2018-2019 **Highlights Report**

Illinois **Bioengineering**

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Contents

2	Everitt Lab Update
4	The Grainger College of Engineering
6	Research Highlights
15	Alumni Spotlight
16	Carle Illinois College of Medicine
18	New Faculty
20	Department News
24	A Sampling of New Research Funding
26	Undergraduate Education
28	Graduate Education
30	Awards and Honors
32	Where are Illinois Bioengineers?

The Illinois Bioengineering annual Highlights Report informs alumni, industry partners, peers, friends, faculty, students, staff and other stakeholders about the department's accomplishments and newsworthy activity. This issue covers the fiscal year 2018-2019.

Department Head Message

Dear Friends and Colleagues,

We have much to celebrate in Bioengineering at the University of Illinois at Urbana-Champaign! When I took over the leadership as head of the department in March 2019, we recently had settled into the renovated Everitt Laboratory. A campus landmark, the building was dedicated to electrical engineering pioneer William L. Everitt in 1949. In September 2018, our campus celebrated the building's renewal, and we are enjoying the new space.

The department is thriving and has generated many "groundbreaking" accomplishments that include the first bioengineering department to: create an engineering-based college of medicine, start an engineering-based basic science cancer center, and obtain an NSF Revolutionizing Engineering Departments (RED) grant, to name a few.

We have tremendously strong partners on campus, as bioengineering faculty members participate actively in campus-wide initiatives and institutes, including the Cancer Center at Illinois, Materials Research Lab, the Carl R. Woese Institute for Genomic Biology, the Beckman Institute for Advanced Science and Technology, and the Nick Holonyak Jr. Micro and Nanotechnology Lab. The department's continued relationships with the Carle Illinois College of Medicine and Carle Foundation Hospital, as well as with other leading medical centers, will provide great opportunities for impactful research and also will facilitate the advancement of academic medicine at Illinois.

Among Bioengineering faculty who earned awards for their excellence this year: Rashid Bashir was named a Fellow in the National Association of Inventors, Rohit Bhargava became a member of the Association of American Cancer Institutes and was named a Researcher to Know in 2018, Stephen Boppart became executive associate dean and chief diversity officer for the Carle Illinois College of Medicine and earned the 2019 SPIE Biophotonics Technology Innovator Award, and Shuming Nie was ranked among the world's most influential researchers by Clarivate Analytics.

In 2018, our former department head, Rashid Bashir, became the dean of the College of Engineering at Illinois. In Spring 2019, the college received a new $100 million gift from The Grainger Foundation and was renamed The Grainger College of Engineering.

I am grateful to have the opportunity to lead the department during this exciting period. I look forward to working with all our stakeholders — students, faculty, alumni, staff, donors and friends.

Mark Anastasio
Department Head
Donald Biggar Willett Professor in Engineering

Newly renovated **Everitt Laboratory** a huge

It has been a year of revitalization for Everitt Laboratory. On September 21, 2018, the campus officially celebrated Everitt Lab as the new home for the Department of Bioengineering. Through tours, speakers, a video and reception, the event highlighted the legacy of the building's namesake, William L. Everitt, a professor, dean, author and inventor who spent 24 years at Illinois.

In attendance at the celebration were Everitt's family, who shared their joy in taking part in such a momentous occasion.

"I am grateful," said William Everitt III. "We're honored for his name to still be here and that the forefront of technology will still have his name on it. Because that's what he believed."

The two-year, $55 million renovation of the 124,000-square-foot building provides the department with contemporary facilities necessary to educate the next generation of bioengineering healthcare innovators and leaders, while providing additional lab and creative space for research that can help improve the human condition.

William Everitt defined the engineering curriculum and "turned Illinois into a world leader," said Rashid Bashir, former head of the Bioengineering department and current dean of The Grainger College of Engineering. "We're thrilled to continue his innovative spirit in the new home for a department that continues to change the world by building upon a rich tradition of success with its life-changing discoveries."

During the past year, Everitt Lab also was home to the inaugural class of the new Carle Illinois College of Medicine, the world's first medical school with an engineering-focused curriculum. Both Bioengineering and medical students also benefit from the $10 million Jump Simulation Center in the basement of Everitt Lab. The Center offers innovative equipment and not only provides technology that helps train medical students but is also a site for testing new medical devices, low-cost mobile technologies for rural and developing areas, medical simulation tools, and bio-printing and bio-fabrication techniques.

boost in resources and morale

The Center can provide customized training programs for hospitals and entities looking for the latest in simulation technology.

“Anything they want to test in an operating room, they can test in our facility,” said Thenkurussi (Kesh) Kesavadas, director of the Healthcare Engineering Systems Center at Illinois. “It is a place where new doctors can learn what happens inside a clinic, and students will experience what it will feel like in an urgent care center.”

Bioengineering faculty and students also have noticed the value of learning and working in the new building.

Greg Underhill, associate professor in Bioengineering said, “Moving into our new home in Everitt has been greatly beneficial by providing a fully integrated space for research and teaching. In particular, the interactive classrooms and teaching laboratory spaces have been transformative for students.”

“I was glad that I was able to call Everitt Lab my home base during my senior year,” said Matthew De Venecia, 2019 BIOE graduate. “The large study spaces and teaching tech in the classrooms easily made it one of the best places to work. My favorite spot … was the senior design lab because the white boards, 3D printers, and workshop tools enabled our creative freedom.”

Viraat Goel, another 2019 BIOE graduate, agrees. “Having a new base in the beautifully renovated Everitt Lab this past year came with a huge boost in both resources and morale. Having spent the majority of my undergrad in the Digital Computer Lab, I was incredibly grateful for BIOE to have an expansive space of its own. The research labs and equipment, especially in the Cell and Tissue Teaching Lab, were exceptional to work in, and the Senior Design Lab became the *de facto* studying, socializing and prototyping spot for the senior class. Finally, by giving both Bioengineering and the new College of Medicine a home base, Everitt fostered a sense of community, created excitement, and became a ‘home’ for the student body.”

The College of Engineering is now

The University of Illinois at Urbana-Champaign's College of Engineering has become The Grainger College of Engineering, recognizing a new $100 million gift from The Grainger Foundation and more than $300 million in total support.

The Grainger Foundation's total support represents the largest amount ever given to a public university to name a college of engineering, with more than $200 million provided in the last six years.

The college has been named in recognition of the contributions of The Grainger Foundation to the excellence of the college and in honor of distinguished alumnus William W. Grainger.

William W. Grainger graduated from the university's electrical engineering program in 1919 and, in 1927, he founded the industrial supply company W. W. Grainger, Inc. Grainger is an Illinois-based Fortune 500 company with more than 25,000 employees worldwide.

As part of the naming, The Grainger Foundation will provide the additional $100 million unrestricted gift to the college's endowment, building upon its past, significant foundational support for even greater impact during the college and university's ambitious With Illinois campaign and beyond.

"What an anniversary! One hundred years after William W. Grainger graduated from our college, his impact is still felt. We are forever grateful," Rashid Bashir, dean of The Grainger College of Engineering, said.

In addition, The Grainger Foundation is currently matching all gifts to the Engineering Visionary Scholarship Initiative for undergraduates—dollar-for-dollar, up to $25 million. The Grainger Matching Challenge was established in 2017 and runs through the end of 2019.

Redefining Our Next 150 Years

The new $100 million gift from The Grainger Foundation is part of the University of Illinois at Urbana-Champaign's With Illinois $2.25 billion capital campaign. The Grainger College of Engineering's goal for the campaign is $550 million, of which almost 85 percent has been raised. This momentum is redefining The Grainger College of Engineering, its student body, its faculty, and the global impact of its research.

We do the impossible every day, and we're going to continue for the next 150 years.

The Grainger College of Engineering

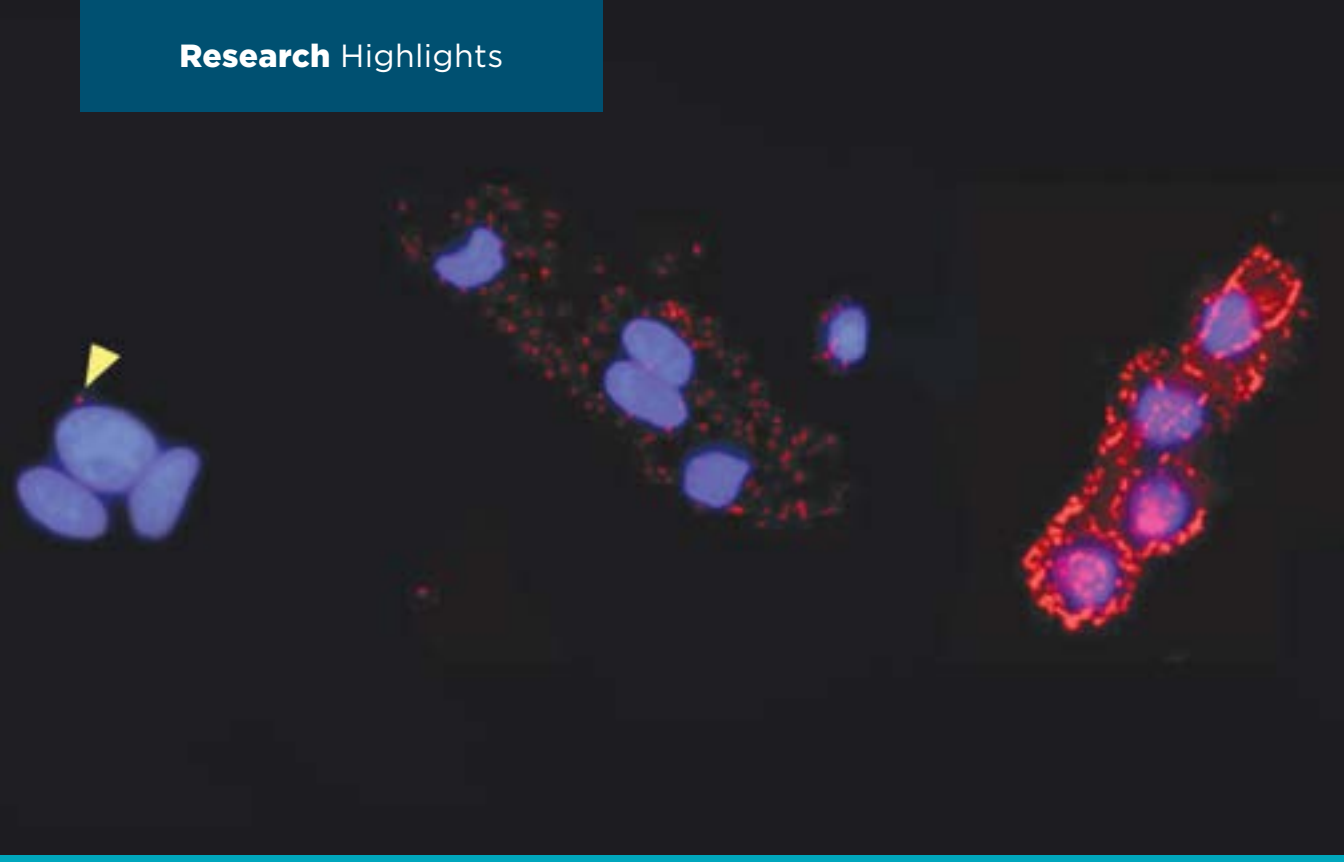
Here are some of the other projects and initiatives currently under way:

