

# IGB NEWS

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Volume 10 Number 8

## UPCOMING EVENTS

### IGB Seminar (ONC-PM)

*Functional Impact of Post-Transcriptional Gene Networks in Health and Disease*  
January 23, 2018, 12:00 p.m.  
612 Carl R. Woese Institute for Genomic Biology

Auinash Kalsotra, PhD  
University of Illinois  
Department of Biochemistry

### IGB Seminar (GEGC)

*TBD*  
January 30, 2018, 12:00 p.m.  
612 Carl R. Woese Institute for Genomic Biology

Li-Qing Chen, PhD  
University of Illinois  
Department of Plant Biology

### IGB Seminar (IGOH)

*TBD*  
February 13, 2018, 12:00 p.m.  
612 Carl R. Woese Institute for Genomic Biology

Katia Koelle, PhD  
Duke University  
Biology Department

### Fox Family Innovation and Entrepreneurship Lecture

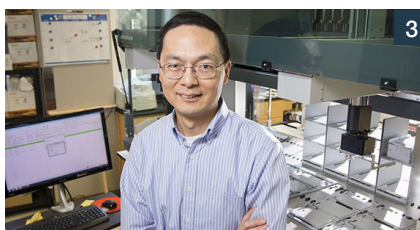
*TBD*  
February 13, 2018, 12:00 p.m.  
612 Carl R. Woese Institute for Genomic Biology

Andrew Miller, PhD  
Co-Founder and CEO  
Karuna Pharmaceuticals

## FEATURED NEWS



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**Genomic Study Explores Evolution of Gentle 'Killer Bees'**



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**A New Way To Do Metabolic Engineering**



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**On the Grid: Happenings at IGB**

## IMAGE OF THE MONTH



This month features a newly hatched first instar honey bee larva captured on a Zeiss AxioZoom V16. This project aims to develop a system to rear honey bees in the laboratory using advanced robotics. Once established, the system will be used to study how parasites, pathogens, pesticides and nutrition interact to affect bee health. Supported by a DARPA grant, research was conducted by Julia Fine, William Streyer, Ran Chao and Nathan Beach of the Gene Robinson laboratory.

### IGB News

Share your news with the IGB. Send ideas on stories, articles, and features to [nvasi@illinois.edu](mailto:nvasi@illinois.edu).



## Genomic Study Explores Evolution of Gentle ‘Killer Bees’ in Puerto Rico

A genomic study of Puerto Rico’s Africanized honey bees - which are more docile than other so-called “killer bees” - reveals that they retain most of the genetic traits of their African honey bee ancestors, but that a few regions of their DNA have become more like those of European honey bees. According to the researchers, these changes likely contributed to the bees’ rapid evolution toward gentleness in Puerto Rico, a change that occurred within 30 years.

The findings, reported in the journal *Nature Communications*, could lead to advances that will bolster honey bee populations in the Americas, the researchers said.

Africanized bees are the offspring of African honey bees and their European counterparts. In the late 1950s, these aggressive “killer bees” escaped from an experimental breeding program in Brazil. That program had set out to produce a desirable mix of traits from the gentle European bees and their African counterparts, which were more aggressive, disease-resistant and adapted to a tropical climate.

Ironically, what scientists failed to do in the laboratory was eventually accomplished by happenstance. Africanized honey bees arrived in Puerto Rico (most likely on a ship, by accident) in the 1990s, and within three decades had evolved into the gentle, yet hardy, Africanized bees that dominate the island today. Biology professor Tugrul Giray, of the University of Puerto Rico, first reported on the gentle Puerto Rican bees in the journal *Evolutionary Applications* in 2012. Giray is a co-author of the new study.

To gain insight into how the bees became gentle, the researchers sequenced the genomes of 30 gentle Puerto Rican bees, 30 Africanized bees from Mexico and 30 European honey bees from central Illinois.

