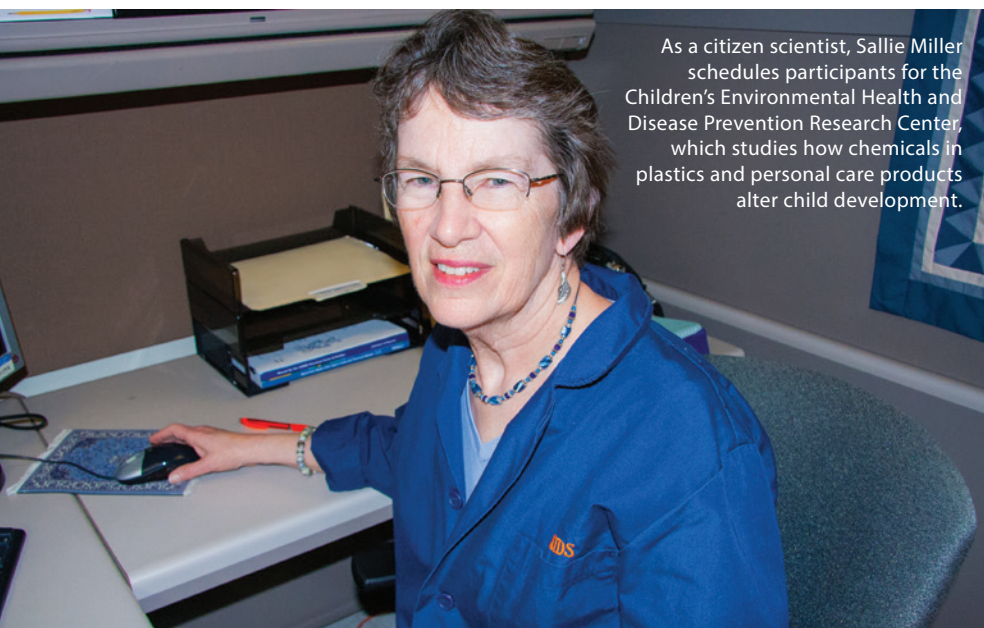
"We are so grateful for our OLLI volunteers. They truly make the wheels turn in our lab so that we're able to get this work done," said Schantz. "We have some citizen scientists working with the database and participant scheduling, and some working directly with the participants. We love them—we couldn't do our work without them."

Miller and the other citizen scientists in Schantz's lab play an important role in connecting with the participants.

"Our citizen scientists are all female and they know how to work with mothers and babies from their past experiences," Schantz said. "It provides a level of relatability and understanding that our students don't always have."

Miller has always been invested in learning. She got her undergraduate degree in math and a master's in industrial engineering. She and her husband moved to Champaign-Urbana in 1976, when he became a professor in the Department of Mechanical Science and Engineering, and she started working in healthcare. She also helped instill a love of learning in their three daughters, who all received advanced degrees.

"I know I could be slowing down," Miller said. "But I like doing this. I was interested to see what they were doing, what they wanted me to do, whether I would enjoy doing it or not. It keeps me active and it keeps my mind sharp. Why wouldn't I take advantage of that?"



As a citizen scientist, Sallie Miller schedules participants for the Children's Environmental Health and Disease Prevention Research Center, which studies how chemicals in plastics and personal care products alter child development.

I know I could be slowing down, but I like doing this. It keeps me active and it keeps my mind sharp. Why wouldn't I take advantage of that?

Sallie Miller, OLLI Citizen Scientist

Albert Himoe, also a citizen scientist, stands in front of a cluttered lab bench and holds a plastic tube up to the light, looking for the small mass of DNA clinging to the side of the tube. It looks like a dry wad of mucus.

Himoe has spent the last four days preparing this seemingly insignificant speck of genetic material. It contains a special gene that will play an integral role in genetic research on Fragile X Syndrome (FXS), the most common cause of inherited cognitive impairment with 20 to 30 percent being diagnosed with autism.

Stephanie Ceman, a professor of cell and developmental biology and an affiliate with both the Institute for Genomic Biology (IGB) and the Beckman Institute, has been studying this condition since 1997.