- More than $80 million raised in support of the Engineering Visionary Scholarship Initiative.
- A complete renovation and 25,000-square-foot addition to the Mechanical Engineering Building with tremendous support from alumnus Sidney Lu.
- The construction of the Siebel Center for Design.
- Construction of the Campus Instructional Facility.
- Expansion and renovation of the Hydrosystems Lab, Newmark Lab, and the Department of Civil and Environmental Engineering's new Smart Bridge.

The new $100 million gift will be very flexible on how its proceeds can be used and what programs it will support.

"All of us here at The Grainger Foundation are delighted that this gift will further strengthen one of the most distinguished engineering schools in the world," said David W. Grainger, chairman of The Grainger Foundation.

For more on this story, visit:
grainger.illinois.edu/news/features/grainger-naming

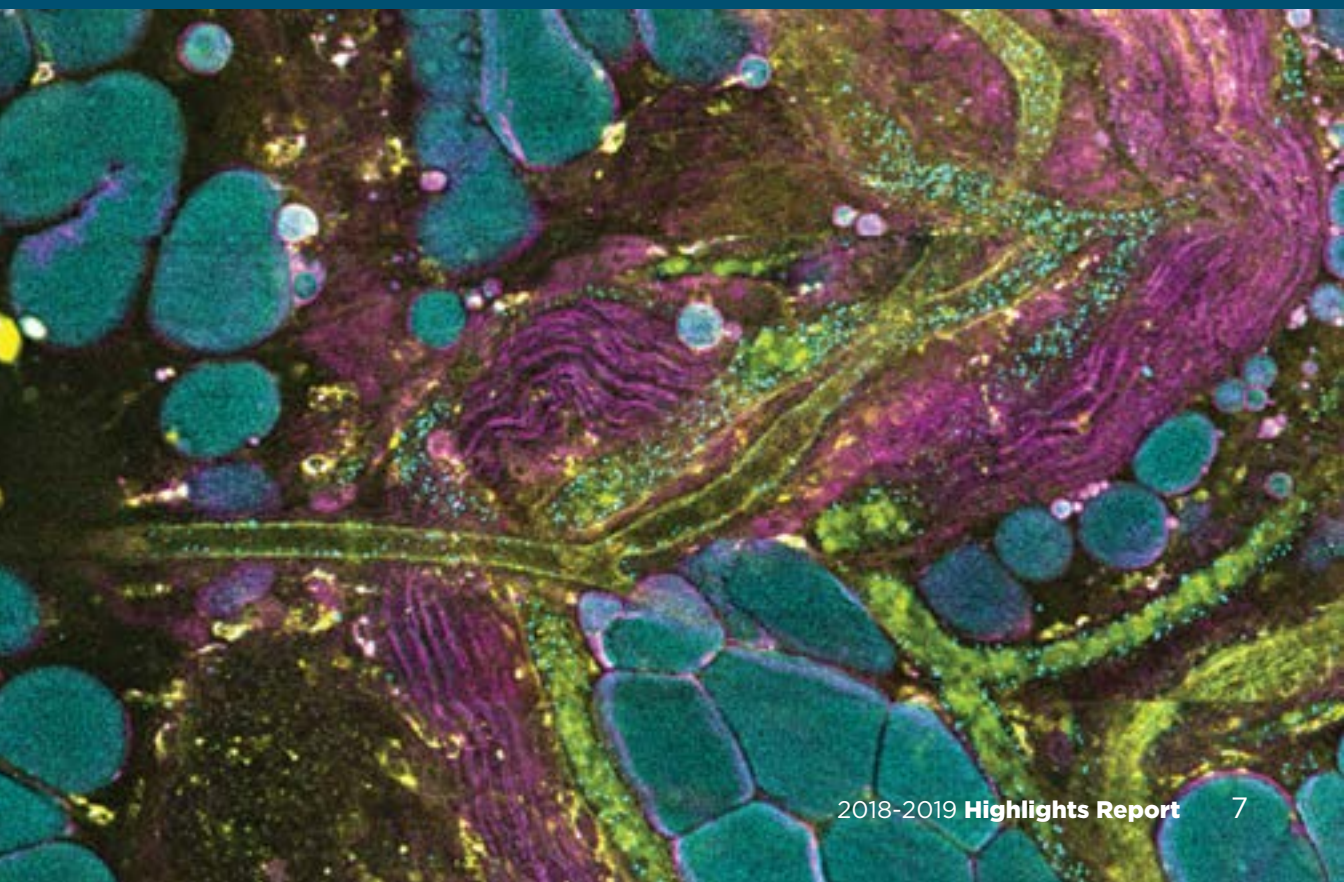


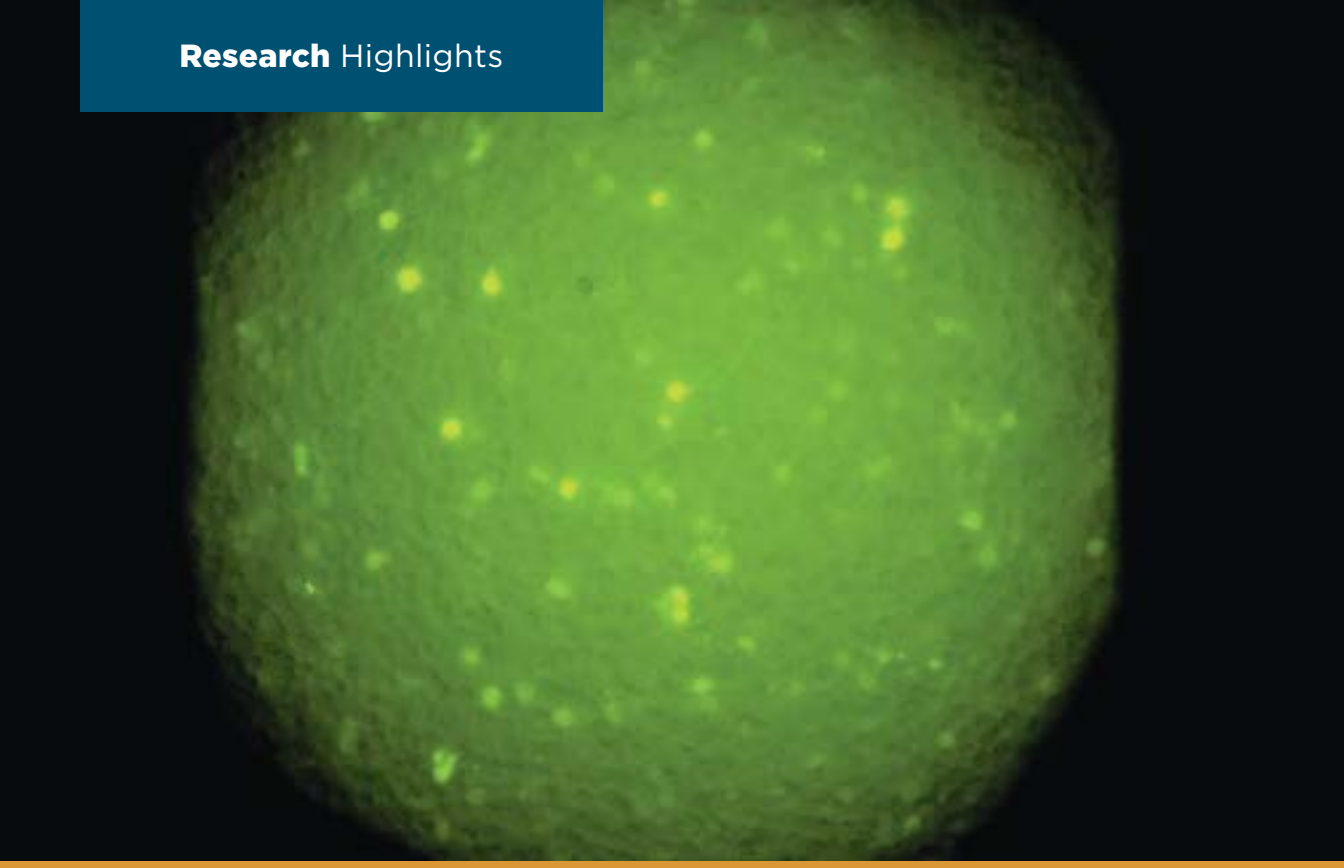
Illinois researchers are first to count growth factors in single cells