“The benefit of having these three populations is that you can compare and contrast between the three,” said

University of Illinois postdoctoral researcher Arian Avalos, who conducted the research with U. of I. entomology professor Gene Robinson; crop sciences professor Matthew Hudson; and Guojie Zhang and Hailin

*From left, IGB Director Gene Robinson, postdoctoral researcher Arian Avalos, and Professor of Crop Sciences Matthew Hudson.*

Pan, of the Chinese Academy of Sciences. “We asked, ‘How is the genome of the gentle Africanized bee different than other Africanized populations? What parts of the genome are similar to European bees?’”

The team discovered that, for the most part, the genomes of the gentle bees resembled those of their Africanized forebears. Specific regions of the DNA, however, had shifted in the gentle bees, reflecting more of their European heritage. These regions appeared to be under “positive selection.” This means that something in the bees’ environment was favoring these genetic signatures over others.

The scientists hypothesize that the bees evolved to be more docile as a result of living on a very densely populated island from which they could not easily escape. Humans likely eradicated the most aggressive bees, aiding their more docile counterparts.

“Evolution involves changes in the frequency of gene variants across a population, and that’s what we’re seeing in Puerto Rico,” said Robinson, who directs the Carl R. Woese Institute for Genomic Biology at Illinois. “Now we know that these gentle Africanized bees can be genetically distinguished both from other Afri-

canized honey bees and from European honey bees.”

The new findings offer a bit of hope for the beleaguered beekeeping industry, the researchers said. European honey bees tend to have less genetic diversity than Africanized bees, which carry both European and African honey bee genes. European honey bees also are more susceptible to a host of debilitating parasites and pathogens. Their rapid decline since 2005, a phenomenon known as colony collapse disorder, is disrupting agriculture around the world.

“The fact that we’ve shown that the genetics of these Puerto Rican bees are very distinct from the European bees, and the fact that they are demonstrably gentle, makes it very interesting as a potential way to mitigate pollinator decline,” Hudson said.

In particular, the Africanized bees are highly resistant to the varroa mite, a parasite of bees that undermines their health and spreads disease. The mites - along with pesticides used to treat infested bees - are believed to be major factors in the widespread decline of honey bees across the globe.

In previous research in the Giray laboratory, scientists showed that Puerto Rico’s gentle Africanized bees groom themselves aggressively when infested with varroa, removing the mites almost as soon as they appear.

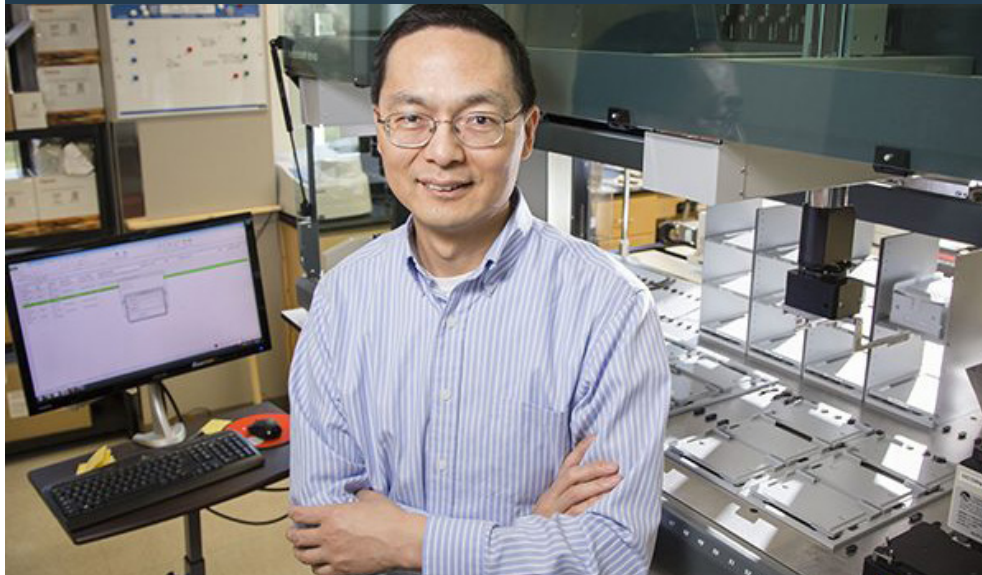
“Infestation of European honey bees with the mites elicits very little response,” said Avalos, who previously worked with Giray in Puerto Rico. “This could be good news for beekeepers who want to develop a gentle honey bee that is also varroa-resistant.”

