IGB NEWS

Upcoming Events

Monthly Profiles

Happenings at IGB

Image Of The Month

Research News

Department Announcements

Volume 13 Number 4

UPCOMING EVENTS

IGB Science Chats

If you missed any of the IGB Science Chats below, they are available to view on the IGB Calendar page located at www.igb.illinois.edu/igb-calendar.

"A COVID-19 Primer: Virology, Immunology, Evolution, and Epidemic Modeling"

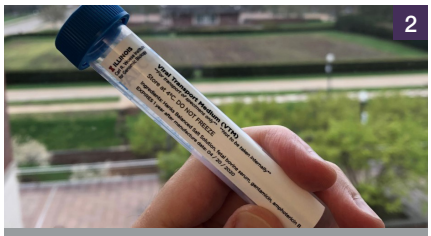
"Digital Resolution Biosensing: New Approaches in Cancer and COVID-19"

"Micromechanical and Microstructural Characterization of Collagenous Tissue for Applications in Pre-term Birth and for Diseased and Damaged Tissue"

"Adapting Commercial Systems to Create Multidimensional Tissue Models"

"Is the Cure to COVID-19 Worse than the Problem? An Economic Perspective"

FEATURED NEWS



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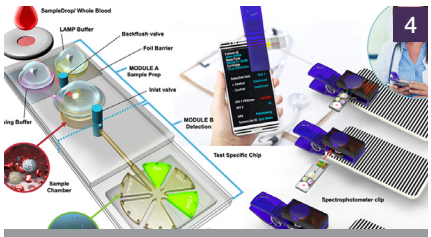
Illinois partners with Carle Health and State



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Inexpensive, portable detector identifies pathogens in minutes

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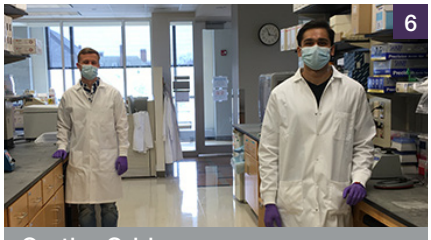
Monthly Profile: Dave Zhao



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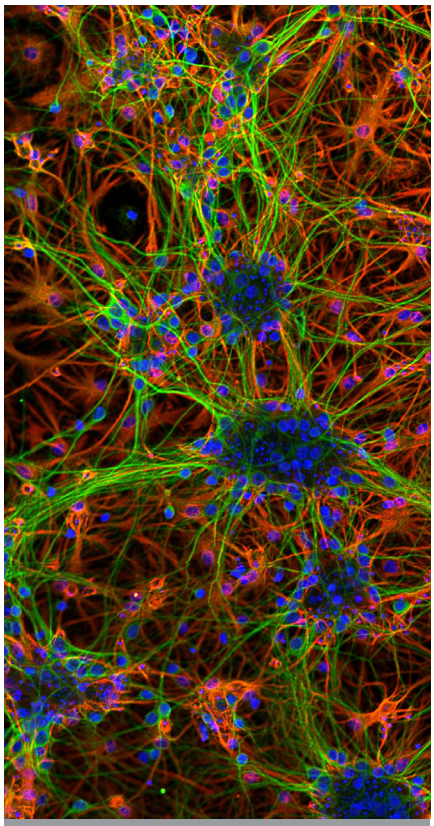
On the Grid: Happenings at IGB

IMAGE OF THE MONTH



This month's image show that neurons exhibit high levels of branching, neurite extensions, and neural connectivity when they are cultured on N-cadherin based substrates. The green color represents microtubule-associated protein 2 (MAP2), a marker for neurons. The red color represents glial fibrillary acidic protein, a marker for glia. The blue color is DAPI staining of the nuclei. The picture is taken on the Zeiss LSM 700 confocal microscope. Courtesy of Ellen Qin, PhD Student, Materials Science and Engineering, Hyunjoon Kong Lab & Co-Advisor Deborah Leckband.

IGB News

Share your news with the IGB. Send ideas on stories, articles, and features to *nvasi@illinois.edu*.