Growth factor molecules determine cell behaviors, and when humans have low or high levels of growth factors in their tissues, it can result in diseases, including cancer. In recent research, a team at the University of Illinois at Urbana-Champaign reported the invention of a new technology platform that digitally counts the amount of growth factor entering an individual cell. Previously, growth factor binding was inferred by cell response after introduction of the growth factor. But the Illinois team "showed the first direct cause-and-effect relationships of growth factors in single cells," said **Andrew Smith**, Bioengineering associate professor, who led the study. The work has major implications for further study in drug response, cell signaling, drug resistance, and especially for improved cancer treatments. The team's technology tags each growth factor with a single-engineered infrared fluorescent quantum dot, which can then be viewed using a 3D microscope. In the study, the team counted how many epidermal growth factor molecules bound to human breast cancer cells that were pre-patterned on island-like surfaces. The research was published in Nature Communications and was funded by the National Institutes of Health and the University of Illinois at Urbana-Champaign.

Novel imaging technique brings diagnostic potential into operating room

Extracellular vesicles (EVs), particles naturally released by cells, are a key to determining the spread of cancer in a tumor environment. A team of researchers at the University of Illinois has created a custom portable imaging system that examines untreated human breast tissue in the operating room. Without dyes or toxic ulatraviolet light, it delivers real-time visualization of the tumor environment, including information about EVs. Using the system, the team also examined healthy breast tissue from reduction surgeries. The contrast between images from the two types of samples showed higher EV densities and shorter tumor-to-margin distances in the cancerous tissue. The work, published in Science Advances, is expected to offer a new tool for cancer diagnosis and prognosis using EVs as a label-free biomarker. Leading the study is **Stephen Boppart**, professor of Bioengineering and of Electrical and Computer Engineering and executive associate dean and chief diversity officer in the Carle Illinois College of Medicine. The National Institutes of Health, including the National Institute of Biomedical Imaging and Bioengineering, and the National Cancer Institute, as well as the Cancer Center at Illinois, funded the research.



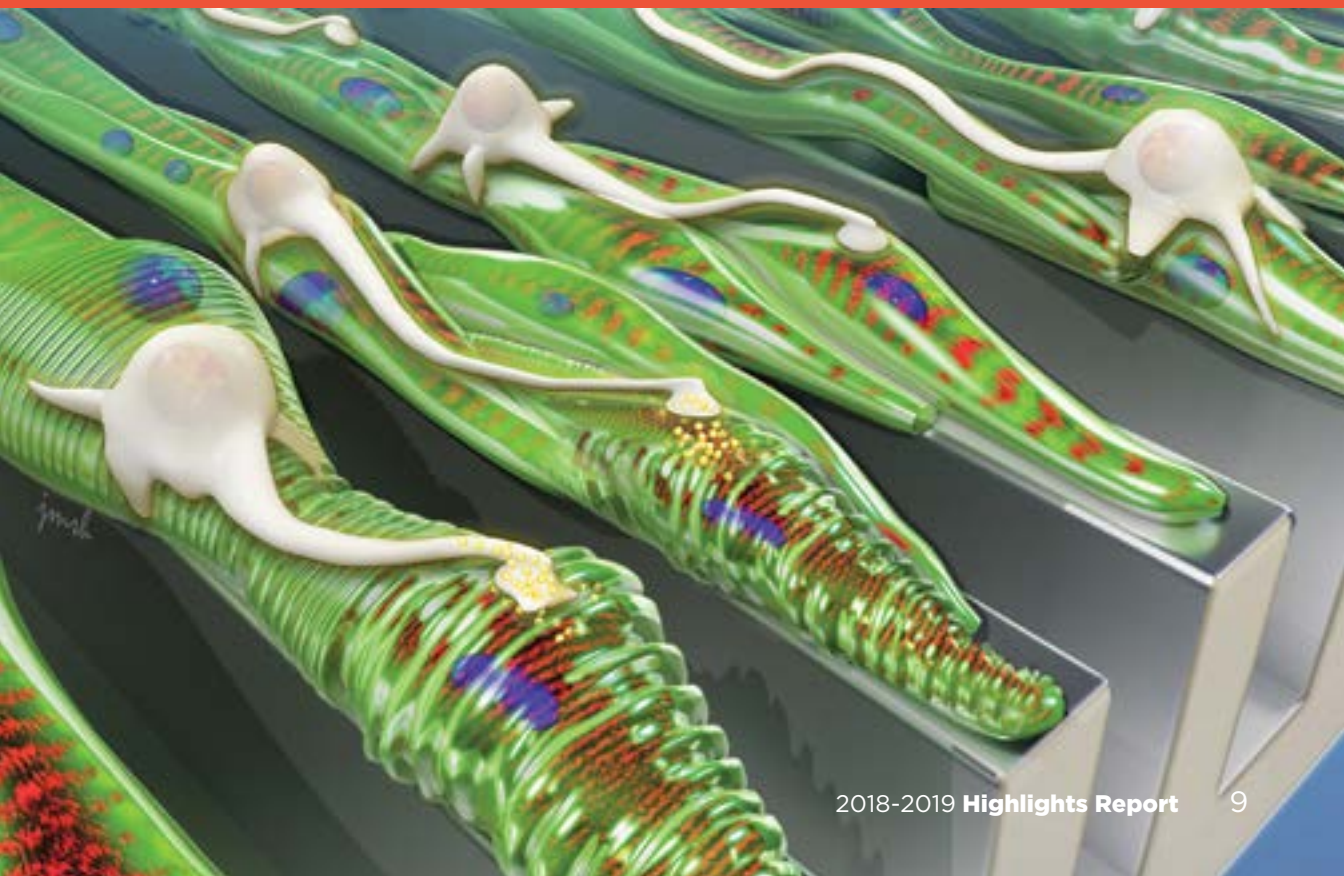


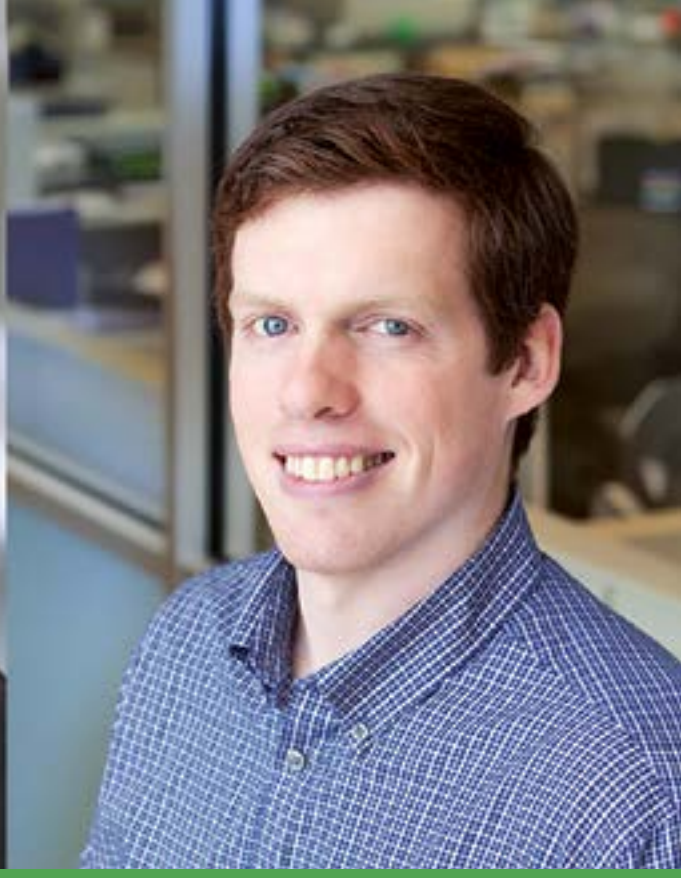
Cell size and cell-cycle states **play key decision-making roles in HIV**

Human immunodeficiency virus (HIV) has become a manageable chronic disease, treated with antiretroviral drugs. Though the drugs are used to prevent AIDS (acquired immune deficiency syndrome), they don't provide a cure, because the virus affects cells by creating either a replicating (treatable) or latent (silent, not-yet-replicating) state. If scientists could create a way to determine whether a cell is uninfected or latent, they could possibly develop a cure. Researchers at the University of Illinois, led by **Roy Dar**, Bioengineering assistant professor, have investigated the reactivation of cells that were latently infected with HIV in the lab. After identifying and quantifying the cells that reactivate, the team discovered that only larger host cells reactivate, while smaller cells remain latent. They also found that cell-cycle states, by which cellular DNA replicates, play a role in viral reactivation from latency, and they were able to use drugs to control distinct levels of viral reactivation of cell populations in specific cell-cycle states. In addition to helping diagnose HIV and guide the design of drug therapies, the work is expected to have applications in synthetic biology. The team includes Erin Tevonian and Melina Megaridis, recent Bioengineering graduates; Meng-Yao Huang and Yiyang "Tony" Lu, Bioengineering graduate students; and Kathrin Bohn-Wippert, post-doctoral fellow in Bioengineering. The paper appeared in the journal Cell Reports and was co-first-authored by Bohn-Wippert and Tevonian.