The National Science Foundation, the Beijing Genomics Institute and the University of Illinois supported this research. ■

*Written by Diana Yates. Photo by L. Brian Stauffer.*



## RESEARCH



# A New Way To Do Metabolic Engineering

A novel method developed by a group of IGB researchers could change the way metabolic engineering is done.

Researchers from the IGB's Biosystems Design theme, including Steven L. Miller Chair of Chemical and Biomolecular Engineering Huimin Zhao, recently published a paper in *Nature Communications* outlining their new method, which could make the metabolic engineering process more efficient.

Metabolic engineering involves engineering microorganisms to produce value-added products such as biofuels and chemicals. This is achieved by changing or deleting the expression of genes to modify the microorganism's genome. In this process, several targets in the genome are modified in order to achieve specific goals.

"We can easily find several metabolic engineering targets to improve the desired phenotype," said Jiazhang Lian, a visiting research associate at the IGB who is a co-author of the paper. "How to combine these beneficial genetic modifications is one of the biggest challenges in metabolic engineering."

Traditionally, researchers test these targets individually in a series of time-consuming steps. These steps limit productivity and the yield of the final product—two crucial components in the metabolic engineering process.

The researchers decided to create a method that combines all of these steps and executes them simultaneously, making the process faster and easier.

They based this method on the CRISPR system, a method of genetic manipulation that uses a set of DNA sequences to modify genes within a cell.

This system uses three genetic manipulations that are frequently used in metabolic engineering: transcriptional activation, transcriptional interference, and gene deletion.

By using these manipulations simultaneously, scientists can explore different combinations of manipulations and discover which combination is best.

"We can now work with 20 targets," Zhao said. "We can implement all of these (manipulations) for each target in a combinatorial manner to find out which combination actually will give us higher productivity or yield of the final product."

The researchers tested the method in a species of yeast that is used in winemaking, baking, and the production of biofuels. They showed that using this method could improve the production of a specific product.

Their system, called CRISPR-AID, will allow researchers to easily explore all the possible target combinations. But the key is to find the optimal combination.

"If we compare metabolic engineering to a basketball team, we cannot build a strong team by simply putting the best players together," Lian said. "Instead, we should try to find those who can collaborate and work synergistically."

Their new system opens up thousands—even mil-

lions—of possibilities, which presents another logistical challenge.

They plan to find the best combinations by developing a high throughput screening method or using a robotic system such as the iBioFAB, a system located in the IGB that automatically produces synthetic biosystems.

"I believe the combination of CRISPR-AID with high throughput screening and iBioFAB will significantly advance the metabolic engineering field in the near future," Lian said.

Zhao hopes to test their method on other organisms, using the same engineering principles but modifying the protocol for different organisms.

Eventually, they hope to extend to the genome scale — to be able to test all the genes in an organism at once — which would be a considerable leap in the field of metabolic engineering.

"If we can do that, we can make it truly modularized and also standardize the procedure," Zhao said. "Then we really increase the throughput and the speed of metabolic engineering."

Several research efforts aim to engineer microorganisms for the production of biofuels and chemicals, so any tools that can speed up the process are significant. Zhao believes this is true for their method.

"It's not just an incremental improvement," he said. "It's a new way to do metabolic engineering." ■

*Written by Emily Scott. Photo by L. Brian Stauffer.*

# ON THE GRID HAPPENINGS AT THE IGB

## AWARDS



### CARLA CÁCERES

Carla Cáceres, Professor of Animal Biology (IGOH) was elected a 2017 Fellow of the American Association for the Advancement of Science.