FEATURE

Illinois partners with Carle Health and State to increase COVID-19 testing

Back in early March, when the COVID-19 pandemic began shuttering businesses and schools across the United States, Chris Brooke (IGOH) wondered how he'd teach his classes online. As the virus spread with astonishing speed, however, and it became frighteningly clear that COVID-19 threatened something far greater than just the spring semester, Brooke, a professor of microbiology, asked a bigger question: How can we help stop it?

At the same time, discussions were underway between Carle Health and the University of Illinois to develop plans to curb the pandemic. Brooke recruited colleagues to help, sparking a campuswide effort now underway to dramatically increase COVID-19 testing in the local community and the entire state of Illinois.

Spurred by reports that local health officials lack the means to process tests for the coronavirus, units across campus have mustered machines, materials, and personnel to partner with Carle Health in establishing a COVID-19 testing site.

Not only has the effort allowed healthcare workers at Carle to begin testing for COVID-19, thus reducing the wait period for local tests to within 24 hours in many cases, but the University of Illinois has now expanded the partnership to the Illinois Department of Public Health and Illinois Emergency Management Agency to ramp up testing operations. Laboratories across campus are mobilizing to provide COVID-19 testing supplies for thousands of tests across the state.

"It's been a tremendous team effort, involving lots of people and lots of different partnerships. It's one of the best things about U of I. We know how to work together. It's so amazing to see everybody team up and try to get something done that's impactful," said Marty Burke (MMG), the May and Ving Lee Professor for Chemical Innovation in the Department of Chemistry and associate dean for research at the Carle Illinois College of Medicine. "This is just how we roll."

Brooke, who specializes in human virology, spoke to local officials and learned that local healthcare providers were unable to perform adequate testing for COVID-19. Test samples were being sent away to state labs for analysis, leaving patients to wait for days before they knew the results.

The reasons for the complications in COVID-19 testing are many, Brooke said. The procedures necessary to test for the coronavirus are more involved and less user-friendly than those for other viruses, such as influenza. Nationwide restrictions on COVID-19 testing and supply shortages also contributed to the slow start in testing, he added.

Brooke said that it became clear that local medical centers had very limited capacity to run adequate numbers of molecular testing for COVID-19.

"The test is basically a procedure that we do in our lab on a daily basis," Brooke said. "I didn't really understand why, locally as well as around the country, we were struggling to perform this critical test that was based on this really common procedure that research labs around the country are doing regularly. So that's what got me engaged."

Responding to a request for help from Carle, Brooke approached research partners around campus for assistance providing Carle with the means to conduct tests, and the response was immediate. Following a flurry of assessment, legal work, and support from the Office of the Vice Chancellor for Research and Innovation to clear regulatory hurdles, campus laboratory machines were loaned to Carle. Within days, the necessary components were in place to begin test validation, and COVID-19 testing was launched.

"While Carle had the ability and expertise to test within our lab, it's not on the scale that would become necessary as this region reached the level of COVID-19 community spread," said Kayla Banks, PhD, RN, and vice president of quality at Carle Health. "By partnering with the University of Illinois to use additional equipment, we've been able to increase testing capabilities for the region. We can now deliver results within 24 hours which means patients and physicians have answers sooner to determine appropriate care."

Providing personnel and machines for local testing

Three campus units, the Carl R. Woese Institute for Genomic Biology (IGB), the Roy J. Carver Biotechnology Center (CBC), and the College of Veterinary Medicine, have loaned equipment, supplies and personnel to support the work. IGB and CBC provided real-time quantitative polymerase chain reaction (qPCR) instruments, which have the ability to amplify and identify specific RNA segments within a sample. If COVID-19, an RNA virus, is present in a mucus sample taken from the patient's nose, the machine has the sensitivity to detect and confirm whether that patient has COVID-19.

Mark Mikel, CBC associate director, said that an engineer from ThermoFisher Scientific, which manufac-

tured the center's qPCR instrument, came to help enable the transfer to Carle and conduct re-calibration for optimal performance. Mark Band, director of the CBC's Functional Genomics facility, assisted staff at Carle with installation and setup.

