IGB NEWS

Upcoming Events
Monthly Profiles
Happenings at IGB
Image Of The Month
Research News
Department Announcements

Volume 14 Number 3

UPCOMING EVENTS

Mikashi Award Impact Presentations
April 20, 2021, 12:00 p.m.
RSVP here

Hear presentations from Dr. Brian Cunningham and Dr. Paul Hergenrother on how Mikashi Award funding from the Kleinmuntz Center supported their work on cancer research.

IGB Postdoc Association Presents
The Ultimate STEM Career Guide
April 22, 2021, 12:00 p.m.
Join via Zoom

Kathie Olsen
Founder and President,
KLO International, LLC

Art of Science 11.0: Elemental
May 1-8, 2021, 11:00 a.m. - 3:00 p.m.
University of Illinois Arboretum
1800 South Lincoln Avenue, Urbana

The Art of Science 11.0 installation will be open for socially-distant outdoor viewing daily (weather permitting). Parking available.

IGB Fellows Symposium
May 6, 2021, 9:00 a.m. - 5:00 p.m.
Register Here

Learn about IGB research, submit a poster, and connect with other students on campus at the virtual 2021 Fellows Symposium.

FEATURED NEWS

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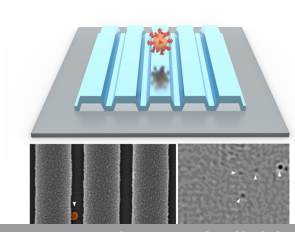

Microscope detects individual viruses, powers rapid diagnostics

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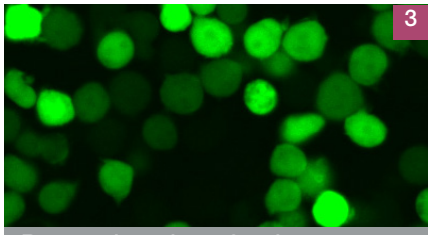

Researchers hunt for drugs that keep HIV latent

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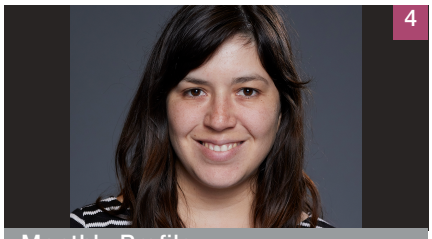

Monthly Profile: Pamela Martinez

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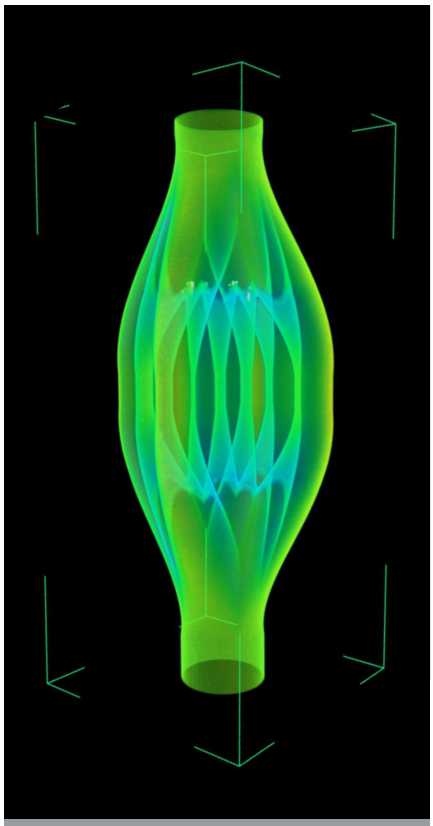
On the Grid: Happenings at IGB

