



# IGB NEWS

Upcoming Events  
Monthly Profiles  
Happenings at IGB

Image Of The Month  
IP @ IGB  
Department Announcements

Volume 8, Number 8

## UPCOMING EVENTS

### IGB Seminar (BCXT)

*Invisible Influence: Exploring the Human Microbiome*  
January 26, 2016, 12:00 p.m.  
612 Carl R. Woese Institute for Genomic Biology

Jack A. Gilbert, PhD  
Argonne National Laboratory

### IGB Seminar (GEGC)

*Title to be announced*  
February 2, 2016, 12:00 p.m.  
612 Carl R. Woese Institute for Genomic Biology

Amy Marshall-Colon, PhD  
Department of Plant Biology  
University of Illinois

### IGB Seminar (RBTE)

*Title to be announced*  
February 9, 2016, 12:00 p.m.  
612 Carl R. Woese Institute for Genomic Biology

Kristopher A. Kilian, PhD  
Department of Materials Science and Engineering  
University of Illinois

### IGB Seminar (BCXT)

*Title to be announced*  
February 23, 2016, 12:00 p.m.  
612 Carl R. Woese Institute for Genomic Biology

Sergei Maslov, PhD  
Department of Bioengineering  
University of Illinois

### IGB Seminar (GNDP)

*The Microbiota Gut-Brain Axis in Medicine: Why the Intersection of Microbiology and Neurobiology Matters*  
March 1, 2016, 12:00 p.m.  
612 Carl R. Woese Institute for Genomic Biology

Mark Lyte, PhD  
Department of Veterinary Microbiology and Preventive Medicine  
Iowa State University

## FEATURED NEWS



2

DOE ARPA-E Awards \$5M to Study Water Use Efficiency



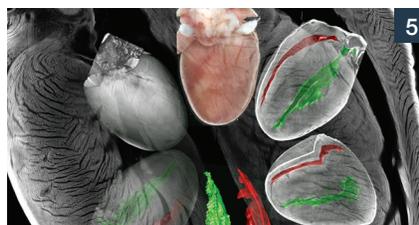
3

Ground-level Ozone Reduces Maize and Soybean Yields



4

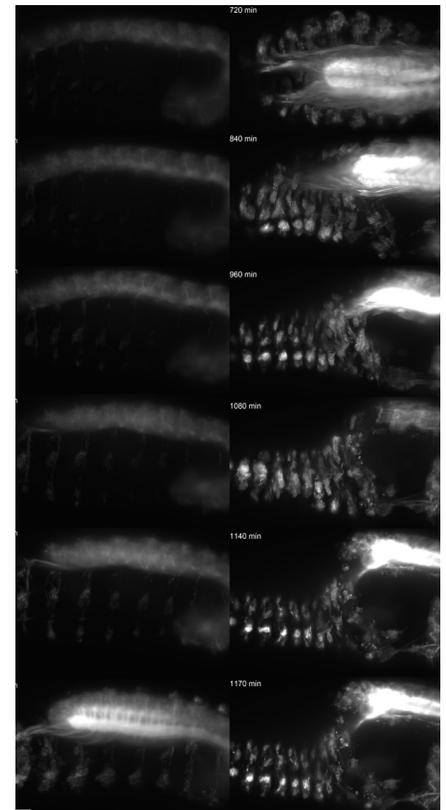
Profile: Ruby Mendenhall



5

On the Grid: Happenings at IGB

## IMAGE OF THE MONTH



This month's image features the neural network of the genus *Drosophila*, or fruit fly. This shows the development of the network over a 20 hour period, and was taken using the Zeiss Lightsheet Z.1.

This image is provided courtesy of Alireza Tofangchi, Barghav S. Sivaguru, Maria Anna Vakaki, & Kingsley Boateng, of the Taher Saif Lab.

## IGB News

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



## University of Illinois Awarded \$5M to Increase Water Use Efficiency in Bioenergy Sorghum

The University of Illinois has been awarded a 3-year, \$5 million grant from the DOE Advanced Research Projects Agency-Energy as part of its OPEN 2015 funding initiative (ARPA-E OPEN). Under Principal Investigator Andrew Leakey, Associate Professor of Plant Biology, the interdisciplinary and multi-institutional team intends to increase the water use efficiency (WUE) of sorghum, a valuable bioenergy crop.