"The response on campus has been totally unselfish," Mikel said. "If we find something in the lab that is needed for COVID-19 diagnosis by Carle, we give it to them. It's been really a highly orchestrated effort across campus."

Carol Maddox, professor of pathobiology and microbiology section head of the Veterinary Diagnostic Laboratory in the College of Veterinary Medicine, said that the lab provided Carle with an RNA extraction instrument, used to purify the viral RNA for RT-PCR amplification to detect COVID-19. They also provided multi-channel and dispensing pipettors, used for transfer and precise measuring, to help staff increase the speed and ease of handling specimens and reagents. Thus, patients at Carle, OSF Health, and Christie Clinic have, in many cases, been receiving test results within a day.

As the veterinary laboratory routinely performs animal disease surveillance, Maddox said, two Veterinary Diagnostic Lab staff members, Therese Eggett and Evette Vlach, stepped forward to help train Carle employees to operate the instruments.

"They (Eggett and Vlach) have also passed the COVID-19 proficiency tests and are now assisting the Carle staff so that additional testing can be performed, including on weekends and evenings, increasing the capacity for COVID-19 testing," Maddox said.

The donation of testing components for local and state testing

Two initiatives took shape on campus to provide COVID-19 testing supplies that are in drastically short supply: one was focused on the creation of nasopharyngeal swabs, and the other was focused on creating liquids necessary to conduct COVID-19 testing.

Brooke, Burke, and Doug Mitchell (MMG), Alumni Research Scholar Professor of Chemistry, collaborated to mass produce liquids necessary for COVID-19 testing, including buffered saline and viral transfer media (VTM), an essential mix of buffers, nutrients, and antimicrobials that's in short supply. VTM is used to preserve test samples from patients until testing occurs.

As faculty with appointments in the IGB, they were granted laboratory space in the institute to begin producing VTM using base materials from their own research supplies. A pair of laboratory technicians from Burke's laboratory, Justin Lange and Akanksh Shetty, stepped forward to help, and soon the team was mass producing VTM. That caught the attention of state officials, who asked them to produce enough VTM for 10,000 tests per week. The VTM will be sent to a state laboratory in Springfield, with Illinois Emergency Management Agency reimbursing the university for the direct cost of the product.

As the agreement with the state of Illinois took shape, the Carl R. Woese Institute for Genomic Biology made available six more laboratory spaces, in addition to the one already being used, to scale up VTM production. With additional faculty and staff stepping forward to assist with production, Burke said, the lab teams could be producing enough VTM for 20,000 COVID-19 tests per week.

"It has been deeply gratifying to see how faculty, staff, and students have stepped up to make it possible for the institute to contribute to this critical effort, from sourcing scarce materials, to facilitating deliveries, to organizing, training, and supervising staff, to actually preparing the VTM," said Gene Robinson (GNDP), Swanlund Chair of Entomology and IGB Director. "This has been an inspirational team effort fueled by altruism."

Meanwhile, another campus team is spearheading the mass production of nasopharyngeal swabs (also in short supply), which are used to collect test samples from patients' noses. In collaboration with Carle diagnostic labs, the team reverse-engineered a commercial swab to design and test their own.

The team, which includes Mitchell, Jeffery Moore (BSD), a Stanley O. Ikenberry Chair and professor of chemistry and materials science and engineering, and director of the Beckman Institute for Advanced Science & Technology, and Nancy Sottos, a Swanlund Chair and head of the Department of Materials Science and Engineering, developed a method to create enough swabs that, if validated, could meet a portion of the need in the state of Illinois.

The team also includes Martin Gruebele, James R. Eiszner Endowed Chair in Chemistry and head of the Department of Chemistry, providing oversight as the plan calls for using glassware ovens found in organic chemistry labs in Roger Adams Lab to create the swabs. Mitchell described the process as converting a precursor rod into a viable swab using a hot draw. The key, he said, is to stretch the material in a way that retains rigidity in the handle while allowing for flexibility in the portion that enters the patient's nose.