### HANNAH HOLSCHER

Hannah Holscher, Assistant Professor of Nutrition (MME) received the New Innovator in Food and Agriculture Research award from the Foundation for Food and Agriculture Research (FFAR) for outstanding research in food and agriculture.

## MEETING



### CENTER FOR COMPUTATIONAL BIOTECHNOLOGY AND GENOMIC MEDICINE (CCBGM)

The Center for Computational Biotechnology and Genomic Medicine (CCBGM) held its biannual meeting at Illinois this Fall to discuss the state of the center and present updates on the funded projects. CCBGM is a NSF Industry/University Cooperative Research Center under the CompGEN Initiative, with directors from Illinois, University of Chicago, and Mayo Clinic. Several IGB members in bioinformatics, computer science, bioengineering, and psychology, among other disciplines serve, including Mikel Hernaez, IGB Director of Computational Genomics, and each meeting brings industry representatives from companies including Abbott, IBM, Lilly, Intel, and Dow. Leader of the Computational Genomics for Reproduction Health theme, Professor of Molecular and Integrative Physiology Derek Wildman, gave the invited presentation, entitled Computational Methods for Insight into Hypoplastic Left Heart Syndrome.

## CERTIFICATE



### FOX FAMILY INNOVATION AND ENTREPRENEURSHIP CERTIFICATE PROGRAM

Academics and business leaders are realizing that science, technology and business are no longer separate entities, but actually require each other to thrive. The Fox family and the IGB have partnered to bring a series of speakers to discuss all aspects of innovation and entrepreneurship. Past speakers have included members from the Office of Technology Management and the Technology Entrepreneur Center on campus, to external speakers from public and private industry. This certificate program has been designed to introduce IGB and science academics to fundamental business methodologies including creating a business plan, managing intellectual property, overseeing finances, marketing and customer discovery, and other skills essential for entrepreneurial ventures.

The thirteen week curriculum will expose students to an environment and resources from around campus that are necessary to become a successful innovator and entrepreneur. Full details and program registration [available here](#).

## HIGHLY CITED

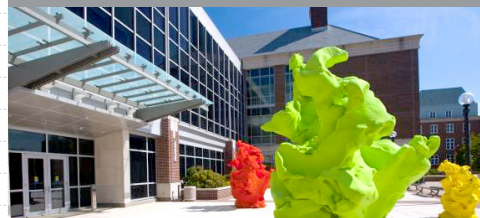


### FIVE ILLINOIS RESEARCHERS RANK AMONG WORLD'S MOST INFLUENTIAL

Five faculty members at the University of Illinois at Urbana-Champaign have been named to the 2017 Clarivate Analytics Highly Cited Researchers list (previously known as the Thomson Reuters Highly Cited Researchers list), including four from the IGB. The list recognizes "leading researchers in the sciences and social sciences from around the world," according to Clarivate Analytics. It is based on an analysis of journal article publication and citation data, an objective measure of a researcher's influence, from 2005-15.

The highly cited Illinois researchers this year are: crop sciences and plant biology professor Lisa Ainsworth (GEGC, highly cited in plant and animal science), civil and environmental engineering professor Tami Bond (geosciences), crop sciences and plant biology professor Stephen P. Long (GEGC/BSD, plant and animal science), chemistry professor Yi Lu (BSD/ONC-PM, chemistry), and psychology professor Brent Roberts (GNDDP, psychiatry, psychology).

## RETREAT



### IGB RETREAT

The IGB Retreat will take place on April 14, 2018 within the building. Faculty members only, please use the following link to RSVP for the retreat so we have accurate attendance numbers:

<http://www.igb.illinois.edu/igb-retreat-rsvp>

# DEPARTMENT ANNOUNCEMENTS

## BUSINESS OFFICE

### HOLIDAY BREAK REDUCED SERVICE DAYS

As we approach the holiday season we are providing a reminder of the upcoming holiday schedule and the accompanying gift days.