Sorghum, like nearly all plants, transpires through stomata: small pores on the surface of the leaf that allow for gas exchange. By decreasing the stomata, researchers hope to increase WUE by reducing the amount of moisture lost. In addition, by shifting a larger percentage of photosynthetic activity to lower leaves, the higher local humidity will further reduce water loss.

By combining these approaches, the team predicts via its mathematical models that it may develop sorghum with a 40% improvement in WUE. “That means that we should be able to expand the growing area into regions that are currently too dry to produce a profitable crop,” said Leakey. “And in the areas that are already suitable for growing, plants will suffer less in drought years, and make more biomass with the water that there is.”

All in all, this research could unlock more than 9 million new acres currently unusable for energy crop production, and increase production on currently farmed land by nearly 30% on average. Much of the newly available land is located to the west of sorghum’s current range, inspiring the project’s name, WEST (Water Efficient Sorghum Technologies).

These technologies fall into two main areas of interest: identifying naturally-occurring alleles that increase WUE, and using biotechnology to manipulate sorghum genes for the same purpose. “We can combine both natural alleles and those we’ve enhanced through genomic methods into novel lines,” said Steve Long, University of Illinois Gutzgell Endowed Professor of Plant Biology and Crop Sciences and WEST Deputy Director. “We anticipate that many of these genetic markers will be similar

*(above) Andrew Leakey, Associate Professor of Plant Biology, will lead a multi-institutional team to increase the water use efficiency of sorghum*

in other C4 crops, which means it would be possible to translate many of our findings to increase the efficiency of the closely related crops corn and sugarcane.”

“It’s about trying to provide solutions that make agriculture more productive and more sustainable,” concluded Leakey. “That’s a really key goal for this century.”

WEST is a collaboration with researchers from the University of Wisconsin at Madison, the University of Nebraska at Lincoln, Cornell University, and USDA Agricultural Research Services, Texas under lead institution the University of Illinois. Funding comes from ARPA-E OPEN, providing support for research that will transform and disrupt current energy technologies by improving production and ef-

iciency. WEST represents the third ARPA-E grant at the Carl R. Woese Institute for Genomic Biology at the University of Illinois, of which Leakey and Long are faculty members. ■

*Written by Kathryn Metcalf. Photo by L. Brian Stauffer.*



*IGB has previously received two Advanced Research Projects Agency-Energy (ARPA-E) grants. The first, PETROSS (Plants Engineered to Replace Oil in Sugarcane and Sweet Sorghum), engineers sugarcane and sweet sorghum, two of the world’s most productive crops, into ultra-productive biofuel crops.*

*The second, MEPP (Mobile Energy-crop Phenotyping Platform) will develop all-terrain automated ground rovers for high throughput field phenotyping.*

## RESEARCH



Researchers have quantified the loss in crop quality and yield from ground-level ozone emissions over the last 30 years. Soybean and corn yields have been reduced by 5 percent and 10 percent, respectively, an annual revenue loss of over \$9 billion nationwide.

# Ground-level Ozone Reduces Maize and Soybean Yields

Despite government regulations, ground-level ozone – an odorless gas that forms as polluting nitrogen oxides drift in sunlight across the countryside – continues to threaten crop quality and yield. In a new study, researchers quantify this loss from historical yield data for the first time. They show that over the last 30 years, ozone emissions have reduced soybean and corn yields by 5 percent and 10 percent, respectively.

The findings are reported in the *Proceedings of the National Academy of Sciences*.

Justin McGrath led the study as a postdoctoral fellow with the Carl R. Woese Institute for Genomic Biology at the University of Illinois with plant biology and crop sciences professor Stephen Long and USDA Agricultural Research Service scientist Elizabeth Ainsworth.

Emissions regulations have had a positive effect on reducing ozone-related damage to crop plants, the researchers found, but may need to be upgraded to

reduce crop damage and ease the resulting financial burden on growers, Long said.

