

IGB NEWS

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Volume 13 Number 2

UPCOMING EVENTS

PLEASE NOTE

Upon review of the current state of affairs, as well as considering decisions made in other academic and public settings, all events, meetings, and symposia have been postponed canceled for the semester.

CANCELLED: IGB SEMINAR - IGOH
Tue, 03/24/2020

Turlough Finan, PhD
McMaster University; Professor,
Department of Biology

POSTPONED:
IGB Symposium - Rubisco Oxygenase:
50 Years of Progress and Looking into
the Future
Fri, 03/27/2020

CANCELLED:
IGB PIONEERS SEMINAR - GNDP
Tue, 03/31/2020 - 12:00

Elisabeth Binder, PhD
Max Planck Institute of Psychiatry in
Munich

CANCELLED:
Committee on Diversity Roundtable
Thu, 04/02/2020 - 1:30

CANCELLED: IGB Special Seminar
Fri, 04/03/2020 - 13:00

Kendall Powell
Science Journalist and Contributor,
Nature Careers

CANCELLED:
IGB Distinguished Public Lecture
START: Tue, 04/07/2020

Michael Rosbash, PhD
Nobel Laureate
Peter Gruber Endowed Chair in
Neuroscience, Professor of Biology
Brandeis University

FEATURED NEWS



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**SynFoNI: Strengthening
synthetic biology in food**



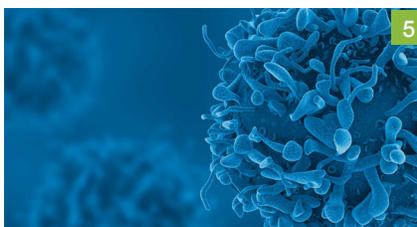
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**Seed funds from alumnus furthers
neurological disease research**



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**Monthly Profile:
Fisk University**



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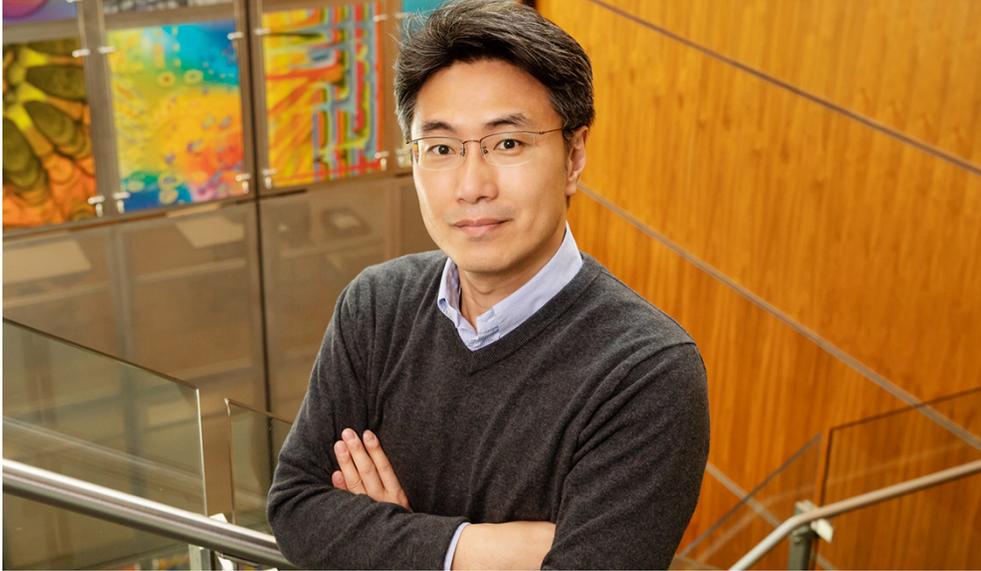
**On the Grid:
Happenings at IGB**



This month features a fossilized earwig preserved in amber from the Dominican Republic. The amber is Early Miocene in age, between 16 and 18 million years old. In this specimen the eyes, antennae, and folded wings are clearly visible, along with the forceps, or pincers, at the end of the abdomen that are characteristic of earwigs. It is also possible to count the number of plates on the underside of the abdomen which indicates that this specimen is an adult female. Taken with the new NSI X5000 High Resolution MicroCT.

IGB News

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



SynFoNI: Strengthening synthetic biology in food and nutraceutical production

Over the years, the democratization of synthetic biology for the production of food has led to products like the Impossible burger, a burger impostor that uses plant tissues instead of meat. Despite this, food companies remain hesitant to utilize synthetic biology due to concerns with genetically modified foods.