The Beckman Institute is creating a training video which can demonstrate how to create a swab within about 90 seconds. Once the swabs are validated at Carle and the Illinois Department of Public Health, group members and other researchers plan to produce up to 300,000 swabs to help deal with the crisis.

"We came to the lab to reverse engineer the nasopharyngeal swab with a safe, inexpensive, rapid, scalable method from common laboratory supplies and equipment," Moore said. "When our initial idea hit a snag, the graduate students put their ingenuity to work and improvised a brilliant solution that checked all the boxes."

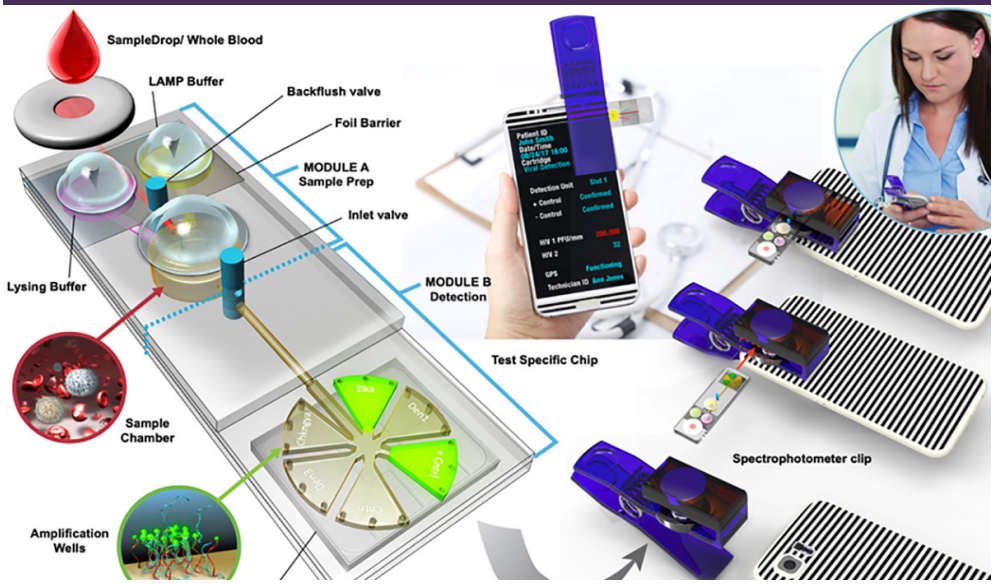
Mitchell said it hasn't been easy to essentially turn an academic environment into a factory to fight COVID-19, but he is strongly motivated.

"Healthcare workers are those on the front lines of dealing with this disease; however, there is essentially no testing being done on those individuals who are exposed every day to patients with COVID-19," he said. "How many people have been infected in hospitals and in the community through asymptomatic transmission of the virus? Without widespread testing, we will never know. The amount of testing that has been done thus far is a very far cry from what needs to be performed."

Brooke said that it's been stressful to get the testing up and running, but that he feels some satisfaction for making a difference.

"What we're doing is small," he added, "compared to the health workers who are actually serving patients on the front lines." ■

Written by Dave Evensen and Therese Pokorney. Photos by Chris Brooke and Nicholas Vasi.



Inexpensive, portable detector identifies pathogens in minutes

Most viral test kits rely on labor- and time-intensive laboratory preparation and analysis techniques; for example, tests for the novel coronavirus can take days to detect the virus from nasal swabs. Now, researchers have demonstrated an inexpensive yet sensitive smartphone-based testing device for viral and bacterial pathogens that takes about 30 minutes to complete. The roughly $50 smartphone accessory could reduce the pressure on testing laboratories during a pandemic such as COVID-19.

The results of the new multi-institutional study, led by University of Illinois at Urbana-Champaign electrical and computer engineering professor Brian Cunningham (CGD Director/MMG) and bioengineering professor Rashid Bashir (CGD/RBTE), are reported in the journal Lab on a Chip.