Himoe joined Ceman's lab in 2011. For Himoe, the Citizen Scientist Program was the perfect way for him to put his background in science to work. "Since I wasn't doing anything in particular, I thought I'd like to keep going," he said, smiling. "So I signed up."

Himoe earned a bachelor's degree in chemistry from Reed College in 1959, followed by a doctorate in organic chemistry from the University of Chicago in 1964. He completed his postdoctoral studies at Cornell University. Next he studied enzyme mechanisms as a faculty member at Baylor College of Medicine.

Later in his career, Himoe delved into how ancient Romans nourished their crops before modern chemical fertilizers and eventually ended up at Illinois where he worked with an agronomy professor and a physician before he became a citizen scientist in 2011 and was hired as an academic hourly in 2013.

At the age of 75, Himoe has seen firsthand how research has evolved over the years. He began his career back when computers came with punch cards, and calculators only did the most elementary of operations. Before automatic pipets, he used neoprene bulbs to suck up the liquids.

Today, Himoe manages the lab for Ceman. With his cluttered lab bench and paper-covered desk, Himoe has found an academic home in their lab.

Himoe clones DNA, makes buffers, fills solutions, maintains the water baths, sterilizes the lab's supplies, disposes of the bio-waste and biodegradable materials, and much more.

"When Albert does these tasks, and we know they are done right, that's gold," Ceman said. "That unburdens me, and that unburdens the graduate students, and he does it without complaining."

Himoe also isolates DNA that contains a special gene called FMR1. For most people, this gene provides the body with instructions to make a protein called FMRP, which is vital for a healthy, functional brain. People with FXS have an abnormal and repressed FMR1 gene so their bodies can't make the vital FMRP protein.

The FMR1 gene is inserted into the circular DNA of a bacterium, like adding a link to a bracelet. Over a three-day process, the bacterium replicates, creating extra copies of the genes to be used in studies. Once there are enough copies, Himoe isolates the DNA using a commercial kit.

Eventually, Himoe spots the DNA precipitate clinging to the side of the test tube. He carefully removes the excess ethanol with an automatic pipet, an overlooked mainstay of 21st century science.

The four-day process has yielded about a milligram of DNA, which weighs about as much as a paper clip. It's enough to keep



Albert Himoe, a citizen scientist at the Institute for Genomic Biology, removes excess liquid from a DNA pellet with an automatic pipet. Credit: Claire Sturgeon

the lab's FXS experiments going for nearly three weeks.

The small white mass is dissolved with a buffer and poured into an Eppendorf tube. The tube is nestled in a box of other tubes, marked with other dates. Inside each tube are thousands of copies of a special gene, each containing the same secret instructions to understanding cognition, and, perhaps one day, curing FXS.

Any lab or faculty member at the Beckman Institute or IGB can request to have an OLLI member work in their lab, and all OLLI members are encouraged to participate.

"It's a great opportunity for our members to become a part of the campus research enterprise, especially because the strength of the sciences at U of I is so amazing," Catanzarite said. "It's a mutually beneficial relationship—our members get to contribute to important research, and the labs benefit from volunteers who bring different skills and life experiences to their work."

LOOKING TOWARD THE FUTURE

As a Ph.D. civil engineering student, Jason Patrick helped integrate 3D microvascular networks into structural fiber-composite materials, providing them with multifunctional capabilities, including self-healing and electrical reconfigurability. His next role: One of the 2014 Beckman Postdoctoral Fellows.



Jason Patrick's enthusiasm is evident. When talking about his research, both his tireless energy and his ambitious plans for the future make it clear how invested he is in his work. His dedication is paying off.

Patrick will complete his Ph.D. in civil engineering this summer, and will then continue on as one of the 2014 Beckman Postdoctoral Fellows, which allows him to conduct his own research with multiple faculty collaborators for up to three years at the Beckman Institute.

As a postdoc, he will focus on the development of authentic biomimetic materials—synthetic systems that operate very much in the same way nature does. He is aiming to combine self-healing systems with self-sensing functionality, creating materials that can communicate where damage has occurred, heal it autonomously, and continue to monitor the status of the structure.