Neurons integrate better with muscle grown on grooved platforms

When muscle tissue is grown outside the body and integrated with nerves, it can be applied to reconstructive and rehabilitative medicine and used to develop biobots that deliver therapeutic drugs. It is fairly straightforward to grow muscle tissue on a flat surface but more difficult to get it to function like it does inside the body. Researchers at the University of Illinois and the Korea Advanced Institute of Science and Technology (KAIST) have developed a grooved platform on which to grow the engineered muscle, discovering that the grooves help neurons more effectively integrate with the muscle. This creates responses and functionality that are more like muscles act in the body, and it leads the team closer to their goal of creating muscle that responds to neurotransmitters as it responds in the body. Researchers include: Project Co-leaders Hyunjoon Kong, professor of Chemical and Biomolecular Engineering at Illinois, **Rashid Bashir**, professor of Bioengineering and dean of the Grainger College of Engineering at Illinois, and Sung Gap Im, associate professor of Chemical and Biomolecular Engineering at KAIST; also from Illinois are: Marni Boppart, associate professor of Kinesiology and Community Health; and Clare Ko and Gelson Pagan-Diaz, Ph.D. students in Bioengineering. Both Bashir and Kong also are affiliated with the Carle Illinois College of Medicine. The artist's rendering (below), by Janet Sinn-Hanlon, shows grooved surfaces helping muscle grow into aligned fibers, which provide a track for neurons to follow.



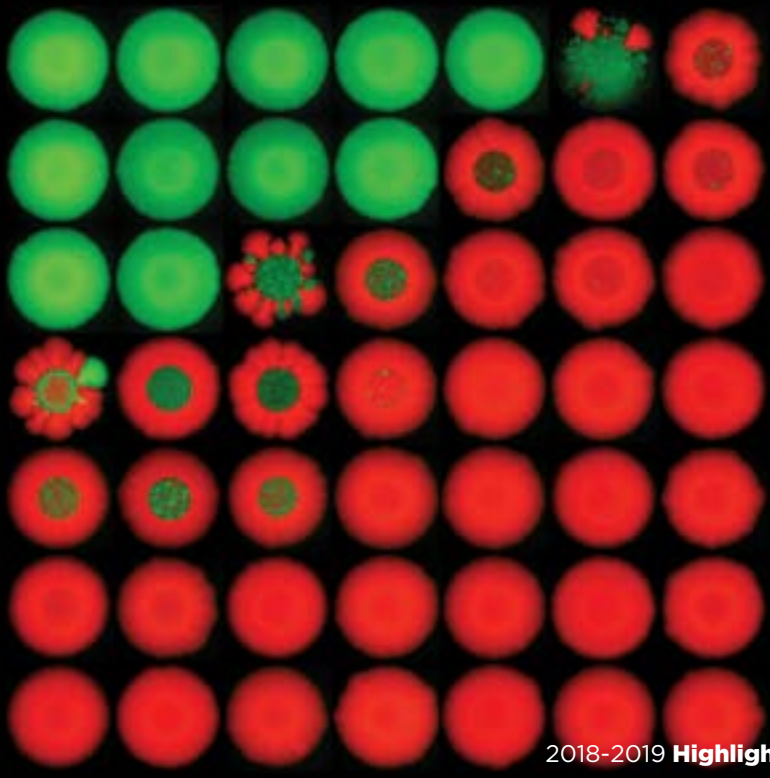


Researchers are first to sequence rare bacteria that causes rampant tooth decay

When good and bad bacteria in our mouths become unbalanced, tooth decay occurs. The bad bacteria, *Streptococcus mutans*, forms a biofilm and takes sugars we eat and ferments them into acid, which decalcifies our teeth and causes cavities. Scientists know, though, that there is a second harmful bacteria, *Streptococcus sobrinus*, that accelerates tooth decay in some people, but very little is known about this microbe. This will soon change, because a team of Illinois Bioengineering researchers led by Assistant Professor **Paul Jensen** (above, right) has successfully sequenced the complete genomes of three strains of *S. sobrinus*. Jensen says *S. sobrinus* is difficult to work with in the lab and it is not present in all people, so researchers have instead focused their efforts over the years on understanding the more stable and prevalent *S. mutans*, which was sequenced in 2002. Now that the *S. sobrinus* sequencing is complete, Jensen and his students — including Mia Sales, recent Bioengineering graduate and first author on the paper (above, left) — worked on building computational models to better understand how the two bacteria interact and why *S. sobrinus* can cause such potent tooth decay when combined with *S. mutans*. The team already has confirmed that *S. sobrinus* lacks complete pathways for quorum sensing, which is the ability bacteria have to sense and react to nearby bacteria and ultimately proliferate. The work was published in Microbial Resource Announcements.

The distance of microbial competitions **shapes their community structures**

Microbes constantly compete with each other for nutrients, space and other resources across multiple spatial scales. When close together, they assemble a molecular device to inject toxins into their neighbors, suppressing their growth. When far apart, microbes release a small toxic molecule that travels through the community into other cells, causing their death. **Ting Lu**, associate professor in Bioengineering, wanted to know if the varying distances of interactions affect the organization of microbial communities. Addressing this question can help researchers to understand how these communities assemble and to create functional artificial ecosystems for disease treatments. Lu's research team developed synthetic microbial communities and mathematical models to study the role of varying distances during microbial battles. Their results reveal an important reciprocal relationship between space and time. In the community where one type of microbe kills another, the team found that long-range competition was more effective, as it took less time for the microbe to kill its competitor at a long range than at a short range. In contrast, for communities with bidirectional killing, their structures diverge into distinct monoculture colonies under different initial conditions. The team believes their study, published in Science Advances, may be the first experiment to uncover the role of spatial interaction scale in the organization of microbial communities. The research was funded by the National Science Foundation, the Office of Naval Research, the American Heart Association, the Brain and Behavior Research Foundation, and the National Center for Supercomputing Applications at Illinois.

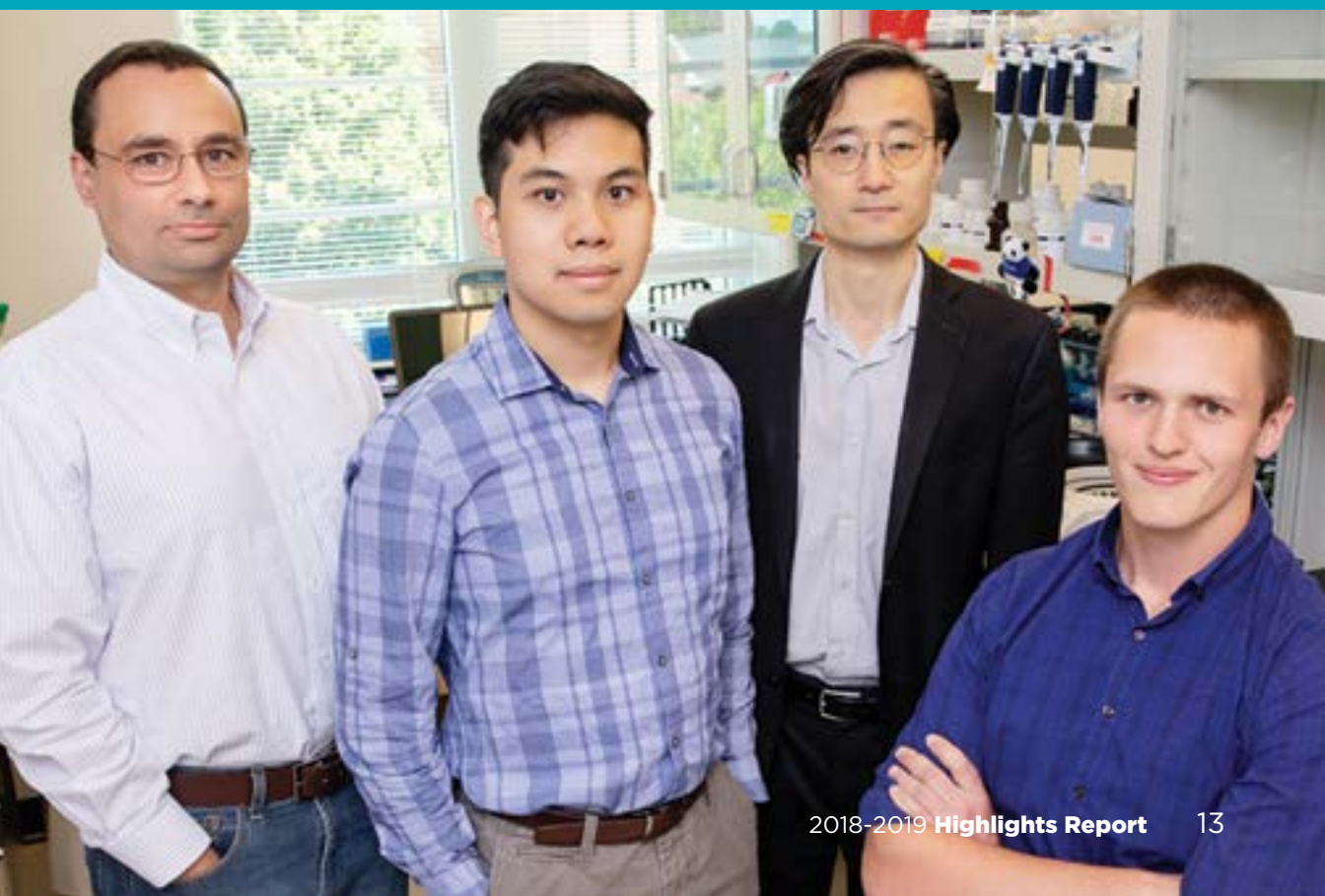


Researchers develop imaging agent for receptor that is key to multiple diseases

An international research collaboration, led by **Wawrzyniec Dobrucki**, associate professor of Bioengineering and of Medicine at Illinois, has developed a noninvasive multimodal nanoparticle-based imaging agent that can assess the receptor for advanced glycation end-products (RAGE). More accurate assessment of the receptor, which was recently identified as a key structure involved in diabetic complications, also could help with earlier cancer diagnosis or advanced targeted therapy. The overexpression and activation by RAGE with its ligands initiate a number of biochemical pathways leading to oxidative stress and inflammation that are known to contribute to the pathogenesis of several diabetes-related complications, neurodegenerative disorders, as well as numerous cancer types. The advanced glycation end-products (AGE) generated during the glycation process and their receptor represent a new biomarker of a disease process involving inflammatory pathways. A major focus of the four-year study was developing and characterizing the imaging tracer — synthesized in the lab — because there was no existing mechanism for imaging AGE and their receptor. The team focused its work on cardiovascular pathologies and cancer, and the next paper — already submitted for publication — shows for the first time the imaging of prostate cancer using the same particle. The work was published in Theranostics, and the image on this page, which was created by Jose Vazquez of Beckman Institute's Visualization Lab, appeared on the inside front cover of the journal issue.