"The challenges associated with rapid pathogen testing contribute to a lot of uncertainty regarding which individuals are quarantined and a whole host of other health and economic issues," Cunningham said.

The study began with the goal of detecting a panel of viral and bacterial pathogens in horses, including those that cause severe respiratory illnesses similar to those presented in COVID-19, the researchers said.

"Horse pathogens can lead to devastating diseases in animal populations, of course, but one reason we work with them has to do with safety. The horse pathogens in our study are harmless to humans," Cunningham said.

The new testing device is comprised of a small cartridge containing testing reagents and a port to insert a nasal extract or blood sample, the researchers said. The whole unit clips to a smartphone.

Inside the cartridge, the reagents break open a pathogen's outer shell to gain access to its RNA. A primer molecule then amplifies the genetic material into many millions of copies in about 10 or 15 minutes, the researchers said. A fluorescent dye stains the copies and glows green when illuminated by blue LED light, which is then detected by the smartphone's camera.

"This test can be performed rapidly on passengers before getting on a flight, on people going to a theme park or before events like a conference or concert," Cunningham said. "Cloud computing via a smartphone application could allow a negative test result to be registered with event organizers or as part of a boarding pass for a flight. Or, a person in quarantine could give themselves daily tests, register the results with a doctor, and then know when it's safe to come out and rejoin society."

"Cloud computing via a smartphone application could allow a negative test result to be registered with event organizers or as part of a boarding pass for a flight. Or, a person in quarantine could give themselves daily tests, register the results with a doctor, and then know when it's safe to come out and rejoin society."

There are a few preparatory steps currently performed outside of the device, and the team is working on a cartridge that has all of the reagents needed to be a fully integrated system. Other researchers at the U. of I. are using the novel coronavirus genome to create a mobile test for COVID-19, and making an easily manufactured cartridge that Cunningham said would improve testing efforts.

Study co-authors with Cunningham and Bashir were Fu Sun, Anurup Ganguli and Matthew B. Wheeler, of the U. of I.; and Ryan Brisbin and David L. Hirschberg, of RAIN Incubator; Krithika Shanmugam, of the University of Washington; and veterinarian David M. Nash.

The National Science Foundation and the Center for Genomic Diagnostics at the IGB supported this research.

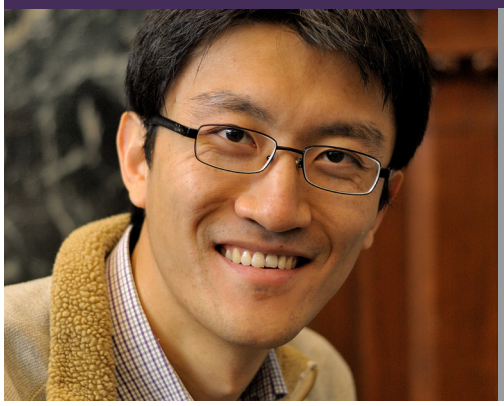
Bashir also is the dean of the Grainger College of Engineering at Illinois.

Cunningham also is affiliated with bioengineering and materials science and engineering, the Holonyak Micro and Nanotechnology Lab, the Carle Illinois College of Medicine and the Beckman Institute for Advanced Science and Technology at Illinois.

Cunningham serves as a consultant to and owns stock in Reliant Immune Diagnostics, the company that licensed the technology described in this news release. ■

Written by Liz Ahlberg Touchstone. Photo courtesy of Esteban Gabazza/Nature Communications.

MONTHLY PROFILE



Sihai Dave Zhao is an assistant professor of statistics and in the Carle Illinois College of Medicine. He is a member of the Gene Networks in Neural and Developmental Plasticity research theme and an affiliate member of the Computing Genomes for Reproductive Health research theme in the IGB.

Dave Zhao

Math as a pathway to universal biological truths

Many biologists turn to statistics as a tool to make sense of the particular question or particular field. Dave Zhao (CGRH/GNDP) found his passion in statistics as he searched for a much more comprehensive understanding of the natural world.