“We had suspected for some time that surface ozone pollution, which can be surprisingly high in rural areas, was affecting crop yields, but until now there had not been a means to quantify this from actual yield data,” Long said.

Ozone damage occurs when the gas enters a plant’s leaves and dissolves in water within the leaves, producing toxic byproducts. Water availability increases a plant’s vulnerability to ozone damage. The higher the concentration of ground-level ozone, the greater the likelihood of damage.

The researchers analyzed historical crop yields and climate and ozone data from 1980 to 2011 across the continental United States, focusing on corn and soybean. They found that past and current levels of ground-level ozone were reducing yields of both crops.

“Laboratory studies had suggested that soybean was vulnerable to ozone, but the 10 percent yield loss in corn is a surprise and very significant,” Ainsworth

*“We had suspected for some time that surface ozone pollution, which can be surprisingly high in rural areas, was affecting crop yields, but until now there had not been a means to quantify this from actual yield data.”*

said. Even when water was not readily available during a period of drought, ozone damage was still extensive, she said.

The researchers calculated an annual loss of just over \$9 billion nationwide between the two crops due to ozone damage. One way to ease this financial burden is to increase air-quality control regulations, McGrath said. Such regulations already appear to have reduced the amount of ozone-related crop damage, he said.

There is, however, some better news. Ainsworth is leading projects to identify genes in corn and soybean that decrease the crops’ vulnerability to ozone. These may provide another means to decrease these losses, the researchers said.

The National Science Foundation and the University of Illinois supported this research. ■

*Written by Sarah Banducci and Diana Yates. Photos by Kathryn Faith, Haley Ahlers, and L. Brian Stauffer.*



From left, IGB postdoctoral fellow Justin McGrath, USDA Agricultural Research Service scientist Elizabeth Ainsworth, and plant biology and crop sciences professor Stephen Long.

## PROFILE



*Ruby Mendenhall is an Associate Professor in Sociology, African American Studies, Urban and Regional Planning, and Social Work. Her research focuses on issues of social inequality over the life course and the role of public policy and individuals' agency in facilitating social and economic mobility.*

# Ruby Mendenhall: How stress Gets Under the Skin

David Satcher, former U.S. Surgeon General, noted in his 2005 research that if health disparities were eliminated there would be approximately 80,000 fewer African-American deaths each year. According to the documentary *Unnatural Causes: Is Inequality Making Us Sick*, the 80,000 deaths is the equivalent of an airplane full of African-Americans falling out of the sky every single day every year. Unfortunately, remarks Ruby Mendenhall, “we don’t fully understand the complexity of problems associated with the high levels of African-American excess death.”

Mendenhall has been invested in understanding health inequality her entire career. After completing an undergraduate degree in occupational therapy, she began work in the pediatrics unit and protective services team of Cook County Hospital (now the John H. Stroger, Jr. Hospital). “A turning point for me there,” said Mendenhall, “was seeing that a lot of the children there were failing to thrive, meaning that they weren’t gaining weight like they should for their age, or had developmental delays.”

“When we asked the children’s mothers what was happening, they would say that they didn’t have enough money to buy formula, so they would water it down and that’s why the child wasn’t gaining weight. Also, many of the families who came in for therapy were living in Robert Taylor [a large Chicago public housing community] at the time, so the mothers didn’t want to put their children down on the floor because of the rats and roaches, which affected their children’s development.”

Those mothers sparked Mendenhall’s desire to examine and attempt to alleviate the costs of chronic poverty and stress for African-American mothers, leading her to complete her Master’s degree at the University of Chicago’s Harris School of Public Policy. From there, she became a lobbyist with the Ounce of Prevention Fund, working at both the federal and local level to address child care and welfare (cash transfers) related issues.