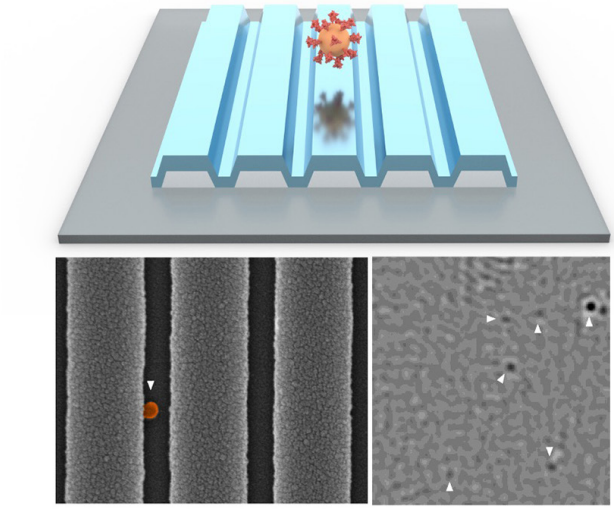
IMAGE OF THE MONTH



This month shows the inside contour surface of a Heat Exchanger (Condenser) produced by direct metal laser sintering (DMLS). Reconstructed surface contours like this created in Imaris from X5000 Xray CT date are used to compare the geometrical parameters of the printed object to the design. The sample was scanned using the X5000 NSI High Resolution Micro-CT and rendered in 3D using Imaris at the Core Facilities. Image provided by Kazi Fazle Rabbi from the Nenad Miljkovic Group.

IGB News

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



Microscope that detects individual viruses
could power rapid diagnostics

A fast, low-cost technique to see and count viruses or proteins from a sample in real time, without any chemicals or dyes, could underpin a new class of devices for rapid diagnostics and viral load monitoring, including HIV and the virus that causes COVID-19.

Researchers at Illinois described the technique, called Photonic Resonator Interferometric Scattering Microscopy, or PRISM, in the journal *Nature Communications*.

"We have developed a new form of microscopy that amplifies the interaction between light and biological materials. We can use it for very rapid and sensitive forms of diagnostic testing, and also as a very powerful tool for understanding biological processes at the scale of individual items, like counting individual proteins or recording individual protein interactions," said study leader Brian Cunningham (CGD director/MMG), the Intel Alumni Endowed Chair of electrical and computer engineering and a member of the Holonyak Micro and Nanotechnology Lab.

In optical microscopes, light bounces off any molecules or viruses it encounters on a slide, creating a signal. Instead of a regular glass slide, the PRISM technique uses photonic crystal: a nanostructured glass surface that brilliantly reflects only one wavelength of light. Cunningham's group designed and fabricated a photonic crystal that reflects red light, so that the light from a red laser would be amplified.

"The molecules we are looking at – in this study, viruses and small proteins – are extremely small. They cannot scatter enough light to create a signal that can be detected by a conventional optical microscope," said graduate student Nantao Li, the first author of the paper. "The benefit of using the photonic crystal is that it amplifies the light's intensity so it's easier to detect those signals and enables us to study these proteins and viruses without any chemical labels or dyes that might modify their natural state or hinder their activity – we can just use the intrinsic scattering signal as the gauge for determining if those molecules are present."

Above: PRISM for COVID-19 detection. At top, concept art. Bottom left, a microscope image of a single virus on the photonic crystal surface. Bottom right, a PRISM image with six viruses detected.

The researchers verified their technique by detecting the virus that causes COVID-19. PRISM detected individual coronaviruses as they traveled across the slide's surface. The researchers also used PRISM to detect individual proteins such as ferritin and fibrinogen. The technique could allow researchers to study such biological targets in their natural states – watching as proteins interact, for example – or researchers could seed the surface of the photonic crystal slide with antibodies or other molecules to capture the targeted items and hold them in place.