With the emergence of genome editing techniques, such as CRISPR-Cas, Professor of Food Science and Human Nutrition (FSHN) Yong-Su Jin (BSD/CABBI/MME) believes both the consumer and manufacturer can benefit from synthetic biology with minimal risks. This idea was used to propose the Synthetic Biology for Food and Nutrition Innovation (SynFoNI) program for which Jin currently serves as Director along with Deputy Director and Professor of FSHN Mike Miller (IGOH/MME).

“Instead of changing many things which are mostly undesirable in the cell, we can use molecular surgery to change desirable base pairs with CRISPR-Cas,” said Jin. “If we can do that, we can reduce the risks and create consumer products in a highly safe manner.”

SynFoNI was chosen along with 17 other programs to receive funding over a three year period for the Investment for Growth program through the Office of the Provost, which aims to invest in programs that lead to financial sustainability and revenue generation. First submitted as an Agricultural, Consumer and Environmental Sciences (ACES) proposal, SynFoNI was forwarded to the campus level after passing internal competition.

“The clear goal of SynFoNI is to make ACES and Illinois a world leader in applying synthetic biology to food and nutritional problems,” said Jin. “We are going

to leverage excellent research facilities and programs here, which will provide the infrastructure to facilitate collaborations between the industry and the scientists on campus.”

“In this program, we will teach students the technology and skillset required for applying synthetic biology towards food and nutritional problems.”

SynFoNI plans to build a network that integrates the IGB, the Integrated Bioprocessing Research Laboratory, the FSHN program, ACES farms, and numerous food companies in the Chicago area, with plans to create a Food Innovation Center at the Discovery Partners Institute in Chicago.

The initiative will also provide a new professional science master’s (PSM) program in synthetic biology for food and nutrition, in addition to a new minor in fermentation science at ACES. Students in the PSM program will also get a unique training opportunity by learning about and using The Illinois Biological Foundry for Advanced Biomanufacturing (iBioFAB) machine for their research projects.

“We view the workforce as a critical limiting factor in synthetic biology,” said Jin. “In this program, we will teach students the technology and skillset required

for applying synthetic biology towards food and nutritional problems.”

In addition to collaborative research, SynFoNI also proposes to host workshops, plan outreach activities, and invite companies for industrial affiliated programs. Workshops will focus on teaching students the necessary skillsets and educating CEOs of food companies about expected risks and benefits of synthetic biology while outreach activities will be geared towards the general public. The primary goal of these activities is to increase the interactions between the food science and nutritional science leaders with students and faculty members at Illinois.

“The social reception is a limiting factor and so one of the goals is to research how to aid the general public when using these food products,” said Jin. “SynFoNI is a great way to approach the general public with genomics in synthetic biology.”

Jin believes that now is the time of a new revolution where genome editing technology replaces genetically modified foods. With SynFoNI in place, the strengthening of the Illinois Food and Agricultural industry research and training will take synthetic biology in food production to the next level.

“I am really grateful for the support from the IGB and opportunities to collaborate with top notch scientists,” said Jin. “I would like to evolve this relationship by bringing more external industry people to the IGB. SynFoNI will be a good testbed for interactions with the industry and a great way to close the gap between the IGB and commercialization.” ■

Written by Alisa King. Photo L. Brian Stauffer.

RESEARCH



Seed funds from alumnus furthers cell culture models of neurological diseases

Neurological diseases such as Alzheimer's disease, Parkinson's disease, and multiple sclerosis affect millions of people worldwide and yet, there exist no known cures. Multiple sclerosis, a disease that causes deterioration of the nerves due to miscommunication between the brain and body, was of particular interest to Illinois alumnus Scott Fisher. As an alumnus, Fisher had a desire to give back to the university but to also honor his late wife Bonita J. Fisher, who was diagnosed with multiple sclerosis.

Driven by this desire, Fisher initiated the Director's Innovation Fund, which fueled the collaborative nature of the IGB by supporting research conducted in the Gene Networks in Neural & Developmental Plasticity (GNDP) and Regenerative Biology & Tissue Engineering (RBTE) themes. As a result of the seed funds, Professor of Cell and Developmental Biology Lisa Stubbs (GNDP theme leader) and Robert W. Schaefer Professor of Chemical and Biomolecular Engineering Brendan Harley (RBTE theme leader) were further funded by the National Cancer Institute within the National Institutes of Health (NIH) to use three-dimensional hydrogel systems to study neurodegenerative disease models, particularly Alzheimer's disease.