**Monday, December 25, 2017**

Christmas Day Observed

**Tuesday, December 26, 2017**

Day after Christmas Holiday Observed – Designated Holiday

**Wednesday, December 27, 2017**

Gift Day

**Thursday, December 28, 2017**

Gift Day

**Friday, December 29, 2017**

Gift Day

**Monday, January 1, 2018**

New Year's Day Holiday Observed

#### Reduced Service Days:

As in the past, IGB will be closed starting December 25, 2017 through January 1, 2017 and most employees will not be working those three days.

Please note the three gift days must be used December 27th, 28th, and 29th; they cannot be "saved" to use at another point in time.

Questions regarding reduced service days, please contact Jacinda King at 244-2276 or [jkking@illinois.edu](mailto:jkking@illinois.edu). ■

## COMMUNICATIONS

### ILLINOIS TRANSITIONS TO ONE LOGO

On October 13th, 2017 the Illinois system moved to one logo to use for all branding, rather than the "column I" and the "block I" as in the past. The column I has been retired, per the university guidelines "Using the block I as the only logo consolidates and strengthens the university brand's impact. This return to a single graphic (logo) ensures that the entire campus can leverage the full benefit of our legacy and take advantage of the instant global recognition the block I enjoys."

Existing physical materials with the column I can be used until the supply is depleted, any new items created must have the block I as the primary identity.

If you have any questions about proper usage of the logo, refer to <http://creativeservices.illinois.edu/brand/> or feel free to contact Nicholas Vasi at [nvasi@illinois.edu](mailto:nvasi@illinois.edu). ■

## OPERATIONS & FACILITIES

### IGB HOLIDAY SCHEDULE AND BUILDING INFORMATION

- The IGB building will be closed. This includes administrative offices, purchasing, shipping and receiving, and Array Cafe.
- All exterior doors will be locked, and all card access doors require entry with a valid IGB prox card.
- Check your i-Card expiration date. Access will automatically be deactivated if your i-Card expires on or before December 31, 2017. You must renew your i-Card at the i-Card Center prior to December 20.
- Do not place orders for packages that may be scheduled for delivery December 25-January 1. No packages or mail will be received or sent during this time by IGB Shipping and Receiving. Please contact [receiving@igb.illinois.edu](mailto:receiving@igb.illinois.edu) for questions related to shipping, receiving, or mail. Questions related to purchasing should be directed to the IGB Business Office at [purchasing@igb.illinois.edu](mailto:purchasing@igb.illinois.edu).
- Take extra care when entering the IGB both via the exterior doors during off-hours and doors leading into secured spaces within the IGB at any time.
- Do not let unknown people into the IGB or secured spaces. Anyone needing access should be directed to Operations and Facilities for prox card or key access permissions.
- Be aware of people loitering around the doors and grabbing the door before it closes behind you to gain access.
- Absolutely NO doors should be propped open to compromise IGB security.
- Be observant of your surroundings and report any suspicious behavior immediately by calling 911 from a campus phone.
- Turn off all lights when you leave your area.
- If you notice any urgent building issues (water leaks, CT room temperature problems, etc.) please call the Public Safety Dispatch Office at 217-333-0340 for off-hours assistance. During holiday break, emails sent to [facilities@igb.illinois.edu](mailto:facilities@igb.illinois.edu) will not be immediately addressed.
- "No parking" and permit only parking areas are still enforced. IGB bagged meters on Mathews and IGB dock parking spaces are available by permit only. Ticketing/towing may occur at vehicle owner's expense if parked in non-assigned space without permit.
- Be aware of the potential for ice forming on streets, sidewalks, and parking lots across campus. Using customary winter caution is the most important means of protection against injury. Look at the walkway in front of you frequently or continuously when you suspect there could be slick spots. To report persistent areas of ice accumulation, please contact the Service Office at 217-333-0340.
- The University of Illinois Public Safety website has helpful information regarding personal safety, as well as other topics of interest. <http://www.dps.uiuc.edu/universitypolice/campussafety.html> ■