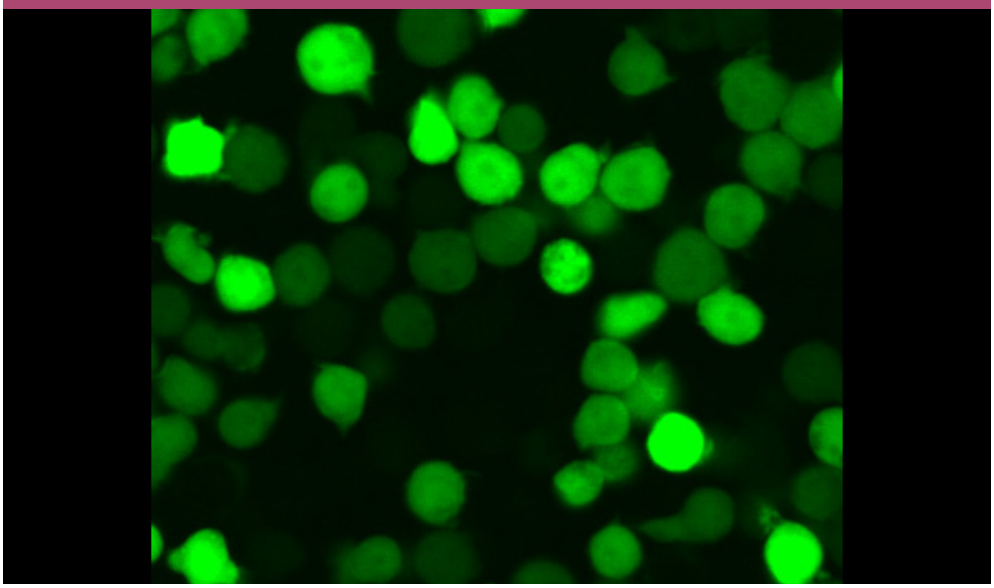
"It takes 10 seconds to get a measurement, and in that time we can count the number of viruses captured on the sensor," Cunningham said. "It's a single-step detection method that works at room temperature. It is also fast, very sensitive and low cost. It's very different from the standard way we do viral testing now, which involves breaking open the viruses, extracting their genetic material and putting it through a chemical amplification process so we can detect it. That method, called PCR, is accurate and sensitive, but it requires time, specialized equipment and trained technicians."

Cunningham's group is working to incorporate PRISM technology into portable, rapid diagnostic devices for COVID-19 and HIV viral load monitoring. The group is exploring prototype devices that incorporate filters for blood samples and even condensation chambers for breath tests.

"We are also going to use this as a research tool for biology and cancer," Cunningham said. "We can use it to understand protein interactions that are parts of disease processes. We are interested in using it to detect these tiny vesicles that cancer cells shed, and to see what tissues they come from, for diagnosis, and also to study what cargo they are transporting from the cancer cells."

The National Science Foundation and the National Institutes of Health supported this work. ■

Written by Liz Ahlberg Touchstone.
Photo by Nantao Li.



Researchers hunt for drugs
that keep HIV latent

When the human immunodeficiency virus infects cells, it can either exploit the cells to start making more copies of itself or remain dormant—a phenomenon called latency. Keeping these reservoirs latent is a challenge. A new paper, published in the *Proceedings of the National Academy of Sciences*, has found a way to look for chemicals that can keep the virus suppressed into its dormant state.

"The current drug treatments block healthy cells from becoming infected by the virus," said Yiyang Lu, a PhD student in the Dar lab. "The latent reservoir poses a bigger problem because it can start producing the virus at any time. Consequently, patients have to remain on antiretroviral therapy all their lives to prevent a viral rebound."

So far, there are two types of drug treatment strategies: shock-and-kill, where reactivated cells are killed due to HIV, and a second drug cocktail prevents other cells from being infected, or block-and-lock, which forces the virus into a deep latent state so that it does not reactivate again. The problem with the first approach is that there are always some leftover reservoirs that do not get activated. The problem with the second approach, which the researchers are trying to solve, is that there aren't many drugs that have been discovered.

Since the transition from latency occurs randomly, measuring the fluctuations in gene expression can provide more coverage than the average gene expression. "Commercial drug screens usually look at mean gene expression. Instead, we used a drug screen that looks at fluctuations in gene expression. Our screen allowed us to therefore find more compounds that could have been overlooked," Lu said.

Above: Microscopy image of a T-cell population harboring a shortened form of the HIV virus that expresses a green fluorescent protein. Different drug treatments result in the various amounts of cell-to-cell variability in gene expression.