New CRISPR technique **skips over portions of genes that can cause disease**

University of Illinois researchers led by **Pablo Perez-Piñera** (pictured below, far left), Bioengineering assistant professor, and Jun Song (second from right), Physics professor, have adapted CRISPR gene-editing technology to cause a cell's internal machinery to skip over a small portion of a gene when transcribing it into a template for protein building. In mammal cells, genes are broken up into segments called exons that are interspersed with regions of DNA that don't appear to code for anything. When the cell's machinery transcribes a gene into RNA to be translated into a protein, there are signals in the DNA sequence indicating which portions are exons and which are not part of the gene. The cell splices together the RNA transcribed from the coding portions to get one continuous RNA template by recognizing specific sequences known as splice acceptors. CRISPR-SKIP alters a single base in the splice acceptor before the beginning of an exon, causing the cell to read it as a non-coding portion. This gives researchers a way not only to eliminate a mutated gene sequence but to influence how the gene is expressed and regulated. The new technique, described in the journal Genome Biology, will soon be used for treating genetic diseases caused by genome mutations, such as Duchenne's muscular dystrophy, Huntington's disease, Amyotrophic Lateral Sclerosis, or even some cancers. Also pictured below are Alan Luu (second from left), Physics Ph.D. student, and Michael Gapinske (far right), Bioengineering Ph.D. student.



Color-changing sensor **detects signs of eye damage in tears**

Researchers at the University of Illinois at Urbana-Champaign collaborated with Leanne Labriola, an ophthalmologist at Carle Foundation Hospital in Urbana, Ill., to develop a new point-of-care, rapid-sensing device that can detect a key marker of eye injury in minutes — a time frame crucial to treating eye trauma and saving the patient's sight. **Dipanjan Pan**, associate professor in Bioengineering and in the Carle Illinois College of Medicine, led the study. The team developed a gel laden with gold nanoparticles that changes color when it reacts with a teardrop containing ascorbic acid, which is released from a wound to the eye. Using the sensor, called OjoGel, the researchers measured ascorbic acid levels in artificial tears and in clinical samples of fluid from patients' eyes. The group expects the gel technology to help identify serious eye injuries much quicker, which helps determine if a patient needs urgent surgery to save his or her vision, and it also could help evaluate patients after eye surgery. In previous work, the team determined that ascorbic acid concentration in tears is a good measure for determining the extent of injury to the eye, and a tiny teardrop is all that is necessary to cause a color change in the OjoGel. After extensive testing, the researchers developed a color key and guidelines for using Pixel Picker, a smartphone app, to precisely measure the concentration in a sample. Future plans include developing a low-cost, easy-to-use clinical device. The team includes Santosh Misra, postdoctoral researcher; Ketan Dighe, visiting scholar; Aaron Schwartz-Duval, Ph.D. student in Bioengineering; and Zaixi Shang, summer scholar. Published in the journal Biosensors and Bioelectronics, the work was supported by the National Science Foundation, American Heart Association and Carle Foundation Hospital.

Matt Schuelke

BS 2013 Bioengineering
Student
Mayo Clinic
Medical Scientist Training Program

After five years in Mayo Clinic's M.D./Ph.D. program, **Matt Schuelke** says his Illinois Bioengineering degree is still paying dividends. Bioengineering trained students in a unique breadth of fields, he said, ranging from electrical engineering to biomechanics to regenerative medicine. In the Mayo Medical Scientist Training Program (MSTP), Schuelke conducts research that engineers viruses and the immune system to fight cancer. He is exploring ways to adapt existing viral and immune-based therapies to treat a rare pediatric brain stem tumor called Diffuse Intrinsic Pontine Glioma (DIPG). His Ph.D. thesis is designed to prompt the next step toward clinical trials for DIPG therapy. After completing his medical and Ph.D. degrees, Schuelke plans to enroll in a pediatrics residency and hopes to join a pediatric hematology-oncology fellowship where he will launch his career in pediatrics research as an immuno-oncologist.

Yue Zhuo

PHD 2015 Bioengineering
Research Fellow
Harvard Medical School

Yue Zhuo spent the 2018-2019 academic year as the inaugural Thomas F. Deutsch Fellow in Biomedical Optics at Massachusetts General Hospital, which is affiliated with Harvard Medical School. The Optical Society and The Wellman Center for Photomedicine created the fellowship to honor Dr. Deutsch's contributions to the field of biomedical optics. Zhuo earned her Ph.D. in Bioengineering in 2015 and, in 2016, was a postdoctoral fellow at the Beckman Institute for Advanced Science and Technology. Also at Illinois, Zhuo was a member of the nanosensors research group, where she worked on developing a label-free platform to dynamically and quantitatively monitor the interactions between live cells and substrate during adhesion and migration with high resolution, high sensitivity, and long-term imaging. Currently Zhuo is a research fellow at Harvard Medical School.

Future physician innovators at Illinois

The Carle Illinois College of Medicine is the first in the world to integrate engineering principles with teaching medicine. The four-pillar approach infuses basic sciences, clinical sciences, engineering and innovation, and medical humanities into all four years.

Rashid Bashir, former head of Bioengineering and executive associate dean of the medical school, now dean of The Grainger College of Engineering, explains the goal of the curriculum that is entering its second year.

"The mission is to create real environments with virtual situations," Bashir said. "These include mock facilities for the intensive care unit, the operating room and the patient-doctor interaction."

"We've developed a new curriculum in which we still teach the material that students need to be successful physicians while grounded in compassion and care," he added. "And we do this by utilizing visualization with 3D virtual reality headsets that enable you to see inside the body and virtual environments that place you inside an operating room."

This type of learning completely transforms the educational experience and provides for deeper understanding, enhanced curiosity, and better problem-solving skills — all based in the most current technology available.

The medical students learn from the best, including Brad Sutton, a professor in Bioengineering and in the Carle Illinois College of Medicine. Sutton's research interests include developing magnetic resonance imaging (MRI) methods to understand the structure and function of the brain and its age-related changes, imaging blood flow and mechanical properties of the brain, and developing techniques to understand how the brain controls muscles during speech and swallowing.

"Brad is the go-to person on our campus for conducting MRI research," said Rohit Bhargava, a Founder Professor of Engineering; professor in Bioengineering, in Chemical and Biomolecular Engineering, in Chemistry, and in Electrical and Computer Engineering; and director of the Cancer Center at Illinois. "In addition to developing technology, Brad has enabled many applications for a wide

study engineering-based medicine

variety of science across our campus. He boasts an immense portfolio of collaborative research."

Student Elizabeth Woodburn (above, left, shown conducting CPR training with Illini EMS; photo courtesy of Elizabeth Woodburn) entered the inaugural class of the new medical school as a 2013 graduate of Illinois Bioengineering, which created a unique situation for her. She has been able to share with her classmates an insider perspective on the Illinois community. As one of the youngest members of the first class, Woodburn says she was nervous originally, but she says now, "We all have different backgrounds, but we started on this particular path together very much as peers."

Woodburn was able to dive into her early clinical experience and care for patients under the guidance of Carle physicians. She also was able to further develop a diagnostic tool she created.

"I worked to adapt a portable, inexpensive smartphone spectrometer to be able to analyze urine dipsticks," she said. "After demonstrating that the system could tell the difference between different colors of paper based on the light that they scattered, I identified urine dipsticks as a way that this new technology could meet an existing clinical need. The project and the support I received from my graduate student mentor were invaluable bridges between my previous BIOE training and my current work towards becoming a physician-innovator."

Eventually, Woodburn hopes to practice medicine in a way in which her patients feel comfortable and recognize that she is someone who is there to work through their concerns with them. She also wants to be working on new technologies to bridge the gap between the lab environment and the patient experience.

Mark Anastasio

Amy Baek

Mark Anastasio is the new department head in Bioengineering and a Donald Biggar Willett Professor in Engineering as of March 2019. Anastasio came to Illinois from Washington University in St. Louis, where he was the Joseph and Florence Farrow Professor in the Department of Biomedical Engineering. He is internationally recognized as an expert in tomographic image reconstruction, imaging physics, and the development of novel computed biomedical imaging systems. He has conducted pioneering research in the fields of photoacoustic computed tomography, diffraction tomography, and X-ray phase-contract imaging. Anastasio earned a Ph.D. in Medical Physics and M.S. in Physics from the University of Chicago, M.S.E. in Electrical Engineering from the University of Pennsylvania, and B.S. in Electrical Engineering from the Illinois Institute of Technology. He has earned an NSF CAREER Award for research related to image reconstruction, was elected to the American Institute for Medical and Biological Engineering College of Fellows, was named a Fellow of the International Society for Optics and Photonics, and is a senior member of the Institute for Electrical and Electronics Engineers.