"The funding from Scott Fisher was essential for us," said Harley. "It allowed us to gather the preliminary data we needed to show that we could adapt the biomaterials we are developing to study brain cancer in order to investigate processes related to neurodegeneration. With that data, we were able to talk with Lisa who brings in expertise in neurodegeneration and then put together a proposal to the NIH as a supplement to our existing grant."

Alzheimer's disease, a neurodegenerative disease, is characterized by an accumulation of extracellular beta-amyloid (A β) plaques that can be exacerbated by hypoxia. Nevertheless, the contribution of hypoxia towards progression and pathogenesis of such neurodegenerative diseases re-

main poorly understood. Although animal models have provided some understanding of neurodegenerative diseases, translation of results into human clinical trials have been unsuccessful. Therefore, advanced biomaterial platforms have become more favorable, as they allow for

Above: Professor of Cell and Developmental Biology Lisa Stubbs, left (GNDP theme leader) with Robert W. Schaefer Professor of Chemical and Biomolecular Engineering Brendan Harley (RBTE theme leader) and Research Assistant Professor Sara Pedron-Haba.

replication of the diseased microenvironment and differentiation of neural cells into relevant lineages.

In a proof-of-principle study led by Research Assistant Professor Sara Pedron-Haba, PhD student Samantha Zambuto, and postdoc Julio Serrano, hydrogels, which are polymers used for soft tissue regeneration, were demonstrated as viable cell culture platforms for investigating neurodegenerative processes. More importantly, the hydrogel system could be used to investigate the effects of hypoxia-mediated stress on neural cell populations. Their findings were reported in the journal *MRS Communications*.

"We had the initial idea about looking at oxidative stress because it's related to many of the diseases, but especially the brain because the brain needs a lot of energy," said Pedron-Haba. "We build materials that polymerize with the enzyme laccase that consumes oxygen so that the oxygen concentration will go down and cause oxidative stress."

According to Pedron-Haba, the ultimate goal for the project is to be able to use neural stem cells derived from diseased patients of Alzheimer's and to study the effects of hypoxia on A β metabolism.

"We are now setting the stage to study particular features of diseases," said Pedron-Haba. "We are looking at oxidative stress and how systemic diseases such as heart failure affects blood flow into the brain. If that decrease in blood flow is created in oxidative stress and damages the blood vessels, then maybe that leads to accumulation of A β or destruction of the neuronal network."

Now equipped with a suitable cell-culture platform, they can now study particular features of other neurodegenerative diseases such as multiple sclerosis.

"This supplement is letting us expand the work Scott helped initiate," said Harley. "Each is a stepping stone to larger scientific questions, but honestly without the initial seed from Scott this never would have gotten off the ground." ■

*Written by Alisa King.
Photo by Jillian Nickell.*

MONTHLY PROFILE



Fisk University is a historically minority-serving institution (MSI) in Nashville, Tennessee, of which Fisk students Skye Faucher (left) and Jaia Holleman return to campus as part of the KnowEnG collaboration with Mayo Clinic.

Collaboration provides research-based training of under-represented minorities

As part of a campus-wide initiative to increase diversity, a collaboration with Fisk University was recently approved for an additional five years of continued financial support from the Office of Executive Associate Chancellor for Administration and University Relations and the Office of the Vice Chancellor for Research (OVCRI). Founder Professor of Physics Jun Song (ACPP) will oversee hands-on bioinformatics, data analysis, and biophysics training for under-represented minority undergraduate students from Fisk University, a minority-serving institution (MSI) in Nashville, Tennessee.

The five-year contribution will be matched through cost-share by the IGB and the Department of Physics, which will provide administrative and technological support to hosting students and also manage faculty-faculty collaborations between Fisk University and the University of Illinois. The Grainger College of Engineering will also contribute funds, and its new “Institute for Inclusion, Diversity, Equity, and Access” (IDEA Institute) will help establish research collaborations between Illinois and Fisk faculty members. In addition, the Carver Biotechnology Center’s High-Performance Biological Computing group (HPCBio) will provide personalized training resources and consulting. Formed in 2014, the Fisk collaboration emerged as Illinois was granted one of the Big Data to Knowledge (BD2K) grants from the National Institutes of Health, which aimed to enhance and accelerate analysis of complex data or “big data” related to biomedical sciences. In that same year, an R25 program/partnership between the Knowledge Engine for Genomics (KnowEnG) Center, which included Mayo Clinic, and Fisk University was forged.