"We implemented a time-series drug screening approach that are less commonly used in other labs," said Roy Dar (BCXT/GNDP/M-CELS), an assistant professor of bioengineering. The researchers used a T- cell population, which is a reservoir for HIV, that had been infected by the virus. They imaged the cells in 15-minute intervals for 48 hours and tested over 1800 compounds. They looked at noise maps to identify which drugs can modulate the gene expression.

Using the screen, they were able to find five new latency-promoting chemicals, raising the possibility that similar screens can be successfully adapted to study other systems that exhibit variability in gene expression, such as cancer. They are currently working on understanding how the five novel drugs suppress viral reactivation. "We want to test if these drugs have off-target effects in terms of how many other genes they affect in the host cells," Dar said. "We also want to test these drugs in patient samples to see whether these drugs suppress HIV in them."

The study "Screening for gene expression fluctuations reveals latency-promoting agents of HIV" can be found at https://doi.org/10.1073/pnas.2012191118. The study was funded by the National Institutes of Health, the National Institute of Allergy and Infectious Diseases, and the National Science Foundation. ■

Written by Ananya Sen.

Photo by Yiyang Lu.

MONTHLY PROFILE

Pamela Martinez is an assistant professor of microbiology and statistics and is an affiliate of the Department of Evolution, Ecology, and Behavior. Her research uses concepts from ecology and evolution to understand how pathogens are transmitted and how they adapt to their environment.

Studying disease transmission
using mathematical models

Pamela Martinez grew up in Santiago, Chile wanting to pursue a medical degree. Unfortunately, the undergraduate programs were competitive and she was denied admission. "I needed to have a plan B," Martinez said. "Since I always liked studying science, I decided to join the University of Chile to pursue biochemistry, which connects different fields including biology, chemistry, and physics." During her junior year, Martinez realized that she was interested in theoretical biology and using mathematical models to study biological questions. To pursue this interest, she applied to the Research Experiences for Undergraduates Program at the Santa Fe Institute in New Mexico. "It was the perfect place to work on projects that study complex biological systems. After that experience, I realized that I wanted to pursue a career in academia," Martinez said.

Intriguingly, her PhD career had an unusual start. "I didn't apply to that many universities. My undergraduate mentor encouraged me to work with Mercedes Pascual, who works on the transmission of infectious diseases. At first, I wasn't selected for the PhD program because of my poor TOEFL score. However, Pascual had recently obtained a grant and she asked me to work with her for a year and then apply again," Martinez said. After spending the year working on improving her language skills and seeing whether she was interested in the lab, Martinez reapplied and was accepted into the PhD program. She studied infectious disease dynamics: how pathogens evolve, how they are transmitted, and how they interact with their environment.

Even after completing her PhD, Martinez was still interested in medicine and public health, which lead her to the Center for Communicable Disease Dynamics at the Harvard T.H. Chan School of Public Health. During her postdoctoral work, Martinez worked on different projects that focused on using mathematical models to understand disease transmission. One of the projects focused on the bacteria *Streptococcus pneumoniae* and its accessory genes. Such genes are only present in select individuals in a population, for example antibiotic resistance genes. "We were trying to understand why these genes were present in some but not all bacteria. This knowledge can aid vaccine design, because it is unhelpful if they only target a subpopulation of bacteria," Martinez said. Another project looked at host-parasite interactions in malarial infections. "We were trying to understand what it means to go from having a lower frequency of disease to eradicating it. It's a particularly challenging question when it comes to malaria," Martinez said.

During her postdoctoral studies, Martinez also investigated how human mobility impacts the transmission of the disease, a problem that has gathered attention across the world due to the COVID-19 pandemic. "When COVID-19 hit, we wanted to help. I reached out to the Chilean government and from March onwards, I helped write weekly reports that showed how the lockdown affected people and characterized the socioeconomic effects of COVID-19 transmission in Santiago," Martinez said.

Martinez joined the University of Illinois in November 2020. "The Department of Microbiology was looking for someone with an interdisciplinary background. Although I don't consider myself a microbiologist or a statistician, I am comfortable with both fields," Martinez said. "I was also impressed by the interdisciplinary research that is carried out here. I wanted to be part of such a unique network, and that's what brought me here."