## 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.

Kim, M., Kim, Y., Qian, L., & Song, J. S. (2017). TeachEnG: A Teaching engine for Genomics. *Bioinformatics*, 33(20), 3296-3298. DOI: 10.1093/bioinformatics/btx447

Guo, Z., Sevrioukova, I. F., Denisov, I. G., Zhang, X., Chiu, T. L., Thomas, D. G., ... Potter, D. A. (2017). Heme Binding Biguanides Target Cytochrome P450-Dependent Cancer Cell Mitochondria. *Cell Chemical Biology*, 24(10), 1259-1275.e6. DOI: 10.1016/j.chembiol.2017.08.009

Ping, P., Watson, K., Han, J., & Bui, A. (2017). Individualized knowledge graph: a viable informatics path to precision medicine. *Circulation Research*, 120(7), 1078-1080. DOI: 10.1161/CIRCRESAHA.116.310024

Fan, T. M. (2017). Cancer Patients. In *Veterinary Anesthesia and Analgesia: The Fifth Edition of Lumb and Jones* (pp. 993-1003). Wiley. DOI: 10.1002/9781119421375.ch55

Kadam, D. C., Potts, S. M., Bohn, M. O., Lipka, A. F., & Lorenz, A. J. (2017). Erratum: Genomic prediction of single crosses in the early stages of a Maize hybrid breeding pipeline [G3 Genes-Genomes-Genetics, 6, (3443-3453)] DOI: 10.1534/g3.116.031286. G3: *Genes, Genomes, Genetics*, 7(10), 3557-3558. DOI: 10.1534/g3.117.300143

Khoueir, P., Girardot, C., Ciglar, L., Peng, P. C., Hilary Gustafson, E., Sinha, S., & Furlong, E. E. M. (2017). Uncoupling evolutionary changes in DNA sequence, transcription factor occupancy and enhancer activity. *eLife*, 6, [e28440]. DOI: 10.7554/eLife.28440

Diao, H. Y., Feng, R., Dahmen, K. A., & Liaw, P. K. (2017). Fundamental deformation behavior in high-entropy alloys: An overview. *Current Opinion in Solid State and Materials Science*, 21(5), 252-266. DOI: 10.1016/j.cossms.2017.08.003

Guo, Z., Sevrioukova, I. F., Denisov, I. G., Zhang, X., Chiu, T. L., Thomas, D. G., ... Potter, D. A. (2017). Erratum: Heme Binding Biguanides Target Cytochrome P450-Dependent Cancer Cell Mitochondria (*Cell Chemical Biology* (2017) 24(10) (1259-1275.e6) (S2451945617302830)(10.1016/j.chembiol.2017.08.009)). *Cell Chemical Biology*, 24(10). DOI: 10.1016/j.chembiol.2017.09.012

Rababah, T., Al-U'Datt, M., Al-Mahasneh, M., Odeh, A., Ajouly, T. E., & Feng, H. (2017). Effect of processing and storage at different temperatures on the physicochemical and minerals content of sesame seeds and tehina. *Bulgarian Journal of Agricultural Science*, 23(5), 851-859.

Gage, J. L., Jarquin, D., Romay, C., Lorenz, A., Buckler, E. S., Kaeppler, S., ... De Leon, N. (2017). The effect of artificial selection on phenotypic plasticity in maize. *Nature Communications*, 8(1), [1348]. DOI: 10.1038/s41467-017-01450-2

Brooke, C. B. (2017). Population diversity and collective interactions during influenza virus infection. *Journal of Virology*, 91(22), [e01164-17]. DOI: 10.1128/JVI.01164-17