He plans to work with a truly multidisciplinary faculty team at Beckman: Stephen Boppart, from Integrative Imaging; Jeffrey Moore, Nancy Sottos, and Scott White, from the Autonomous Materials Systems Group, and John Rogers, from the 3D Micro- and Nanosystems Group.

"I'm really looking forward to this next step. It's an opportunity for me to get outside my comfort zone to learn more about micro-electronics and biomedical applications, and to collaborate with these amazing professors who are pioneers in their respective fields," Patrick said. "Coming from civil engineering, the rich, interdisciplinary environment at Beckman has shown me the possibilities of collaborative research. I'm very excited to see what we come up with next."

His future postdoc work is building on concepts from his recently published paper that revealed a new self-healing system allowing fiber-composite materials to heal automatically and repeatedly. The system was developed with Patrick's advisors White, Sottos, and Moore.

Internal damage in fiber-reinforced composites, materials used in structures of modern airplanes and automobiles, is difficult to detect and nearly impossible to repair by conventional methods. A small, internal crack can quickly develop into irreversible damage from delamination, a process in which the layers separate.

This remains one of the most significant factors limiting more widespread use of composite materials.

To solve this problem, Patrick helped create 3D vascular networks—patterns of microchannels filled with liquid healing chemistries—that thread through a fiber-reinforced composite. When damage occurs, the networks within the material break apart and allow the healing chemistries to mix and polymerize, autonomously repairing the material, over multiple cycles.

Coming from civil engineering, the rich, interdisciplinary environment at Beckman has shown me the possibilities of collaborative research. I'm very excited to see what we come up with next.

Jason Patrick

"The beauty of it is, we don't have to probe the structure and say, this is where the damage occurred and then glue it back ourselves," he said. "You can't do that—it's not practical or even possible. Many times the damage is subsurface, and, if it's in an airplane wing for instance, you can't see it, but you need to fix it as soon as possible to avoid catastrophic failure."

Patrick harnessed the power of the interdisciplinary atmosphere and the state-of-the-art facilities at the Beckman Institute to conduct this research.

"I had the opportunity to reach across disciplines and interact with a variety of talented engineers, chemists, and materials scientists," Patrick said.

Patrick used many of the imaging facilities at Beckman, including x-ray computed microtomography (μ CT) and Raman spectroscopy. μ CT enabled the team to visualize the vascular networks they had created inside these composites, and Raman spectroscopy allowed them to characterize the mixing of the healing agents and prove, molecularly, that the process worked.

"We wouldn't have been able to do a quarter of this without the facilities and personnel at Beckman," Patrick said.



New Hire

Brandon Smith

Brandon Smith likes solving problems, and that's why his new position at the Beckman Institute's Illinois Simulator Laboratory (ISL) as a simulation systems research programmer is a perfect fit.

"The best part of the job is the creativity and freedom I'm given. I'm told what problem to solve, not how to solve it, and I can just use my own knowledge of knowing what's out there, researching the options, and making my own decision about the best solution," Smith said. "I didn't know there was a job like this, where I could just creatively explore all these avenues."

In his few months on the job, Smith has worked on several different projects involving the simulation hardware at the ISL. The lab's resources are open to any researcher worldwide, and Smith assists researchers in finding the best way to incorporate the ISL's hardware capabilities. Housed on the south end of campus, the ISL specializes in facilitating advanced scientific understanding of human-computer interaction, and features a flight simulator, driving simulator, motion capture suite, and the Cube and Cave, two immersive 3D virtual environments.

His first project was working with Lisa Frank, former Beckman Senior Fellow, and Hank Kaczmariski, ISL director, to develop a 3D immersive experience in natural and urban environments to ultimately test if virtually walking through the environments would positively or negatively affect those with post-traumatic stress disorder (PTSD). He developed this environment with the next-generation Cube, which uses three 90-inch, LCD/LED monitors.

Smith's job was to program the video player so that the virtual environments played across multiple screens, side by side, and then sync it with the treadmill, so that when participants walked, the video followed along with their footsteps.