The Martinez lab currently has three primary research interests that all revolve around the dynamics of pathogens. The first project focuses on studying the pathogen diversity of rotavirus, which is the most common cause of diarrheal disease among children. Although the current vaccines have reduced the number of infections in developed countries, it does not work well in developing countries. "It is possible that the diversity of the virus in such countries poses a challenge," Martinez said. "If we can understand what drives this diversity, we can develop intervention techniques."

The second research question aims at understanding how climate variability affects pathogens. "Some pathogens cause infections throughout the year, others are common in the winter. For example, the monsoon season in the Bengal area in India and Bangladesh affects the seasonality of cholera and rotavirus" Martinez said. "I am interested in looking at how climate variability and ultimately climate change affects the transmission of diseases."

Martinez is also interested in studying how the demographics of human societies affect disease transmission. "During the pandemic, we realized that COVID-19 impacts poor people in Chile five times more. It's not only because they have higher health risks, they also have less access to healthcare facilities when they are infected," Martinez said. She is currently working with researchers in the IGOH theme and the Department of Anthropology to study similar trends in Rantoul, Illinois, which has a large migrant population. "I am interested in using the work that I did in Chile to help the communities around Urbana-Champaign," Martinez said.

"Since I joined during the pandemic, I haven't been able to meet many of my colleagues. Although I can work from home and I have more free time, it is not ideal," Martinez said. "I have one graduate student from the Department of Mathematics and two undergraduate students from the School of Molecular and Cellular Biology who will continue working with me in the summer. I'm looking forward to having more graduate students this year." Martinez will also be teaching a new course in 2022, which will focus on epidemiology and modeling infectious diseases. "I am passionate about math and I enjoy teaching courses that involve both math and programming skills to better understand biological processes," Martinez said.

Martinez is also involved in promoting the role of women in science. "It is important to acknowledge that male and female researchers may differ in their academic trajectories. Female faculty often agree to take on service roles, for example when I decided to help the Chilean government, which are not necessarily reflected in publications," Martinez said. "Additionally, the ongoing pandemic is affecting women of all backgrounds in academia, a topic that I wrote about in collaboration with 34 other female scientists. It is important to think about this issue and I hope I can help create more opportunities for underrepresented groups." ■

Written by Ananya Sen.
Photo courtesy of Pamela Martinez.

ON THE GRID
HAPPENINGS AT THE IGB

AWARDS

RASHID BASHIR

Rashid Bashir, Professor of Bioengineering and Dean of the Grainger College of Engineering (CGD/M-CELS), has been awarded the American Institute for Medical and Biological Engineering's (AIMBE) 2021 Professional Impact Award for Education.

MARTIN BURKE

Martin Burke, May and Ving Lee Professor for Chemical Innovation and Professor of Chemistry (MMG), was elected a member of The American Society for Clinical Investigation, which seeks to support the scientific efforts, educational needs, and clinical aspirations of physician-scientists to improve the health of all people.

BRIAN CUNNINGHAM

Brian Cunningham, Donald Biggar Willett Professor of Engineering and Professor of Electrical and Computer Engineering (CGD Theme Leader/MMG) received the 2021 Everitt Teaching Award for Teaching Excellence from the Grainger College of Engineering.

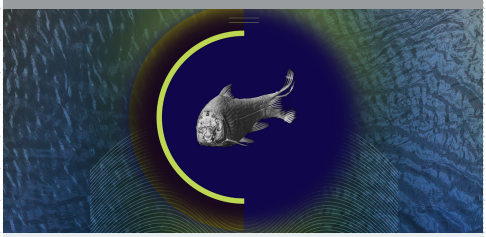
MARTHA GILLETTE

Martha Gillette, Alumni Professor of Cell and Developmental Biology (GNDP/M-CELS), received the 2021 Vision and Spirit Award from the Beckman Institute, which recognizes faculty members who foster collaboration in their research and exemplify Beckman's vision.