“This grant allowed for educational resource exchange and on-site training of MSI students on campus at one of the BD2K centers,” explained Song. “Our center worked with Fisk faculty and students for the past six years, and the collaboration consisted of three components.”

The components he is referring to encompasses two consecutive summer training programs, where students become acclimated to the campus and research

environment in the first year by externing with HPCBio before choosing a faculty member to conduct research with at either the University of Illinois’ SROP (Summer Research Opportunities Program) or Mayo Clinic’s SURF (Summer Undergraduate Research Fellowship) in their second year.

“We provided hands-on training for utilizing a high-performance computing cluster and performing statistical analyses of genomic data,” said Song. “In the end, they got to analyze real sequencing data that were produced by Illinois faculty. Jessica Holmes, the Research and Instructional Specialist in Life Sciences, and other HPCBio staff members coordinated and carried out these activities.”

“Students presented their findings to the IGB faculty, including myself and others involved in the training process, and we broadcasted the presentations live to Fisk University, where Fisk faculty members could comment and ask questions at the end of the presentations,” said Song.

In partnership with Mayo Clinic, a computational biology summer course is also offered to Fisk University faculty members and students, organized by Professor Saurabh Sinha in the Department of Computer Science (CABBI/BSD/GNDP/GSP) who co-directed the BD2K center with Professor Jiawei Han (GNDP) and taught by IGB and HPCBio faculty and staff. In addition, a bioinformatics seminar, taught by Professor Sandra Rodriguez-Zas (GNDP) in the Department of Animal Sciences, is broadcasted from the IGB to Fisk University in the spring, which has been ongoing for four years. Fisk University students are also provided with interactive learning tools such as educational games that reinforce bioinformatics concepts learned during lectures.

Last summer, two Fisk University students, Jaia Holleman and Skye Faucher, spent five weeks learning programming languages, executing a bioinformatics pipeline, gaining professional development skills, and touring facilities and labs within the IGB.

Both Holleman and Faucher are biochemistry and molecular biology majors, having participated in the program because of their shared interest in biological

research and bioinformatics.

“When I received the application for the BD2K program, what sparked my interest the most was that the program combined both biology/research and computer science,” said Holleman. “It was so great being able to meet new people, broaden my horizons, and explore a field that I didn’t know I would have necessarily been interested in.”

“I became interested in the BD2K program after completing a small research project on the applications of bioinformatics for my bioinformatics class and my mentor, Dr. Brian Nelms, advised me to apply,” said Faucher. “I enjoyed being surrounded by a group of aspiring young scientists, much like myself, and experiencing the true interdisciplinary nature of science through discussions about our educational and career goals.”

“As a campus-wide initiative, we wanted to establish this kind of bridge program between MSI and Illinois,” said Song. “The Department of Physics will be the first example of this bridge program, and there is great interest on campus to extend this bridge program to the entire College of Engineering as well as the College of Liberal Arts and Sciences.”

Song views the collaboration with Fisk University as a springboard for future partnerships with other MSI, with the goal of increasing overall diversity on campus.

“The IGB and the Physics department are leading this effort to increase diversity on campus, and it is based on the solid foundation that was established through the BD2K center here,” said Song. “The IGB, HPCBio, SROP, the Department of Physics, and the Center for the Physics of Living Cells are the core components of the future direction that we will take. I think this initiative is a major accomplishment that would not have been possible without the dedicated effort of many people involved and the support from the Chancellor’s Office.” ■

Written by Alisa King. Photos courtesy of Skye Faucher and Jaia Holleman.

ON THE GRID HAPPENINGS AT THE IGB

AWARDS



PAUL HERGENROTHER

Paul Hergenrother, Kenneth L. Rinehart Endowed Chair in Natural Products Chemistry and Professor of Chemistry (ACPP theme leader/MMG), has been appointed the Cancer Center at Illinois Deputy Director. Paul currently co-leads the CCIL research program, Cancer Discovery Platforms Across the Engineering-Biology Continuum.

NEW ARRIVAL



WENYAN MEI

Professor Wenyan Mei has joined the IGB as an affiliate member in the Microbiome Metabolic Engineering (MME) Research Theme. Dr. Mei is a Research Assistant Professor in the Department of Comparative Biosciences in the College of Veterinary Medicine. She received her PhD from the Shanghai Institute of Biochemistry and Cell Biology, and was a postdoctoral research associate at the University of Pennsylvania School of Medicine. Her lab is interested in understanding how stem cells control their self-renewal and differentiation, and how their dysregulation causes diseases.