Taneja, I., Reddy, B., Damhorst, G., Dave Zhao, S., Hassan, U., Price, Z., ... Zhu, R. (2017). Combining Biomarkers with EMR Data to Identify Patients in Different Phases of Sepsis. *Scientific Reports*, 7(1), [10800]. DOI: 10.1038/s41598-017-09766-1

de Flamingh, A., Roca, A. L., & van Aarde, R. J. (2017). Origin and phylogeography of African savannah elephants (*Loxodonta africana*) in Kruger and nearby parks in southern Africa. *Conservation Genetics*, 1-13. DOI: 10.1007/s10592-017-1005-z

Duan, W., Huang, J., Kowalski, J. A., Shkrob, I. A., Vijayakumar, M., Walter, E., ... Wei, X. (2017). "wine-Dark Sea" in an Organic Flow Battery: Storing Negative Charge in 2,1,3-Benzothiadiazole Radicals Leads to Improved Cyclability. *ACS Energy Letters*, 2(5), 1156-1161. DOI: 10.1021/acseenergylett.7b00261

Wolfe, A. J., Si, W., Zhang, Z., Blanden, A. R., Hsueh, Y. C., Gugel, J. F., ... Movileanu, L. (2017). Quantification of Membrane Protein-Detergent Complex Interactions. *Journal of Physical Chemistry B*, 121(44), 10228-10241. DOI: 10.1021/acs.jpcc.7b08045

Kolossov, V. L., Sivaguru, M., Huff, J., Luby, K., Kanakaraju, K., & Gaskins, H. R. (2017). Airyscan super-resolution microscopy of mitochondrial morphology and dynamics in living tumor cells. *Microscopy Research and Technique*. DOI: 10.1002/jemt.22968

Kim, B., Takechi, K., Ma, S., Verma, S., Fu, S., Desai, A., ... Kenis, P. J. A. (2017). Non-Aqueous Primary Li-Air Flow Battery and Optimization of its Cathode through Experiment and Modeling. *ChemSusChem*, 10(21), 4198-4206. DOI: 10.1002/cssc.201701255

Jagtap, S. S., & Rao, C. V. (2017). Production of d-arabitol from d-xylose by the oleaginous yeast *Rhodospiridium toruloides* IFO0880. *Applied Microbiology and Biotechnology*, 1-9. DOI: 10.1007/s00253-017-8581-1

Andrade, F. C. D., Kramer, K. Z., Monk, J. K., Greenlee, A. J., & Mendenhall, R. (2017). Financial stress and depressive symptoms: the impact of an intervention of the Chicago Earned Income Tax Periodic Payment. *Public Health*, 153, 99-102. DOI: 10.1016/j.puhe.2017.08.017

Cheng, Q., Juen, J., Bellam, S., Fulara, N., Close, D., Silverstein, J. C., & Schatz, B. (2017). Predicting Pulmonary Function from Phone Sensors. *Telemedicine and e-Health*, 23(11), 913-919. DOI: 10.1089/tmj.2017.0008

Kim, M. J., Oh, H. J., Kim, G. A., Setyawan, E. M. N., Choi, Y. B., Lee, S. H., ... Lee, B. C. (2017). Birth of clones of the world's first cloned dog. *Scientific Reports*, 7(1), [15235]. DOI: 10.1038/s41598-017-15328-2

Park, K., Cho, N. H., Jeon, M., Lee, S. H., Jang, J. H., Boppart, S. A., ... Kim, J. (2017). Optical assessment of the in vivo tympanic membrane status using a handheld optical coherence tomography-based otoscope. *Acta Oto-Laryngologica*, 1-8. DOI: 10.1080/00016489.2017.1395515

Stelle, L., Schoenheit, T., Brubaker, A., Tang, X., Qu, P., Cradock, K., & Higham, A. (2017). Radioactive Seed Localization Versus Wire Localization for Nonpalpable Breast Lesions: A Two-Year Initial Experience at a Large Community Hospital. *Annals of Surgical Oncology*, 1-6. DOI: 10.1245/s10434-017-6102-1 ■

# I ILLINOIS

IGB News is published by the IGB Communications Office.  
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www.igb.illinois.edu 17.155