"I had first been interested in biology . . . to really understand biology, you have to understand chemistry. To understand chemistry, you have to understand physics. So I kept going," he said. "I don't want to devote my life to studying one molecule, one protein, one gene or anything like that. Statistics can explain all of this . . . that's how I ended up here."

After completing a master's degree in statistics and a PhD in biostatistics at Harvard University, Zhao moved on to a postdoctoral position in the Department of Biostatistics and Epidemiology at the University of Pennsylvania before joining the Department of Statistics at Illinois. To a biologist turned statistician, the team science approach offered by the IGB had unique appeal.

"I came to Illinois because this is a very strong statistics department and because the IGB provides an environment where people really are solving real problems," Zhao said. "I really want to be part of a team that really uses these methods, because I didn't want to be just a statistician . . . I wanted to develop things that were really statistically solid, but at the same time can be useful."

Zhao has worked hard to establish his research program in a niche that, even in the interdisciplinary environment of the IGB, has pushed him to forge a new path. The dual goals of truly innovative statistics research that also has utility and appeal for those engaged in genomics work are harder to balance than may be apparent at first glance. While the fast-growing field of genomics does demand statistical expertise and the development of new methods, identifying novel areas of statistical study requires more creativity and care.

"In a collaborative research environment like this, if you asked me when I just started, I had this vision that statistics and my [genomics] work here could combine and I could contribute to both statistics and genomics," Zhao said. "The role that I envisioned is the ideal everyone hopes they can get to."

As Zhao has developed his research program, he is focusing on two genomics-adjacent statistical questions. The first is an investigation of the best way to estimate the true values ofof for a large number of measurements in an experimental data set—a need that arises often in genomic research.

"For example, in single cell denoising [reducing the impact of noise or error in a data set], you want to estimate the true expression level of every gene in every cell. That's a couple thousand genes, so a couple of thousand features" that a statistical approach must handle, Zhao said. "The naive approach of doing one at a time is suboptimal, and what you instead want to do is borrow information from across all the data that you see to estimate each at a time . . . that is a general problem in many fields, not just genomics. What I'm studying is a particular approach to solve questions like this."

> *"I really want to be part of a team that really uses these methods, because I didn't want to be just a statistician . . . I wanted to develop things that were really statistically solid, but at the same time can be useful."*

This area of Zhao's research is broad and theoretical, starting from basic mathematical principles. His second area of focus is more specific and methodological, and also related to his collaborative work at the IGB.

"The idea came from all the genomics that I had done here and in my postdoc, and it was it's an integrative genomics question. If you have a phenotype and a genetic variant, people want to do association," he said. "The problem is that if you don't have enough samples, you don't have enough power, because you have so many variants . . . so what if I tell you that I have on the same individuals genotype data, phenotype data and expression data? How do I use it?"

The simplest approach, Zhao noted, is to use gene expression data as a proxy for phenotype, since it is biologically "closer" and therefore should be less noisy than a phenotype measurement.

"The difficulty is that you don't know exactly how the gene expression is associated with the phenotype. So basically, what you do is you first figure out how to model this . . . if you knew what the true relationship was between your phenotype and your gene expression, you wouldn't need that first step of estimating that true relationship, you would just use that true relationship," Zhao said. "It turns out that in some cases, if you estimate that relationship, even if you don't know it, you can still gain power. I'm interested in this phenomenon of being able to have something in the middle and gain statistical power for this overall association."

This area of work is relevant for the GNDP theme, which studies relationships among genotype, gene expression, environmental factors, and complex phenotypes such as social behavior. Zhao is currently exploring how techniques that work for a data set examining a small number of genes can be successfully extended to take advantage of more comprehensive genomic data sets.

As Zhao has established himself at the IGB, he has also contributed in other ways to the work of the theme. Like most interdisciplinary researchers, he has reflected a lot on the difficulty of defining his area of study and successfully communicating with colleagues in both statistics and various biological fields, but feels he is in a good place to pursue these challenges.