BRENDAN HARLEY

Brendan Harley, Robert W. Schaefer Professor, Chemical & Biomolecular Engineering (RBTE Theme Leader/EIRH) was awarded the Clemson Award for Basic Research from the Society For Biomaterials, recognizing an original contribution to the basic knowledge and understanding of the interaction between materials and tissue.

EXHIBITION



ART OF SCIENCE 11.0: ELEMENTAL

This year's Art of Science 11.0 installation will be open for socially-distant outdoor viewing, May 1 to May 8th from 11am-3pm daily (weather permitting) at the University of Illinois Arboretum. Parking is available at 1800 South Lincoln Avenue near the Noel Welcome Garden, along South Lincoln Avenue, or north of Japan House. Opening day will be April 30th from 3:00-7:00pm.

Sponsored by the IGB, BodyWork Associates, and the Catherine and Don Kleinmuntz Center for Genomics in Business and Society

BIOECONOMY

APPLICATIONS NOW OPEN FOR YOUNG INNOVATOR PROGRAM

The Young Innovator program is a ten-week summer program offered through the Kleinmuntz Center. Designed to teach graduate students and post-docs the skills necessary to become innovative leaders, participants will learn about the process of innovation, protecting intellectual property, and how to develop their discoveries beyond the laboratory. Upon completion of the program, all participants will earn a certificate. Additionally, winners of the idea competition, held at the end of the program, will be awarded between $5,000 to $20,000 to develop their projects over one year. Application deadline is Friday, April 30th. For more info click here.

ON THE GRID
HAPPENINGS AT THE IGB

SYMPOSIUM

IGB FELLOWS SYMPOSIUM

IGB FELLOWS SYMPOSIUM MAY 6, 2021

Learn about IGB research, hear about current issues in the life sciences, and connect with other students on campus at the 2021 Fellows Symposium. Featured keynote lectures will be from Dr. James Davis, Former IGB Fellow and Computational Biologist, Division of Data Science and Learning, Computing, Environment and Life Sciences Directorate, Argonne National Laboratory, and Dr. Paul Turner, Rachel Carson Professor of Ecology and Evolutionary Biology, Yale School of Medicine, Yale University.

Register for free at fellows.igb.illinois.edu.

CONFERENCE

DEEP TECH U

DeepTechU is a new conference organized by the University of Chicago's Polsky Center that combines educational panels aimed at faculty and students interested in entrepreneurism with a showcase of 48 deep tech companies emerging from universities and national labs in the greater Midwest. Panel topics include learning how to launch a company based on your research, exploring the resources available to innovators in the Midwest, and best practices for securing SBIR/STTR funding and pitching to VCs. DeepTechU is being held virtually from April 20 – 22, 2021, registration is free and the event is open to all.

More about the event at https://www.deeptechu.com or register here.

GRANT

NEW GRANT AWARDED TO STUDY GENOMIC PRIVACY ATTITUDES

The concept of genomic privacy has recently become important due to the rise of sequencing services, which can inform people about their ancestry or genetic predispositions to health disorders. However, it is unclear what concerns people may have about data privacy. A new grant, awarded by the University of Illinois Urbana-Champaign and the Carl R. Woese Institute for Genomic Biology (IGB), aims to understand these concerns. The $35,000 grant will be used over the course of 18 months, with the option to renew for another 12 months.

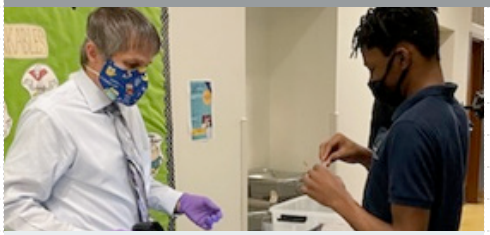
"Although broad questions about genomic privacy concerns have been raised in the past, we're trying to understand which particular aspects of genomic privacy are worrying to laypeople," said Stephen Schneider, a research fellow in the Genomic Security and Privacy (GSP) theme at IGB. "We want to know how they define genomic privacy and what are the different types of questions they have. Hopefully, the results will give us ideas about how to develop technologies that address their privacy concerns."