Smith is also working with veterinary medicine researcher Janet Sinn-Hanlon and Kaczmariski to create 3D interactive models of Digital Imaging and Communications in Medicine (DICOM) data, which includes images from MRI, CT, and PET scans, so that veterinary medicine researchers can virtually dissect and interact with DICOM scans, like the MRI scan of an animal leg (featured on cover).

The Cube is connected to an ordinary Xbox Kinect game system, which utilizes movements from the human body to control the screen. A Kinect doesn't require a controller—a camera built into the system picks up body movements so users can interact with the content on the screen in a natural way. Researchers can use one arm to grab a piece of the image, and another arm to move, rotate, and zoom in and out.

"I wanted to build a system that would be intuitive to researchers, so they wouldn't have to use any controllers—they could just use their body. So the Kinect system made sense," Smith said. "Researchers can use their arm movements to make cuts, dissect, and fly these muscles, tendons, and bones around in the 3D environment."

In the future, researchers would like to use this system for training programs so veterinary medicine students can virtually conduct surgery without the use of a cadaver. Long-term goals are to allow medical professionals to view 3D MRI data before a surgery, for instance, so they are better prepared for a procedure.

Smith received both his undergraduate degree in statistics and computer science and his master's degree in bioinformatics and animal science at the University of Illinois at Urbana-Champaign. After working as an independent video game creator and then as a programmer for an educational game company, Smith decided to look into coming back to the U of I.

"This job was just too good to pass up—not only did it really interest me, but it fit my skills really well," Smith said.

One of the things Smith would like to bring to the ISL simulation software is graphics from the Unity Game Engine, a game development ecosystem that offers high-quality rendering of 3D and 2D content. This system will allow for new kinds of research scenarios to explore, yielding the greatest possible advances in understanding the connections between humans and technology.

"That's what we like to do at the ISL," Smith said. "Bring in our cool technology and then help people out."

Beckman Scientists Launch INSIGHT Study

As President Obama's BRAIN Initiative looks at ways to better understand how the human mind works, researchers at the Beckman Institute are leading innovation in the science of brain training by examining new ways to improve reasoning and problem solving.

A multidisciplinary study based at the Beckman Institute is being conducted by researchers across the world to determine what kind of training best improves adaptive reasoning and fluid intelligence.

The project, named INSIGHT, recently received \$12.7 million in funding over 42 months from the Intelligence Advanced Research Projects Activity (IARPA), under the Office of the Director of National Intelligence. The INSIGHT project directly supports IARPA's SHARP (Strengthening Human Adaptive Reasoning and Problem-solving) program, whose goal is to develop evidence-based tools and methods that can improve the quality of human judgment and reasoning in complex, real world environments.

The study, headed by Aron Barbey, full-time faculty member in Cognitive Neuroscience, is designed to establish a comprehensive and rigorous brain training protocol that incorporates the best available cognitive, physical fitness, neuroscience, and nutritional interventions for the enhancement of fluid intelligence.

The INSIGHT brain training system is based on recent evidence in cognitive neuroscience indicating that specific training interventions may lead to increased general cognitive abilities,

including enhancement in fluid intelligence, which is the ability to effectively solve problems and recognize meaningful patterns in novel situations, Barbey said.

"For decades, scientists at the Beckman Institute have developed powerful interventions to improve human performance," said Barbey. "For the first time, these discoveries are being implemented within a comprehensive brain training system that is designed to enhance fluid intelligence. The INSIGHT brain training system incorporates some of the best available scientific evidence for building better brains and, we believe, has great potential for success."

Barbey's research group investigates the neural architecture of human intelligence, with particular emphasis on the prefrontal cortex. In a series of landmark studies, Barbey and colleagues have mapped several brain systems related to general intelligence, fluid intelligence, working memory, and cognitive flexibility. Their study of fluid intelligence is considered to be one of the largest and most comprehensive analyses yet in this exciting area of neuroscience research.

INSIGHT will be one of the largest scientific studies investigating fluid intelligence conducted to date: nearly 2,000 individuals organized into four cohorts over a three-and-a-half year period, for more than 100,000 hours of planned data collection. INSIGHT program participants will engage in the training activities over 18 weeks in an effort to improve reasoning and problem solving skills.