"The reason I like IGB is because . . . you're not a physicist or not a computer scientist. That way of doing science is really different from a [traditional] university way of doing science, where you have your discipline. I think that leads to all the questions like what field are you in?" he said. "I have my two tracks . . . and then I have everything I do here, which is being part of a team and trying to figure out the answer to this question." ■

Written by Claudia Lutz. Photo courtesy of Dave Zhao.

ON THE GRID
HAPPENINGS AT THE IGB

AWARDS

LISA AINSWORTH

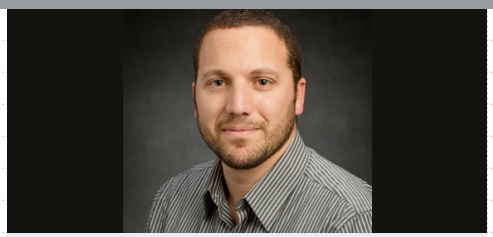
Lisa Ainsworth, a research plant physiologist with the USDA Agricultural Research Service and adjunct professor of plant biology and crop sciences (CABBI/GEGC), was elected to the National Academy of Sciences.

STEPHEN BOPPART

Stephen Boppart, Abel Bliss Professor of Engineering (RBTE), was awarded best healthcare product at the 12th Annual Prism Awards for his company's product TOMi Scope, which offers an improved quality of care for ear infection sufferers.

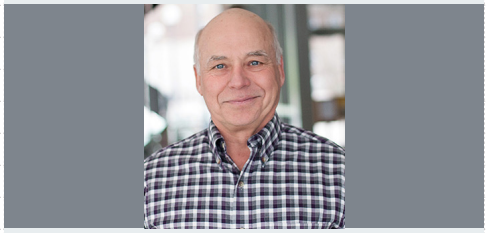
BRIAN CUNNINGHAM

Brian Cunningham, Donald Biggar Willett Professor of Engineering and Professor of Electrical and Computer Engineering (CGD Theme Leader/MMG) was selected as a Fellow of the Royal Society of Chemistry, an honor given to researchers whose efforts have made outstanding contributions to chemical sciences.



ROY DAR

Roy Dar, Assistant Professor of Bioengineering (BCXT/GNDP), received an NSF CAREER award for his project "Viral control of cell migration in diverse host-cell types." CAREER awards are given to early-career faculty who exemplify leadership through research and education.



DONALD ORT

Donald Ort, Robert Emerson Professor of Plant Biology and Crop Sciences (GEGC leader/BSD/CABBI) received the Charles Reid Barnes Life Membership Award from the American Society of Plant Biologists (ASPB), an annual award for meritorious work in plant biology.

JIAN PENG

Jian Peng, Assistant Professor of Computer Science (CABBI) received the Overton Prize from the International Society for Computational Biology, in recognition of research, education, and service accomplishments in computational biology and bioinformatics.

ANDREW SUAREZ

Andrew Suarez, Professor of Entomology and Head of Evolution, Ecology, and Behavior (GNDP) was named the inaugural Jeffrey S. Elowe Professor in Integrative Biology, an endowment to support faculty and students in the School of Integrative Biology.

THEME LEADER

ALISON BELL ASSUMES LEADERSHIP OF IGB THEME

Professor of Evolution, Ecology and Behavior Alison Bell will be assuming leadership of the Gene Networks in Neural & Developmental Plasticity (GNDP) research theme at the IGB. Bell will succeed Professor of Cell and Developmental Biology Lisa Stubbs, who has accepted a position at Pacific Northwest Research Institute.

"Moving forward, we are poised to tackle the molecular underpinnings of individual variation in social behavior, and the ways in which the environment interacts with genes to produce phenotypes," said Bell. "We take a comparative approach using multiple model organisms and bring the latest genomic technologies and computational methods to bear on fundamental questions about social behavior and the nervous system.

"As theme leader, I see my role as facilitating interactions among a fabulous group of colleagues centered around a common mission. Our theme provides a forum for them to share ideas, hatch plans and push boundaries in their research."