The researchers are hoping to sample a population of 1600 people, evenly divided between Caucasian, African American, American Indian, and Latinx communities. "According to the literature, racial and ethnic minorities tend to have more privacy concerns, but it is unclear why. For this reason, we need to build a questionnaire that allows us to examine the difference between racial and ethnic groups," Schneider said.

Instead of asking laypeople what they're worried about, previous studies have focused on issues that researchers expect laypeople to think about. To remedy this limitation, the researchers are going to ask open-ended questions to explore the privacy concerns. According to Carl Gunter (GSP leader), a professor of computer science, some of the questions that could arise include employer discrimination and family members finding out about health concerns.

"We will also be studying whether concerns about genomic privacy will correlate with other concerns, such as financial privacy, in the literature," said Aleksander Ksiazkiewicz (GSP), an assistant professor in Political Science. "We can then understand if these are generic concerns or whether there is something unique in this context."

SHIELD



SHIELD ILLINOIS AND SHIELD CU

SHIELD Illinois and SHIELD CU have expandwed their innovative COVID-19 saliva-based testing to underserved K-12 schools in Illinois through a $1.4 million grant from The Rockefeller Foundation

The new undertaking, SHIELD Illinois: Target, Test, Tell for Underserved K-12 Districts, will be rolled out in schools located in the three cities, targeting vulnerable areas that have been disproportionately impacted by the pandemic.

SHIELD CU is the University's local saliva-based testing program designed to serve Champaign-Urbana and surrounding communities and SHIELD Illinois is a screening testing program and infrastructure that deploys the saliva-based testing across the state. Read the full story here.

DEPARTMENT ANNOUNCEMENTS

CNRG

BIOARCHIVE

The Computer and Network Resource Group is proud to announce the availability of our new archive system, Bioarchive. Bioarchive is designed to hold data for extended periods of time (10 years+) and is intended as a place to safely store data that still has value, but no longer needs immediate access.

Bioarchive has several benefits over the previous Strongbox archive system. To begin, users no longer need access to Biocluster in order to use the system. Instead, you can have an account on the archive and transfer data directly to and from the archive. With the previous system, we were unable to store files larger than 2TB in size, but with the new system, files can span multiple tapes allowing for the storage of files several TB in size. In the years to come, we also expect this new system to reduce the cost of storing data on the archive.

As with the older Strongbox system, all data copied over to the archive is still stored on two tapes. One of these tapes is then sent to our offsite storage facility in Rantoul for safekeeping. This allows for data security in case of any type of disaster or if the primary tape in the archive would be damaged in any way. Data on this older archive system has already been transferred to the new system, and previous users will be contacted over the next month to obtain access.

To transfer data to the archive, those not using Biocluster can do so by downloading the Eonbrowser from Spectralogic and then transferring files to and from the system using a traditional FTP style graphical interface. For those wanting to use command line tools to transfer data, those are available as well and are already installed on Biocluster.

If you are interested in using Bioarchive, please email help@igb.illinois.edu and we can schedule a 30-minute zoom session to get you up and running with the system. ■

BUSINESS

ADOBE SIGN

Adobe Sign is an electronic signature application that allows users to securely sign, initial, and enter other information on an electronic document rather than a physical copy.

Adobe Sign allows for:

- Faster Signatures: Routine approval processes can take weeks because physical documents must be walked or mailed for physical signatures. With Adobe Sign, documents are automatically routed through the approval process as they are signed, eliminating travel time.
- More Visibility In The Approval Process: Adobe Sign tracks in real time each document's location in the approval process and who still needs to sign, with updates sent periodically to remind signers they have a document waiting for their approval. No more physical forms getting lost amid the clutter.
- Easier Storage: Adobe Sign utilizes electronic documents, eliminating the need to scan and store physical documents.

How to get started:

Signers: If you only need to sign documents, you are already good to go! Signing documents using Adobe Sign is easy and straightforward. You do not need an Adobe Sign account to sign documents. You can preview the signing experience here.