New Magnet Moves Into BIC

The Biomedical Imaging Center (BIC) at the Beckman Institute recently acquired a second 3 Tesla Trio whole-body magnetic resonance imaging (MRI) scanner, which will increase its capacity for bioimaging research and development.

BIC provides magnetic resonance (MR) services not only for Beckman researchers, but for researchers around the world. BIC's MRI systems are research-dedicated scanners used to pursue imaging studies in both humans and animals. Recent studies have included work by neuroscientists and psychologists on the

effects of exercise on cognitive function in children and adults; an examination of the emotional and cognitive function of adults with traumatic brain injuries; and studies by researchers from the Departments of Animal Science and Nutrition to map the brains of pigs in an effort to develop clinical interventions for humans.

The new MRI will be heavily used to conduct brain imaging for the INSIGHT study (see above). To watch a timelapse video of the MRI installation, visit go.illinois.edu/MRItimelapse.

Beckman Day of Service

Several volunteers from the Beckman Institute participated in the second annual Community and Campus Day of Service. Beckman employees helped reach the campus goal of packaging 147,000 meals, which were donated to the Eastern Illinois Foodbank. The event was sponsored by Illini Fighting Hunger, a Registered Student Organization (RSO) at the U of I dedicated to addressing local and international hunger issues.



A group of Beckman volunteers at the Day of Service, from left to right: August Cassens, Steve Drake, Diane Beck, Nancy Mansfield, Cybelle Smith, Kai Hall, Patty Jones, and Yanyan Wang.

New Role at BIC Brad Sutton

The Biomedical Imaging Center (BIC) has seen a lot of changes recently. With a new MRI scanner and many new projects starting (see articles on left), BIC is busier than ever before. To help maintain the workflow and ensure users are getting the best data possible, Brad Sutton has been hired as a technical director.

Sutton started working as a research scientist for BIC in 2003. In 2006, he became a faculty member in the Bioengineering Department, and created an independent research program centered around the imaging technologies at BIC. Now, 10 years later, he's returning to play a larger role in the future of BIC.

"I never really got far from BIC. My research focuses on developing technology for imaging physiology of the brain that hasn't been imaged before in order to better understand how the brain works," Sutton said. "A lot of my research uses the machines at BIC, and I've also been helping with technical aspects ever since I got here."

Sutton's lab focuses on trying to increase the speed at which MRI images are reconstructed from data, while also improving the quality of the image. They're specifically looking at ways to measure new aspects of brain physiology, like looking at blood flow within the vessels of the brain, or getting a high-resolution map of how neurons are connected together.

"As technical director, I'll be doing much of the same thing—handling technical aspects of a lot of different machines, while



also trying to push the technological capabilities of the center to enable our users to ask scientific questions they can't currently ask, or didn't know they could ask, such as 'How does stiffness of the brain change with age?'"

The center offers a host of imaging modalities, including two full-body MRI scanners, a SPECT/PET/CT scanner, the Diffuse Optical Imaging Laboratory, ultrasound capabilities, and a 600 MHz Varian MR System.

"We already have scientists associated with each machine," Sutton said, "and they do a great job of ensuring that the best data comes out, so I'll make sure things continue to go well, and then see in what ways we can prepare ourselves for the future, to keep improving, and to continue to be a place that enables the great science that goes on at the Beckman Institute."

Erickson Returns for Senior Fellowship

Kirk Erickson visited the Beckman Institute for a few months to develop collaborations with colleagues investigating links between fitness and cognitive health.



Kirk Erickson returned to familiar ground for his senior fellowship, which gives established faculty from other universities the opportunity to do short-term, onsite, interdisciplinary research with other Beckman Institute researchers.

He received his Ph.D. in psychology from the University of Illinois in 2005, and, after spending six years developing his own lab at the University of Pittsburgh, Erickson took the opportunity in his first sabbatical to “come back home” to develop and continue collaborations.