A physiologist by training, **Amy Baek**, research assistant professor in Bioengineering at Illinois, conducts research that explores extracellular vesicles (EVs), which are circulating cell-derived particles containing regulatory molecules that can affect changes in target cells. Released from many types of cells and associated with cancer progression, EVs are a rapidly growing field of interest. Previous to joining the Bioengineering faculty, Baek was a post-doctoral researcher in the Molecular and Cellular Biology department at Illinois, where her work was funded through a Susan G. Komen fellowship. As a fellow, she worked on a project that examined how cholesterol impacts breast cancer metastasis, which resulted in a paper published in Nature Communications. Baek earned a Ph.D. from the University of Michigan and B.A. from the University of Pennsylvania.

Frank Brooks

Hua Li

As a member of Professor Anastasio's research team, **Frank Brooks**, research assistant professor in Bioengineering at Illinois, develops methods for analyzing medical imaging data acquired with the group's novel pre-clinical X-ray system. Using an uncommonly bright source, the benchtop system produces high-resolution images while significantly reducing the amount of radiation to which a subject is exposed as compared to using a standard computerized tomography (CT) scan. Brooks and the group are developing the technology for use on small animals such as mice, because medical researchers studying various diseases perform much of their modeling on these subjects. Brooks applies statistical learning-based methods to lung images obtained from mice *in vivo*. He also helps design the animal imaging experiments, and with collaborators at other institutions, he is extending those experiments and analyses to various disease models. Brooks earned a Ph.D. from Washington University in St. Louis and conducted post-doctoral research in Radiation Oncology there.

Hua Li is a clinical medical physicist at the Carle Cancer Center in Urbana, Ill., where she is developing advanced imaging and image analysis techniques to help solve clinical problems in radiation therapy and disease diagnosis. She also is an adjunct research associate professor in Bioengineering at Illinois, where she runs the Medical Imaging and Bioinformatics Lab. Her research focuses on developing personalized chemo-radiation therapy for cervical cancer patients. She and her team are exploring a large database of PET, MRI and CT images; standard biomarkers; and clinical outcomes from about 400 cancer patients. The goal is to develop an innovative and accurate radiomics-based prognostic model for predicting cervical cancer treatment outcomes. Previously Li was a faculty member in Radiation Oncology at Washington University in St. Louis, where she collaborated with physicians at the medical school. She also was part of a team that proposed a new PET tumor segmentation algorithm to reduce the variations on tumor volume and provide stable radiomic features. Li earned a Ph.D. in Electrical Engineering and completed residencies at Mayo Clinic. She and her students are three-time winners of the Best in Physics prize from the American Association of Physicists in Medicine.

Mark Anastasio

Mark Anastasio became the new head of the Department of Bioengineering in March 2019. As a member of the Illinois faculty, he is a Donald Biggar Willett Professor in Engineering, and he is Bioengineering's fourth head since it became a department in the College of Engineering in 2003. Anastasio is an internationally recognized expert in tomographic image reconstruction, imaging physics, and the development of novel computed biomedical imaging systems. Previously he was the Joseph and Florence Farrow Professor in Biomedical Engineering at Washington University in St. Louis.

Rashid Bashir

Rashid Bashir, former Bioengineering department head, became the dean of the College of Engineering (now the Grainger College of Engineering) in November 2018. Bashir holds the Grainger Distinguished Chair in Engineering. He joined the Illinois faculty in 2007 as a professor of Bioengineering and Electrical and Computer Engineering. He also is a professor of Medicine in the Carle Illinois College of Medicine and a former director of the Micro and Nanotechnology Laboratory.

Stephen Boppart

Stephen Boppart has joined the leadership team of the Carle Illinois College of Medicine as executive associate dean and chief diversity officer. He is charged with strategically developing the university's first engineering-based college of medicine into a global leader in engineering- and technology-based medical education and healthcare delivery research. Boppart earned a Ph.D. in Medical and Electrical Engineering from the Massachusetts Institute of Technology, an M.D. from Harvard Medical School, and M.S. and B.S. (with option in Bioengineering) in Electrical Engineering from the University of Illinois at Urbana-Champaign. At Illinois, he also is an Abel Bliss Professor of Engineering in Bioengineering, in Electrical and Computer Engineering, and in Medicine, and director of Imaging at Illinois.

Jonathan Sweedler

Yurii Vlasov

A team of researchers at the University of Illinois at Urbana-Champaign are working on developing a silicon platform technology for monitoring a broad range of neurochemicals in the brain with high spatiotemporal resolution and minimal tissue damage. The new research is funded through the National Institutes of Health's Brain Research through Advancing Innovative Neurotechnologies® (BRAIN) Initiative, which is aimed at revolutionalizing our understanding of the human brain. Leading the research at Illinois are Professors **Rashid Bashir**, **Yurii Vlasov**, and **Jonathan Sweedler**, all with appointments in Bioengineering.

Hosted by the Bioengineering department and funded by the Mayo-Illinois Alliance, a joint workshop between Illinois and Mayo Clinic was held at the Urbana campus in April 2019 to address grand challenges in medicine. Illinois Bioengineering faculty were among those presenting during the two-day event, which brought together students from the Mayo Clinic College of Medicine and Science and **Illinois Bioengineering students in the Master of Engineering program**. The aim was to spark innovation, discuss technology-driven solutions to medical issues, and hear from experts in biosensing, artificial intelligence, smart implants and robotics. Activities included team-based problem-solving and tours of campus labs and centers, including the Beckman Institute for Advanced Science and Technology and the Jump Simulation Center.

Karin Jensen

Paul Jensen

New England Biolabs, a supplier of enzymes for biological research, donated reagents to the Department of Bioengineering in late 2018. The reagents are used in a newly developed lab activity in the Cell and Tissue Engineering course, BIOE 202, taught by Teaching Assistant Professor **Karin Jensen**. Jensen developed the activity with Assistant Professor **Paul Jensen** and **Caroline Blassick**, BS '18 BIOE, course assistant. The lab activity helps students visualize enzyme behavior and better understand how enzymes act as catalysts for chemical reactions in biological systems and their wide-ranging implications in biomedical research.

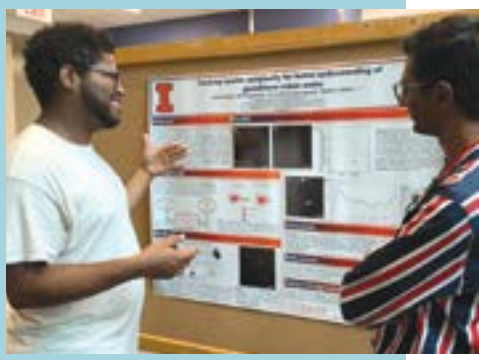
Caroline Blassick

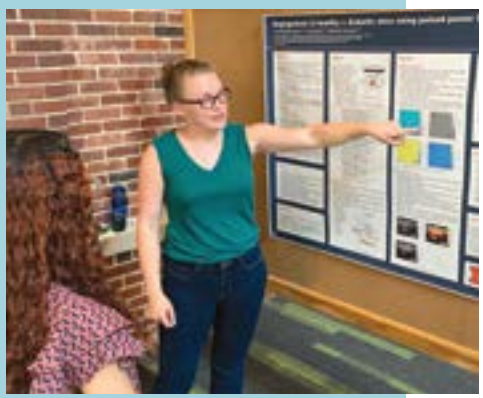
Rashid Bashir and his work with biobots was featured in the PBS News Hour in February 2019, introduced by Judy Woodruff and reported on by Miles O'Brien. Bashir explained how researchers often are trying to mimic nature when developing medical devices and innovations. Bashir and his research team have created biobots made of muscle cells, and they control the biobots' movement with electrical or optical pulses. By replicating nature's design rules, Bashir explained that he and his team are building non-natural systems with living cells, which have numerous potential implications such as targeted drug delivery, toxic cleanup, or the creation of tiny clot-busters to treat heart disease.

Inspired by Dug, the talking dog, from the movie, "Up," a team of students at the University of Illinois at Urbana-Champaign created and demonstrated a EEG-based talking-dog collar for the annual Engineering Open House (EOH) in March 2019. The effort not only earned them an EOH prize, it also garnered national media attention. The team includes (pictured here) Bioengineering students: **Jessica Austriaco** (first row, center), **Matthew De Venecia** (first row, right), **Christine Lannon** (back row, second from right), **Kyla Swain** (first row, left), **Suva Laxminarayanan** (back row, far right), and **James Soole** (back row, far left); and Bliss Chapman (back row, middle), Statistics and Computer Science; and Amanda Maher (back row, second from left), Mechanical Science and Engineering. They fitted the collar to Lannon's dog Alma and were able to "read" Alma's electrical brain signals to determine how she responds to a stimulus such as the presence of a treat. The students 3D-printed their own electrodes to save money and ensured they created a safe device for Alma. After research, discussion, development and testing, they used their system to determine that Alma was excited about a treat, translated that excitement into what she might be thinking, and had a speaker deliver the audio, "Treat! Yes, I want the treat! I do so definitely want the treat! I would be very happy if I would have the treat!"