COMPUTER RESOURCE AND NETWORK GROUP



WINDOWS 7 END OF LIFE

On January 14, 2020, Microsoft started classifying Windows 7 as an End of Life (EOL) product. This means that since January 14, Microsoft has not and will not issue any security updates for Windows 7. CNRG staff have been scouring the building for any remaining Windows 7 systems, but if you have one that you are using, please let us know with help@igb.illinois.edu and we will get your system upgraded to Windows 10.

SINGULARITY CONTAINERS

Have you ever wanted to use software that was distributed in Docker containers? CNRG now supports using containers to run software on Biocluster. If you would like to start using this feature, please let us know with help@igb.illinois.edu and we can assist.

CORE STORAGE CHANGES

With the increase in data generated by the Core Facilities, CNRG has been busy working on a new long term storage solution for the Core Facilities. If you are going to be creating a large amount of data with the Core Facilities, please let us know so that we can help with any of your storage, data transfer, and archival needs.

SYMPOSIUM POSTPONED

POSTPONED

RUBISCO OXYGENASE

RUBISCO OXYGENASE SYMPOSIUM POSTPONED

The symposium organizing committee, in consultation with university administration, have decided that it is prudent and necessary to postpone the Rubisco Oxygenase Symposium due to the COVID-19 situation. We are currently looking into new dates for the symposium. We sincerely regret any inconvenience that this may cause.

TING LU

Ting Lu, Associate Professor of Bioengineering (BSD/BCXT/CABBI/MME) was appointed Donald Biggar Willett Faculty Scholar, which honors faculty members who contribute excellence in research, teaching, and professional service to the University of Illinois.



ANDREW SMITH

Andrew Smith, Associate Professor of Bioengineering (CGD) was appointed Donald Biggar Willett Faculty Scholar, which honors faculty members who contribute excellence in research, teaching, and professional service to the University of Illinois.

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.

Renteria, C., Liu, Y. Z., Chaney, E. J., Barkalifa, R., Sengupta, P., & Boppart, S. A. (2020). Dynamic Tracking Algorithm for Time-Varying Neuronal Network Connectivity using Wide-Field Optical Image Video Sequences. *Scientific reports*, 10(1), [2540]. <https://doi.org/10.1038/s41598-020-59227-5>

Liu, F., Mao, J., Kong, W., Hua, Q., Feng, Y., Bashir, R., & Lu, T. (2020). Interaction variability shapes succession of synthetic microbial ecosystems. *Nature communications*, 11(1), [309]. <https://doi.org/10.1038/s41467-019-13986-6>

Cao, M., Fatma, Z., Song, X., Hsieh, P. H., Tran, V. G., Lyon, W. L., ... Zhao, H. (2020). A genetic toolbox for metabolic engineering of *Issatchenkia orientalis*. *Metabolic Engineering*, 59, 87-97. <https://doi.org/10.1016/j.ymben.2020.01.005>

Uprety, S., Dangol, B., Nakarmi, P., Dhakal, I., Sherchan, S. P., Shisler, J. L., ... Nguyen, T. H. (2020). Assessment of microbial risks by characterization of *Escherichia coli* presence to analyze the public health risks from poor water quality in Nepal. *International Journal of Hygiene and Environmental Health*, 226, [113484]. <https://doi.org/10.1016/j.ijheh.2020.113484>

Qin, E. C., Ahmed, S. T., Sehgal, P., Vu, V. H., Kong, H., & Leckband, D. E. (2020). Comparative effects of N-cadherin protein and peptide fragments on mesenchymal stem cell mechanotransduction and paracrine function. *Biomaterials*, 239, [119846]. <https://doi.org/10.1016/j.biomaterials.2020.119846>

DeAngelis, R., Dodd, L., & Rhodes, J. (2020). Nonapeptides mediate trade-offs in parental care strategy. *Hormones and Behavior*, 121, [104717]. <https://doi.org/10.1016/j.yhbeh.2020.104717>

Suarez, G. P., Udiani, O., Allan, B. F., Price, C., Ryan, S. J., Lofgren, E., ... Fefferman, N. H. (2020). A generic arboviral model framework for exploring trade-offs between vector control and environmental concerns. *Journal of Theoretical Biology*, 490, [110161]. <https://doi.org/10.1016/j.jtbi.2020.110161>