“I worked in (Beckman Director) Art Kramer’s lab when I was here, and we’ve continued to collaborate throughout the years. I also have collaborated with (Beckman researchers) Chuck Hillman, Eddie McAuley, and their labs. I wanted to come back and hear about what they’re doing, the analyses and papers they’re working on, and whether or not I can bring a fresh perspective based on what my lab has already examined,” Erickson said.

During his fellowship, Erickson met with a host of researchers at the Beckman Institute and across campus to collaborate and share data.

“Art, Chuck, Eddie, and I work in a similar fashion: we don’t hold back data,” Erickson said. “So if somebody here was really interested in analyzing some of my data, awesome, here’s the data. Sharing my ideas and projects with them and vice versa—that’s helpful and what I wanted to come from this.”

Erickson’s research has primarily focused on how exercise interventions can positively affect cognitive health. For example, in one of his studies, older adults were asked to briskly walk, three times a week. This caused a significant increase in hippocampal volume, a region important in memory formation and especially important for older adults, when decreasing hippocampus levels could lead to Alzheimer’s and dementia.

His interest in studying how fitness affects brain function was fostered by his work in Art Kramer’s lab as a graduate student.

“When I was at U of I as a graduate student, I was involved in experiments that studied how the brain and cognitive function

are affected by cognitive training and exercise,” Erickson said. “It proved to be the stepping stone for my own research at Pitt.”

Currently, his lab at Pitt examines the cognitive effects of exercise interventions with clinical populations like those with Parkinson’s disease and depression, as well as examining the extent to which both physical activity and dietary changes influence brain health in midlife—when the risk for dementia increases dramatically. His efforts in this field continue to show great promise.

“Kirk is a star—not only in our lab and in the Beckman Institute, but also in the field of neuroscience,” said Laura Chaddock, Beckman postdoctoral researcher who worked with Erickson when he was at U of I, and continues to collaborate with him. “Kirk is a pioneer in the exploration of the development of the brain across the lifespan, and how lifestyle factors and individual differences in aerobic fitness, adiposity, and genetics relate to brain and cognitive health.”

Erickson also made plans for future research collaborations during his senior fellowship.

He wrote a proposal for a dual-site study with the University of Pittsburgh and the University of Illinois, involving Erickson, Kramer, Hillman, and McAuley, among other U of I faculty and students.

“What we’re proposing is an exercise intervention with older adults. We’d do both a brisk walking and a yoga intervention, so we’re combining Eastern and Western approaches to exercise and seeing whether combining both walking and yoga would benefit cognitive and brain function more than either by itself. We’re planning for a lot of cognitive testing and brain imaging, and a lot of subjects because there are two sites.”

The grant proposal combines the expertise and capabilities of 12 faculty members and the facilities available both at Pitt and the U of I. The collaborative effort will involve discipline expertise in cognitive psychology, exercise, brain imaging, yoga, and more.

Visit go.illinois.edu/erickson to watch a video of Erickson when he was a student at U of I, discussing how exercise improves mental fitness as we age.

HONORS & AWARDS



Boppart Earns Innovation Transfer Award; Named Illinois Proof of Concept Awardee

Harnessing the power of his collaborative team at the Beckman Institute, full-time faculty member Steve Boppart of the Bioimaging Science and Technology Group develops medical instruments that will change the way both primary care doctors and cancer surgeons treat their patients, earning him the 2014 Innovation Transfer Award.

He has also been awarded Proof of Concept funding from the University of Illinois Office of Technology Management. The funding will help prove market viability for Boppart's Quantitative Pneumatic Oscope project, which provides a standard surface view of the eardrum, and also sees through the eardrum to visualize middle ear contents using optical coherence tomography (OCT).



Boppart and King Named Fellows of AAAS

Stephen Boppart and William King are among 388 honorees recognized for their "scientifically or socially distinguished efforts to advance science or its applications." Boppart was recognized for "distinguished contributions to optical coherence tomography and its applications to biomedical imaging." King, Beckman part-time faculty member in 3D Micro- and Nanosystems Group, was elected for "seminal contributions to the engineering of nanometer-scale thermal and mechanical systems and their applications to fundamental understanding of the properties of materials."