Rohit Bhargava

Rohit Bhargava and his 3D bioprinter were featured in PC Magazine's "5 Amazing Projects That Will Change the Future of Healthcare," March 6, 2019. The article describes how Bhargava's printer can create a 3D heart with interconnected filaments instead of a multi-layered object that a standard 3D printer generates. The aims are to produce replicas of human organs, blood vessels and other tissue to allow for quick reproductions of experiments and better understand differences between healthy and diseased tissue. Eventually, the entire microenvironment could be 3D-printed, leading to more personalized, targeted diagnoses and treatment for diseases such as cancer. Bhargava is an Illinois professor in Bioengineering, Chemical and Biomolecular Engineering, and in Chemistry, and is director of the Cancer Center at Illinois.





The **Frontiers in Bioimaging** summer research program at Illinois Bioengineering attracted students from universities as close as Terre Haute, Ind., and as far away as Puerto Rico. As part of the National Science Foundation's Research Experiences for Undergraduates (REU) program, 10 students arrived in May 2019 and spent the summer living and learning on the Urbana-Champaign campus. They explored the use of imaging technology in medical applications for diagnosing and treating diseases, enhanced their skills, engaged in professional development, and prepared for graduate school programs and future bioengineering-related careers. The REU is supported by the Department of Bioengineering and takes advantage of Illinois' renowned expertise in bioimaging. The program often exposes students to bioengineering-related fields they may not have considered before. Students work with faculty and graduate student mentors and gain an idea of what graduate school might be like and how to enhance their graduate applications. REU participants at Illinois have had great success post graduation; 90 percent from the previous four UI bioimaging cohorts entered graduate school, and eight of those 40 students are currently enrolled at Illinois.

Mac-Attack: A multi-pronged single-macrophage platform towards defeating Mtb

Roy Dar, PI

SUPPORTED BY: The Jayne Koskinas Ted Giovanis Foundation for Health and Policy

The goal of this project is to combine experimental and computational approaches for investigating Mtb resistance to drug treatment.

Engineering platforms for genome-scale screening of transcriptional activation domains

Pablo Perez-Piñera, PI

SUPPORTED BY: National Institutes of Health, National Institute of Biomedical Imaging and Bioengineering

Perez-Piñera will develop novel techniques for creating artificial proteins through recombination of mammalian genomes with synthetic DNA. This technology will enable the creation of customized proteins that can be programmed to perform specific functions within cells, such as activating expression of specific genes.

In vivo correction of SOD1-linked ALS using single base editing technology

Thomas Gaj, Pablo Perez-Piñera, co-PIs

SUPPORTED BY: Muscular Dystrophy Association

Gaj and Perez-Piñera will develop novel base editing technologies that are compatible with *in vivo* viral delivery to correct one form of amyotrophic lateral sclerosis, a currently lethal and incurable neurodegenerative disease.

EAGER Collaborative Proposal: Developing engineering faculty as engineering education researchers through mentorship

Karin Jensen, PI

SUPPORTED BY: National Science Foundation

Jensen will study best practices of mentoring engineering faculty in engineering education research who are participating in the NSF RIEF program and will provide networking opportunities and training for those faculty.

Automated, model-guided phenotyping to identify metabolite/gene/microbe interactions

Paul Jensen, PI
SUPPORTED BY: National Institutes of Health, National Institute of Biomedical Imaging and Bioengineering

The Jensen Lab is building a robotic system that can design, conduct and analyze its own experiments.

Multi-scale engineering of developmental stochasticity in stem-cell-derived cardiomyocyte organoids

Roy Dar, Hyunjoon Kong, co-PIs
SUPPORTED BY: National Institutes of Health, National Institute of Biomedical Imaging and Bioengineering

The goal of this project is to engineer fluctuations in the expression of pluripotent transcription factors during *in vitro* stem cell aggregate and 2D monolayer formation towards the development of cardiac organoids.

Advanced molecular probes and cell engineering tools for accurate single-molecule analysis of signaling in individual cells

Andrew Smith, Pablo Perez-Piñera, co-PIs
SUPPORTED BY: National Institutes of Health, National Institute of General Medical Sciences

Smith and Perez-Piñera will develop technologies to make biological communication processes visible to the eye through light microscopy so that these events can be quantified in single cells for the first time to understand how they mediate a variety of diseases.

Engineering CRISPR-base editing approaches for correcting mutant HTT

Thomas Gaj, Pablo Perez-Piñera, co-PIs
SUPPORTED BY: CHDI Foundation

Huntington disease is an incurable neurodegenerative disease that causes progressive cognitive and motor symptoms and ultimately, death. Gaj and Perez-Piñera will develop technologies to decrease expression of huntingtin, the toxic protein whose accumulation in the brain causes this disease.

Expanding, revolutionizing undergraduate

Illinois Bioengineering students are learning and working in the newly renovated Everitt Laboratory, which the department moved into in Summer 2018. We share the building with medical students studying in the **Carle Illinois College of Medicine**, the first engineering-based medical school in the country, and the $10 million **Jump Simulation Center**, which opened in August 2018. Bringing together bioengineering and medicine, all under one roof, provides students at every level with numerous research, course and career opportunities within and across disciplines.

In addition to increasing and updating our space, **we also expanded the number of students enrolled in Bioengineering** — and that number has steadily increased each year since we enrolled our first cohort in 2009. In 2018, we brought in 80 new students, the largest class of freshmen to date, and in May 2019, 64 students received their bachelor's degrees in Bioengineering. Our target is 100 new students by Fall 2020 and a total of 400+ undergraduates (287 currently enrolled) in Bioengineering.

The students also benefited from our **Revolutionizing Engineering Departments (RED) program**, supported by the National Science Foundation, which helped us create and complete the first comprehensive offering of elective discipline-breadth courses for freshmen and sophomores, BIOE 100 Introduction to Bioengineering, 120 Grand Challenges in Bioengineering, 200 Bioengineering Career Immersion, and 298 Professional Ecosystems in Bioengineering.

The curriculum remodel helps immerse engineering students in medical problems, providing a clinical experience early in their education.

education in Bioengineering at Illinois

Our 2019 graduating seniors (above) took part in capstone projects as part of Senior Design. Projects include software to quickly send patients' vital signs to emergency room physicians; a robotic platform to improve accuracy in neural probe insertions; more personalized, comfortable headpointers for people with neuromotor impairment; a mechanical arm that holds a radiation sheath to protect healthcare professionals; a "swiss army" catheter combination to aid in repairing aortic aneurysms; a user-friendly fluid drainage system; an umbilical cord catheterization trainer.

They engage with real-life health care challenges, allowing them to creatively imagine the possibilities of engineering-based solutions to medical issues. As the first to receive the NSF RED grant, the Urbana-Champaign campus has taken a leadership position in shaping bioengineering education.

With the new building, we increased teaching lab space, allowing for more exploration and hands-on experience, such as in 3D printing and gene editing. **Seven Bioengineering courses were converted to active learning** classroom formats, which moves students from passively digesting information to actively engaging them in the learning process with meaningful activity that helps develop their critical thinking skills. The revamped courses include: BIOE 201 Conservation Principles in Bioengineering, 205 Signals and Systems in Bioengineering, 220 Bioenergetics, 310 Computational Tools for Biological Data, 360 Transport and Flow in Bioengineering, 414 Biomedical Instrumentation, and 420 Introduction to Biological Control Systems.

Bioengineering also introduced these **new courses** this past year: BIOE 498/598 Biomarkers, 498/598 Finite Element Methods in Biomedicine, 498/598 Surgical Technologies, and 298 Professional Ecosytems in Bioengineering.

As we prepare for the next cohort of incoming students, faculty and staff are looking forward to greeting the Bioengineering sophomores, juniors and seniors as they return to campus and the largest class of freshmen yet, who are just starting their college experience. It is always a special pleasure to welcome our new students to the **Illinois family!**

Bioengineering graduate students focused


Park


Sorrells


Fathi


Zambuto


Medina Almora

Bioengineering Ph.D. students earned prestigious fellowships, scholarships and training opportunities during the past year, including the following.

Jaena Park was awarded a $35,000 Graduate Student Scholarship for Biomedical Sciences from the ASAN Foundation in Korea. Park, who earned her M.S. degree from Korea University, is investigating extracellular vesicles using SLAM-optical microscopy in Stephen Boppart's lab.

Janet Sorrells earned a National Science Foundation Graduate Research Fellowship, which provides a $32,000 stipend in support of outstanding students enrolled in research-based M.S. and Ph.D. programs in NSF-supported disciplines. In 2019, the NSF selected about 2,000 awardees from among more than 12,000 applicants. Sorrells earned her bachelor's degree in Biomedical Engineering at the University of Rochester and is conducting biophotonics research in Stephen Boppart's lab.

Parinaz Fathi participated in the three-week 2019 Science of Signatures Advanced Studies Institute at Los Alamos National Lab, where she worked in multi-disciplinary teams to generate novel, creative solutions to pressing national security problems. Fathi's research focuses on translational medicine applications of biomaterials and nanomaterials. Fathi, who works in Dipanjan Pan's lab, also was selected as one of Illinois' 2019 Mavis Future Faculty Fellows, a program that facilitates training for the next generation of engineering professors.

Samantha Zambuto was selected as a Mavis Future Faculty Fellow at Illinois for the 2019-2020 academic year. She is focusing on women's health and conducting research on modeling the endometrium in Brendan Harley's lab.