Senders: To start sending documents out for signature, contact Carla Dickey, the IGB Unit Security Contact (USC). They can connect you to your group administrator to configure an Adobe Sign account for you.

USCs: You can designate a group administrator to provision accounts for your department by completing the Adobe Sign Access Request form. Once the group admin has an account, they can add additional members to the group to send documents.

Email Addresses: Individual university email addresses (i.e., netid@illinois.edu, netid@uic.edu, or netid@uis.edu) must be used when possible. Resource accounts (e.g, department@illinois.edu), sub-domains (e.g., user@dept.uis.edu), and system office addresses (e.g., netid@uillinois.edu) should NOT be used.

For more info visit https://web.uillinois.edu/esignature/ ■

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.

Armstrong, A. A., & Alleyne, A. G. (2021). A Multi-Input Single-Output iterative learning control for improved material placement in extrusion-based additive manufacturing. *Control Engineering Practice*, 111, [104783]. https://doi.org/10.1016/j.conengprac.2021.104783

Hernández-Saavedra, D., Moody, L., Tang, X., Goldberg, Z. J., Wang, A. P., Chen, H., & Pan, Y. X. (2021). Caloric restriction following early-life high fat-diet feeding represses skeletal muscle TNF in male rats. *Journal of Nutritional Biochemistry*, 91, [108598]. https://doi.org/10.1016/j.jnutbio.2021.108598

Tkachenko, A. V., Maslov, S., Elbanna, A., Wong, G. N., Weiner, Z. J., & Goldenfeld, N. (2021). Time-dependent heterogeneity leads to transient suppression of the COVID-19 epidemic, not herd immunity. *Proceedings of the National Academy of Sciences of the United States of America*, 118(17). https://doi.org/10.1073/pnas.2015972118

Luo, J., Zhang, B., & Roberts, B. W. (2021). Sensitization or inoculation: Investigating the effects of early adversity on personality traits and stress experiences in adulthood. *PloS one*, 16(4), e0248822. https://doi.org/10.1371/journal.pone.0248822

Rymut, H. E., Rund, L. A., Bolt, C. R., Villamil, M. B., Bender, D. E., Southey, B. R., Johnson, R. W., & Rodriguez-Zas, S. L. (2021). Biochemistry and Immune Biomarkers Indicate Interacting Effects of Pre- and Postnatal Stressors in Pigs across Sexes. *Animals*, 11(4). https://doi.org/10.3390/ani11040987

Alfaro, G. F., Rodriguez-Zas, S. L., Southey, B. R., Muntifering, R. B., Rodning, S. P., Pacheco, W. J., & Moisá, S. J. (2021). Complete Blood Count Analysis on Beef Cattle Exposed to Fescue Toxicity and Rumen-Protected Niacin Supplementation. *Animals*, 11(4). https://doi.org/10.3390/ani11040988

Chen, E., Zielinski, C., Deno, J., Singh, R., Bell, A. M., & Hellmann, J. K. (2021). The specificity of sperm-mediated paternal effects in threespine sticklebacks. *Behavioral Ecology and Sociobiology*, 75(4), [68]. https://doi.org/10.1007/s00265-021-03001-8

Farahany, N. A., & Robinson, G. E. (2021). The rise and fall of the "warrior gene" defense. *Science*, 371(6536), 1320-1320. https://doi.org/10.1126/science.abh4479

von Schaumburg, P., Rodriguez-Zas, S. L., Southey, B. R., de Godoy, M., He, F., & Parsons, C. M. (Accepted/In press). White and red sorghum as primary carbohydrate sources in extruded diets of felines. *Frontiers in Veterinary Science*. https://doi.org/10.3389/fvets.2021.668255

Sawant, A., Ebbinghaus, B. N., Bleckert, A., Gamlin, C., Yu, W. Q., Berson, D., Rudolph, U., Sinha, R., & Hoon, M. (2021). Organization and emergence of a mixed GABA-glycine retinal circuit that provides inhibition to mouse ON-sustained alpha retinal ganglion cells. *Cell Reports*, 34(11), [108858]. https://doi.org/10.1016/j.celrep.2021.108858

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