King has also been named the chief technology officer of UI Labs, a nascent U of I-affiliated effort focused on turning academic research into moneymaking, job-creating products.



Jain Receives Sloan Fellowship

Prashant Jain, affiliate faculty member in Nanoelectronics and Nanomaterials, received a 2014 Sloan Research Fellowship from the Alfred P. Sloan Foundation. The Sloan fellowship program awards fellows \$50,000 to pursue their choice of research topics and allows them flexibility in applying funds toward their research.



Rogers Elected to the American Academy of Arts and Sciences

John Rogers of the 3D Micro- and Nanosystems Group has been elected to the American Academy of Arts and Sciences, one of the longest-standing honorary societies in the nation. He will join other new members in an induction ceremony in October at the academy's headquarters in Cambridge, Mass.



Cunningham and Rogers Elected to National Academy of Inventors

Brian Cunningham, of the Nanoelectronics and Nanomaterials Group, and John Rogers have been elected 2013 Charter Fellows of the National Academy of Inventors. According to NAI, "Election to NAI Fellow status is a high professional distinction accorded to academic inventors who have demonstrated a highly prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on quality of life, economic development, and the welfare of society."



Liang and Cunningham Elected to Receive EMBS Technical Achievement Award

Zhi-Pei Liang, of the Bioimaging Science and Technology Group, and Cunningham have been selected to receive the 2014 EMBS Technical Achievement Award. Liang is receiving the award for "fundamental and pioneering contributions to the theory, algorithms, and biomedical applications of model-based magnetic resonance imaging": Cunningham for "development and commercialization of optics-based biosensors and detection instruments for applications in drug discovery, diagnostics, environmental monitoring, and life science research."



Li Elected to IEEE Photonics Society Board of Governors

Xiuling Li, affiliate faculty member in Nanoelectronics and Nanomaterials, was recently elected to serve on the IEEE Photonics Society Board of Governors for 2014-16.

Honors and Awards continue on back page.



Kramer Member of Committee on the Public Health Dimensions of Cognitive Aging

Beckman Director Art Kramer is an invited member of the Committee on the Public Health Dimensions of Cognitive Aging. This committee is organized by the Institute of Medicine of the National Academies, and its purpose is to examine and make recommendations on the public health aspects of cognitive aging, with an emphasis on definitions and terminology; epidemiology and surveillance; prevention and intervention opportunities; education of health professionals; and public awareness and education.



Popescu Promoted to SPIE Fellow

Gabriel Popescu, Beckman full-time faculty member in the Bioimaging Science and Technology Group and assistant professor in electrical and computer engineering, has been promoted to a Fellow of SPIE.



Lansing Named Fellow of ASHA

Charissa Lansing, part-time faculty member in Human Perception and Performance, and associate professor in the Department of Speech and Hearing Science, was recently named a Fellow of the American Speech-Language-Hearing Association. The fellowship recognizes individuals who have made outstanding contributions to the discipline of communication sciences and disorders.

Faculty win A'Design Award

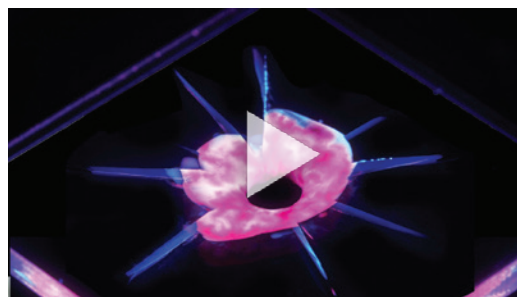
Cliff Shin, from the Cognitive Neuroscience Group, Elizabeth Hsaio-Wecksler, from the Artificial Intelligence Group, Jamie Norton, Beckman Predoctoral Fellow, and Erik Johnson, a Ph.D. student, have received design awards for the Avviare ankle foot orthosis, which can help those with lower limb injury or dysfunction restore normative walking function. The A'Design Competition is an international event recognizing design achievement.

SYNERGY is a publication of the Communications Office of the Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign. Each issue spotlights the people and science that make the Institute one of the premier facilities for interdisciplinary research in the world.

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