In 1996 while working at the Ounce, Mendenhall helped to write a grant proposal for an Early Head Start program, which would provide educational services to children from birth to three years of age. The Ounce was selected as an Early Head Start site and the program would be housed in the Robert Taylor public housing community. Mendenhall transferred from the policy world to the world of Early Head Start. “I wanted to really get a sense of what it was like being in that environment that we talked about so much when I was at Cook County Hospital, instead of advocating for mothers from our downtown office,” said Mendenhall. “So I went to work in Robert Taylor for two years. It was very stressful being around the gun violence and the mothers struggling every day due to poverty.”

After two years, Mendenhall returned to school and earned a Ph.D. in Human Development and Social Policy from Northwestern University. “I was really interested in merging what I knew about human development, and the conditions that people need to be healthy and well, with what I knew about the role of public policy in creating structural change.”

Mendenhall came to the University of Illinois in 2006, where she has a joint appointment in Sociology, African-American Studies, Urban and Regional Planning, and Social Work. Her interests have since brought her to the IGB, where she’s a member of the Gene Networks in Neural and Developmental Plasticity research theme. She is also an affiliate of the Institute for Computing in Humanities, Arts and Social Sciences.

After receiving a grant from the Illinois Campus Research Board in 2013 Mendenhall, along with Professor of Psychology Brent Roberts, IGB Director Gene Robinson, and eight team members, undertook a pilot study that included interviews with South Side mothers as well as blood draws. “The big question was how do neighborhoods with high levels of violence affect black mothers’ mental and physical health? We did depression screenings, PTSD screenings; we looked at coping behaviors

generally associated with Black women such as spirituality and use of social networks. We also wanted to understand factors that allowed them to be resilient, despite their constant exposure to violence and fear. But we also took samples of the mothers’ blood to see how the genes that regulate the immune system may be affected by the high levels of neighborhood stress.”

That study revealed that mothers who reported high levels of subjective neighborhood stress have higher rates of activation of genes regulated by the glucocorticoid receptor, which may suggest increased cortisol output from the hypothalamic pituitary axis (HPA). “Chronic activation of the HPA can create processes that negatively affect health. Stress really can get ‘under their skin.’ That is why our research team is taking a sociogenomics approach to examining how stress in the environment shapes mothers’ health outcomes. The sociogenomics perspective, pioneered by Gene Robinson, highlights the dynamic nature of the genome and how environmental factors can influence patterns of RNA abundance (“gene expression”) to reflect individuals’ historical and current environmental context. But then the question is, can you get stress ‘out from under the skin?’ Can you reduce some of these physiological costs?”

Mendenhall’s current work includes continuing the project she and her team members developed during that pilot study, known as the Developing Responses to poverty through Education And Meaning program, or DREAM. By combining research, intervention and education, DREAM aims to better understand and improve the conditions of low-income African-American communities in Illinois, specifically on the south side of Chicago. The program also seeks to provide stress reduction and health prevention activities. Mendenhall is also working with African-American architects on social design ideas for a DREAM institute in Englewood which seeks to re-imagine the social environment

*cont. on page 5*

of the Black community in a way that fosters optimal human development. The project is called De.SH(ie) for Designing Spaces of Hope (interiors and exteriors).

“When I started the Black mothers project I was thinking about how to make big social changes and affect public policy, but I’ve really been moved by the impact that our pilot study has had on individual women. During one of the interviews, a mother

thanked me for coming to talk to her about what was going on in her neighborhood. She said, ‘The little things make a difference. People don’t even understand that.’ What that mother told me shifted my focus and helped me to understand that little things we can do today can have a big impact on families. Even with our limited research resources, just by recognizing that they are human, that their conditions are very difficult, that the children they love clearly are in constant danger, made a difference. For

me as an African-American female scholar, when I document the mothers’ lived experiences to create new sociological knowledge, work with them to understand and change unequal social structures, and bring the resources of the land-grant University of Illinois to address their struggles, that’s what I’m most proud of in my research.” ■

*Written by Kathryn Metcalf and Claire Benjamin. Photo courtesy of University of Illinois.*

## ON THE GRID HAPPENINGS AT THE IGB

### AWARDS



#### RASHID BASHIR

Rashid Bashir, Bioengineering Professor and Department Head (RBTE) was named a Fellow of the Biomedical Engineering Society (BMES). Fellow status is awarded to BMES members who demonstrate exceptional achievements and experience in the field of biomedical engineering.