ON THE GRID
HAPPENINGS AT THE IGB

THANK YOU

THANK YOU TO OUR VTM TEAM

The IGB has been proud to help support the efforts to make COVID-19 testing more broadly available to those in need. Our recent efforts to create Viral Transport Medium (VTM) in mass quantities to facilitate testing in the state of Illinois have been very successful, with upwards of 35,000 vials produced each week in the IGB labs. Such a massive effort has required the perseverance of many dedicated individuals working closely with a team of faculty, and we recognize them for their tireless work to keep these efforts safely and efficiently coordinated. Without the following individuals, this would not have been able to take place. Thank you for all that you do, and continue to do.

Matthew Boudreau
Graduate Student

Luke Bown
Postdoctoral Researcher

Lauren Carnevale
Graduate Student

Lindsay Chatkewitz
Graduate Student

Laura Daigh
Graduate Student

Stella Ekaputri
Graduate Student

Sara Eslami
Graduate Student

Katie Frye
Graduate Student

Emily Gaither
Laboratory Technical Specialist

Emily Geddes
Graduate Student

Kelsie Green
Lab Assistant

Xiao Rui Guo
Graduate Student

Auroni Gupta
Graduate Student

Lonnie Harris
Graduate Student

Ahmed Hetta
Visiting Scholar

Aya Kelly
Graduate Student

Ashley Kretsch
Postdoctoral Researcher

Justin Lange
Research Assistant

Teresa Anne Martin
Coordinator of Research Programs

Shekhar Mishra
Graduate Student

Jana Radin
Research Scientist

Imran Rahman
Graduate Student

Diana Ranoa
IGB Fellow

Kenneth Ringwald
Postdoctoral Researcher

Carl Schultz
Graduate Student

Kyle Shelton
Graduate Student

Shaun Shetty
Research Technician

Max Simon
Graduate Student

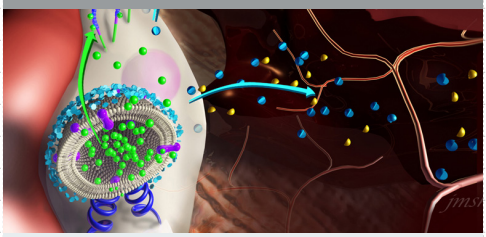
Che Yang
Graduate Student

GRANTS

FACULTY RECEIVE THREE NSF RAPID GRANTS FOR COVID-19 TESTING

Three IGB faculty members have received NSF Rapid Response Research (RAPID) program grants, all of which aim to shorten the amount of time it takes to process a COVID-19 test: Rashid Bashir (CGD/M-CELS/RBTE), Dean of the Grainger College of Engineering, Brian Cunningham (CGD Director/MMG), Professor of Electrical and Computer Engineering, and Yi Lu (BSD/CABBI/CGD), Professor of Chemistry and Bioengineering. Read the full story here.

NEW THEME



NEW IGB THEME M-CELS

Steady progress made by scientists could see the replacement of artificial systems with "Multi-Cellular Engineered Living Systems" (M-CELS) composed of living cells and extracellular matrices organized to perform novel functions absent in natural systems.

Two research programs - bio-hybrid robots and biological processors - form the foundation of the newly formed IGB research theme M-CELS, which will be led by Robert W. Schafer Professor of Chemical and Biomolecular Engineering Hyunjoon Kong (RBTE). Read the full story here.

RECENT PUBLICATIONS

Please include your connection to the IGB in your author byline when submitting publications, as it will greatly help track potential newsworthy items and increase the possibility of coverage.

D'Alessandro-Gabazza, C. N., Kobayashi, T., Yasuma, T., Toda, M., Kim, H., Fujimoto, H., Hataji, O., Takeshita, A., Nishihama, K., Okano, T., Okano, Y., Nishii, Y., Tomaru, A., Fujiwara, K., D'Alessandro, V. F., Abdel-Hamid, A. M., Ren, Y., Pereira, G. V., Wright, C. L., ... Gabazza, E. C. (2020). A *Staphylococcus* pro-apoptotic peptide induces acute exacerbation of pulmonary fibrosis. *Nature communications*, 11(1), [1539]. https://doi.org/10.1038/s41467-020-15344-3

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