Allan, E. R. O., Dores, C. B., Nelson, E. R., & Habibi, H. R. (2020). Acute exposure to physiological doses of triiodothyronine does not induce gonadal caspase 3 activity in goldfish *in vitro*. *General and Comparative Endocrinology*, 289, [113382]. <https://doi.org/10.1016/j.ygcen.2019.113382>

Hernández-Barrueta, T., Martínez-Bustos, F., Castaño-Tostado, E., Lee, Y., Miller, M. J., & Amaya-Llano, S. L. (2020). Encapsulation of probiotics in whey protein isolate and modified huauzontle's starch: An approach to avoid fermentation and stabilize polyphenol compounds in a ready-to-drink probiotic green tea. *LWT*, 124, [109131]. <https://doi.org/10.1016/j.lwt.2020.109131>

Bo, Y., Jiang, Y., Chen, K., Cai, K., Li, W., Roy, J., ... Cheng, J. (2020). Targeting infected host cells *in vivo* via responsive azido-sugar mediated metabolic cell labeling followed by click reaction. *Biomaterials*, 238, [119843]. <https://doi.org/10.1016/j.biomaterials.2020.119843>

Taylor, A. M., & Holscher, H. D. (2020). A review of dietary and microbial connections to depression, anxiety, and stress. *Nutritional Neuroscience*, 23(3), 237-250. <https://doi.org/10.1080/1028415X.2018.1493808>

Bhatia, S. K., Jagtap, S. S., Bedekar, A. A., Bhatia, R. K., Patel, A. K., Pant, D., ... Yang, Y. H. (2020). Recent developments in pretreatment technologies on lignocellulosic biomass: Effect of key parameters, technological improvements, and challenges. *Bioresource Technology*, 300, [122724]. <https://doi.org/10.1016/j.biortech.2019.122724>

Zhang, J. J., Lan, T., & Lu, Y. (2020). Translating *in vitro* diagnostics from centralized laboratories to point-of-care locations using commercially-available handheld meters. *TrAC - Trends in Analytical Chemistry*, 124, [115782]. <https://doi.org/10.1016/j.trac.2019.115782>

Wang, B., & Zhao, H. (2020). Unleashing the power of energy storage: Engineering β -oxidation pathways for polyketide production. *Synthetic and Systems Biotechnology*, 5(1), 21-22. <https://doi.org/10.1016/j.synbio.2020.01.002>

Weitzel, C. S., Li, L., Zhang, C., Eilts, K. K., Bretz, N. M., Gatten, A. L., ... Martinis, S. A. (Accepted/In press). Duplication of leucyl-tRNA synthetase in an archaeal extremophile may play a role in adaptation to variable environmental conditions. *Journal of Biological Chemistry*, [jbc.RA118.006481]. <https://doi.org/10.1074/jbc.RA118.006481>

Peterson, R. D., Wilund, K., Cunningham, B. T., & Andrade, J. (2020). Reply to Comments: Comparison of Methods Study between a Photonic Crystal Biosensor and Certified ELISA to Measure Biomarkers of Iron Deficiency in Chronic Kidney Disease Patients. *Sensors (Basel, Switzerland)*, 20(4), [1149]. <https://doi.org/10.3390/s20041149>

Berenbaum, M. R., & McNutt, M. (2020). Meanwhile, back "at the national academies". *Proceedings of the National Academy of Sciences of the United States of America*, 117(7), 3343-3344. <https://doi.org/10.1073/pnas.2000110117>

Zhao, Y., Maguluri, G., Daniel Ferguson, R., Tu, H., Paul, K., Boppart, S. A., ... Iftimia, N. (2020). Two-photon microscope using a fiber-based approach for supercontinuum generation and light delivery to a small-footprint optical head. *Optics Letters*, 45(4), 909-912. <https://doi.org/10.1364/OL.381571>

Bai, Y., Xing, H., Bai, Y., Tan, L. H., Hwang, K., Li, J., ... Zimmerman, S. C. (2020). Independent control over size, valence, and elemental composition in the synthesis of DNA-nanoparticle conjugates. *Chemical Science*, 11(6), 1564-1572. <https://doi.org/10.1039/c9sc05656d>

Ye, L., Mei, R., Liu, W. T., Ren, H., & Zhang, X. X. (2020). Machine learning-aided analyses of thousands of draft genomes reveal specific features of activated sludge processes. *Microbiome*, 8(1), [16]. <https://doi.org/10.1186/s40168-020-0794-3> ■

ILLINOIS

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