#### RUBY MENDENHALL & AUINASH KALSOTRA

Ruby Mendenhall, Associate Professor, African American Studies of Sociology (GNBP) was named as a 2016-17 Center for Advanced Study Associate, and Auinash Kalsotra, Assistant Professor of Biochemistry (GNBP) was named a 2016-17 Center for Advanced Study Fellow.



#### WILLIAM METCALF

William Metcalf, G. William Arends Professor in Molecular and Cellular Biology in the department of microbiology (leader, MMG) was named a Fellow of the American Association for the Advancement of Science (AAAS). Founded in 1848, AAAS is the world’s largest scientific society, honoring Fellows for scientifically and socially distinguished efforts that advance science and the application of science.

### CLIMATE CONFERENCE



#### LONG SPEAKS AT PARIS CLIMATE CHANGE CONFERENCE

Professor of Crop Science and Plant Biology Stephen Long spoke at the recent 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) in Paris, France. Long was one of six speakers invited by the Grantham Centre for Sustainable Futures at the University of Sheffield to discuss the research challenges associated with developing a climate-smart agri-food system.

### NEW ARRIVAL



#### ROY DAR

Professor Roy Dar has joined the IGB as an affiliate in Gene Networks in Neural and Developmental Plasticity (GNBP). Professor Dar joined the department of Bioengineering in the Fall of 2015. He received his Ph.D. in Physics from the University of Tennessee, Knoxville, and was then a Postdoctoral Fellow at the University of California, San Francisco from 2011-2015. His research interests lie in the areas of drug screening, cellular fate-determination and state transitions, viral and genetic circuitry, stochastic gene expression, single-cell biophysics, and systems biology.

### COVER



#### BIOTECHNIQUES

The cover of the latest issue of *BioTechniques* features an image of a mouse heart created at the Core Facilities at IGB, courtesy of Assistant Director of Core Facilities Mayandi Sivaguru. Some of Dr. Sivaguru’s work can be seen from the paper, available at [bit.ly/20MpiYA](http://bit.ly/20MpiYA).

# DEPARTMENT ANNOUNCEMENTS

## OPERATIONS & FACILITIES

### IGB BUILDING HOLIDAY SCHEDULE & INFORMATION

#### December 24 - January 3

- The IGB building will be closed December 24 through January 3. All exterior doors will be locked and all card access doors will require entry with a valid IGB prox card. Please take care when entering or leaving the IGB not to allow someone you do not recognize into the IGB.
- If you notice any urgent building issues (water leaks, CT room temperature problems, etc.) please call 333-1216 for the Public Safety Dispatch Office. This number is answered by Public Safety during off-hours and they will be able to assist you. Emails sent to [facilities@igb.illinois.edu](mailto:facilities@igb.illinois.edu) during this time will not be immediately addressed.
- IGB administrative offices will be closed December 24 through January 3.
- IGB Shipping and Receiving will be closed December 24 through January 3. No packages or email will be received or sent during this time period. Do not place orders for any packages that will be scheduled for delivery during this time. If you have any questions related to shipping, receiving, or mail, please contact IGB Shipping and Receiving. If you have questions related to purchasing, please contact the IGB Business Office.
- Array Cafe will be closed December 21 through January 3.
- If you are in the building when it is closed, please turn off all lights when you leave your area.
- "No parking" areas are still enforced when the building is closed. IGB bagged meters on Mathews and IGB dock parking spaces are permit parking only. Ticketing/towing may occur at vehicle owner's expense if parked in non-assigned space.

#### Safety

Please 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. Also, look at the walkway in front of you frequently or even continuously, if necessary, when you suspect there could be slick spots. To report persistent areas of ice accumulation, please contact the Service Office, 217-333-0340.

#### I-Card Expiration Date

Please be mindful of the expiration date on your I-card. If your card is scheduled to expire during the Holiday break, make plans to visit the I-card center soon to update your card. If your card expires, your card access is automatically deactivated.