Denise Medina Almora is among seven students awarded a 2019 Beckman Institute Graduate Fellowship at Illinois. Her research will delve into the search for finding alternative therapeutic approaches to cardiovascular diseases. Medina Almora works in Wawrzyniec Dobrucki's lab, and her research will focus on developing a noninvasive imaging strategy to assess angiogenesis and tissue remodeling.

on healthcare solutions to grand challenges

Students from the Class of 2019 **Master of Engineering (M.Eng.) in Bioengineering degree program** (pictured above) participated in a new, unique opportunity to address grand challenges in medicine in an April 2019, two-day workshop funded through the Mayo-Illinois Alliance and hosted by the Bioengineering department. Faculty from Illinois and Mayo Clinic joined the M.Eng. students and Mayo Clinic medical and Ph.D. students to spark innovation and discuss technology-driven solutions to medical challenges during the workshop titled, "Human Diseases at the Crossing of Science, Engineering, and Medicine."

The M.Eng. program combines the strengths of The Grainger College of Engineering and the Gies College of Business and helps students gain an industry edge in medical and healthcare fields. Collaborations and workshops such as the one with Mayo Clinic allow students to expand their knowledge outside of the classroom.

Several concentrations currently are available to students in the one-year M.Eng. in Bioengineering program, **Bioinstrumentation** (with a special focus on medical imaging devices), **General Bioengineering**, and a newly developed concentration in **Pharmaceutical Engineering**. The new concentration is specifically aimed at providing students with integrated technical knowledge in pharmaceutical science, relevant regulations, and process engineering. Students will be trained to integrate knowledge in pharmaceutical science with tools from process engineering and an understanding of regulatory frameworks and business aspects to pursue leadership careers in industry-scale production of drug therapeutics.

M.Eng. in Bioengineering graduates have gone on to industry jobs, BIOE Ph.D. programs, professional schools (medicine and dentistry), and other pursuits.

Awards and **Honors**


Boppart


Bashir


Sutton


Dar


Dobrucki


Lu

Stephen Boppart earned the 2019 SPIE Biophotonics Technology Innovator Award for his development of novel technology in computational optical coherence tomography and its application to basic and clinical sciences. Boppart is a pioneer in the translation and commercialization of optical coherence tomography imaging. He received the award at Photonics West in San Francisco in February 2019.

The National Academy of Inventors named **Rashid Bashir** a Fellow and inducted him during its annual meeting in Houston in April 2019. Bashir was recognized for having demonstrated a prolific spirit of innovation in creating or facilitating outstanding inventions with a tangible impact on quality of life, economic development, and the welfare of society.

Bashir also received the Biomedical Engineering Society's Robert A. Pritzker Distinguished Lecture Award, presented at its annual meeting in October 2018.

Brad Sutton was named a 2019 University Scholar for his excellence in teaching, research and service. The award is presented annually to a select few tenured and tenure-track faculty to recognize outstanding contributions to the university.

Roy Dar received a National Institute of Biomedical Imaging and Bioengineering Trailblazer Award for New and Early Stage Investigators. The award includes almost $600,000 in support over three years for his gene expression, or "noise," research.

Wawrzyniec Dobrucki, Ting Lu and **Greg Underhill** have been promoted to associate professor in the Department of Bioengineering. Dobrucki, also the head of the Experimental Molecular Imaging Laboratory, focuses his research on bioimaging at multi-scale. Lu is engaged in reserach in computational and systems biology and synthetic bioengineering. And Underhill is focused on molecular, cellular and tissue engineering research.

Dobrucki also was named co-chair of the Integrative Imaging research theme at the Beckman Institute for Advanced Science and Technology.

Lu also earned the American Chemical Society Infectious Diseases Young Investigator Award in August 2018, and he received the Dean's Award for Excellence in Research during the annual college awards ceremony at Illinois in April 2019.







Underhill **Smith** **Amos** **Darling** **Nie** **Bhargava** **Fanous**

Each year the college acknowledges a single engineering faculty member with the Collins Award for Innovative Teaching. **Andrew Smith** received the award in April 2019 in recognition of outstanding development or use of new and innovative teaching methods.

Smith also was appointed as a regular member of the National Institutes of Health Emerging Imaging Technologies in Neuroscience study section.

Jenny Amos received the Teaching Excellence Award from the college at its awards ceremony in April 2019. She was honored for playing a major role in designing and implementing Bioengineering's curriculum.

Maddie Darling received an Excellence in Advising Award from the Engineering Council in April 2019. Nominated by Bioengineering students, Darling is ranked among the top 10 percent of advisors in The Grainger College of Engineering.

Four faculty with ties to Bioengineering were named to the Clarivate Analytics Highly Cited Researchers list: **Shuming Nie**, and Bioengineering graduate program professors, Stephen Long, Yi Lu, and Catherine Murphy.

The Clarivate list recognizes leading researchers based on journal article publications and citations.

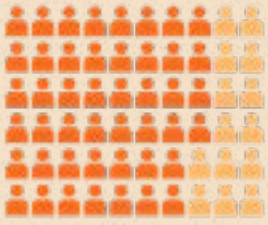
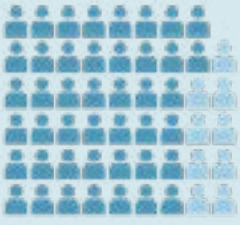
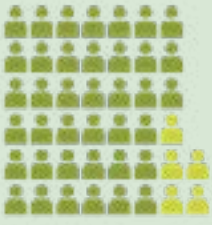
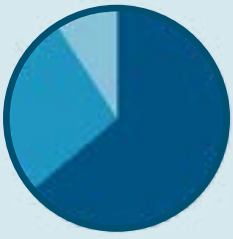
The Illinois Science and Technology Coalition named **Rohit Bhargava** a "Researcher to Know 2018" for his work in cancer. Bhargava is recognized for making a significant impact in his field, demonstrating excellence, and driving innovation.

Michael Fanous, Ph.D. student in Bioengineering, was named the 2019 recipient of the McGinnis Medical Innovation Graduate Student Fellowship at Illinois. Fanous is working on combining optical microscopy, interferometry and phase imaging to revolutionize the understanding of myelin production and provide an ultrasensitive and specific assay for testing drug treatments for diseases such as multiple sclerosis. The fellowship is supported by a gift from Audrey and Jerry McGinnis, BS '58 MechSE, an inventor and founder of Respironics, which made the first CPAP device.

Where are Illinois Bioengineers?

Recent graduates tell us what they are doing

Each year, the Illini Success Initiative surveys UI graduates to find out what they are doing after graduation. Here we show a snapshot of some of that self-reported data for graduates who earned a bachelor's degree in Bioengineering during the academic years: 2015-2016, 2016-2017, and 2017-2018 (most recent data available; data courtesy of Illini Success).

2017-2018 Graduates	2016-2017 Graduates	2015-2016 Graduates
		
Graduates: **60** Respondents: **46**	Graduates: **53** Respondents: **44**	Graduates: **44** Respondents: **39**
		
Employed: **46%** Continuing Education: **48%** Volunteering/Other: **6%**	Employed: **64%** Continuing Education: **27%** Volunteering/Other: **9%**	Employed: **48%** Continuing Education: **50%** Volunteering/Other: **2%**
Average Starting Salary: **$67,510**	Average Starting Salary: **$65,374**	Average Starting Salary: **$61,612**

$59,015 is the reported average starting salary for bioengineers nationwide in **2019**, according to the National Association of Colleges and Employers (NACE).

Top 10 destinations for **Illinois Bioengineers** employed in industry:*

Epic Systems, Eli Lilly & Co., Abbott, AbbVie, Cook Medical, Boston Scientific, Baxter International, Catalent, Jump Simulation, Veeva Systems

*Information collected by UI Department of Bioengineering

2018 Recipient

Vongai Tizora

Rising sophomore in Bioengineering, from Forsyth, Illinois

"Bioengineering is exciting for me because I'll be able to innovate and change the way in which we develop solutions to the biological problems of the world," says Vongai Tizora on why she chose to attend Illinois Engineering.

In her first year, she has become an integral member of the community at Illinois, as a vice president and member of the National Society of Black Engineers, member of the American Medical Student Association, and a volunteer at Carle Hospital.

Her favorite course so far is Frontiers of Cancer Research, offered through the Cancer Scholars Program, which she says, "has exposed me to cancer research and the precautions we are taking to help win the fight against cancer."

Tizora said she is grateful to be a recipient of the Engineering Visionary Scholarship. With her scholarship, she is able to maintain active participation in her community as she continues to conduct research, volunteer and participate in registered student organizations on campus.

"My goal is to become a physician with a background in bioengineering. ... With my donors believing in me and what I have to offer, I will be able to give back to the larger world."

Gifts and commitments to EVSI will be matched through The Grainger Matching Challenge until December 31, 2019.

To make a gift to Bioengineering, visit:

bioengineering.illinois.edu/engage/giving/

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ON THE COVER is an infrared chemical image using a novel laser microscope designed and constructed by **Kevin Yeh** and applied to diagnose cancer from its molecular composition by **Shachi Mittal,** both recent Ph.D. graduates of Illinois Bioengineering. Infrared spectroscopic imaging allows for direct mapping of the sample's chemistry without the use of extraneous dyes and contrast agents, an approach pioneered by **Rohit Bhargava**, Founder Professor in Bioengineering and director of the Cancer Center at Illinois. Applying advanced machine learning algorithms, this new imaging technology will aid pathologists in not only detecting tumors but also the associated microenvironment indicative of cancer progression. The developed technology — described in the Proceedings of the National Academy of Sciences in June 2018 — is significantly higher quality and faster than any other, allowing cancerous samples to be analyzed in minutes.

INSET IMAGE, TOP: Students in Illinois Bioengineering's Worldwide Youth in Science and Engineering summer research program display their "bacteria art."

INSET IMAGE, BOTTOM: Mayo Clinic medical students practice their intubation techniques on a medical-simulation mannequin in the Jump Simulation Center in Illinois' Everitt Lab.