#### IGB Security Reminders

With the holidays approaching, please be reminded to 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 – this compromises IGB security.

We should all be observant of our surroundings and report any suspicious behavior immediately by calling 9-911 from a campus phone.

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/campusafety.html> ■

## BUSINESS

### HOLIDAY BREAK REDUCED SERVICE DAYS

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

**Thursday, December 24, 2015** - 1/2 Gift Day (from Chancellor and the President) and 1/2 Excused Day p.m.

**Friday, December 25, 2015** - Christmas Day Holiday

**Monday, December 28, 2015** - Reduced Service Day

**Tuesday, December 29, 2015** - Reduced Service Day

**Wednesday, December 30, 2015** - Reduced Service Day

**Thursday, December 31, 2015** - Designated Holiday

**Friday, January 1, 2016** - New Year's Day Holiday

#### Reduced Service Days:

As in the past, IGB will be closed starting December 24, 2015 thru January 3, 2016 and most employees will not be working those days. Employees may use floating holidays, vacation, take time without pay, or any combination thereof.

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

## WIRELESS NETWORK UPGRADE

The current wireless network was designed over five years ago and did not anticipate the explosion of devices in the building that would be using it. As a result, the network has become over-utilized and does not perform the way it was intended. Additionally during that time new advances in wireless network have occurred that can increase the range and speed of wireless networks. As a result, we are beginning the process of upgrading the wireless network in the IGB.

Four access points have been deployed to date, to rave reviews among those who are using them. With the advice of these test groups, we are moving forward to deploying this new wireless network across the building. The project is expected to be completed by Spring break, with CNRG hopeful it can be accomplished earlier.

We are also working on adding eduroam to the wireless in the building. There are still many obstacles here that impede our progress, but we hope to add this at a later date. ■

## 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.*

Jeffries JL, Jia J, Choi W, et al. Pseudomonas aeruginosa pyocyanin modulates mucin glycosylation with sialyl-lewis to increase binding to airway epithelial cells. *Mucosal Immunol.* 2015.

Amato KR, Yeoman CJ, Cerda G, et al. Variable responses of human and non-human primate gut microbiomes to a western diet. *Microbiome.* 2015;3(1):53-015-0120-7.

Amato KR, Martinez-Mota R, Righini N, et al. Phylogenetic and ecological factors impact the gut microbiota of two neotropical primate species. *Oecologia.* 2015:1-17.

Petronikoulou N, Nair SK. Biochemical studies of mycobacterial fatty acid methyltransferase: A catalyst for the enzymatic production of biodiesel. *Chem Biol.* 2015;22(11):1480-1490.

Li Y, Kilian KA. Bridging the gap: From 2D cell culture to 3D microengineered extracellular matrices. *Adv Healthc Mater.* 2015.

Turner TL, Zhang G-, Oh EJ, et al. Lactic acid production from cellobiose and xylose by engineered *saccharomyces cerevisiae*. *Biotechnol Bioeng.* 2015.

Dixon SD, Huynh MM, Tamilselvam B, et al. Distinct roles for CdtA and CdtC during intoxication by cytolethal distending toxins. *PLoS One.* 2015;10(11):e0143977.

Biancalani T, Assaf M. Genetic toggle switch in the absence of cooperative binding: Exact results. *Phys Rev Lett.* 2015;115(20):208101 (5 pp.).

McGrath JM, Betzelberger AM, Wang S, et al. An analysis of ozone damage to historical maize and soybean yields in the united states. *Proc Natl Acad Sci U S A.* 2015;112(46):14390-14395.

McGhee KE, Feng S, Leasure S, Bell AM. A female's past experience with predators affects male courtship and the care her offspring will receive from their father. *Proc R Soc B Biol Sci.* 2015;282(1819).

Ilin Y, Choi JS, Harley BAC, Kraft ML. Identifying states along the hematopoietic stem cell differentiation hierarchy with single cell specificity via raman spectroscopy. *Anal Chem.* 2015;87(22):11317-11324.

Bionaz M, Monaco E, Wheeler MB. Transcription adaptation during *in vitro* adipogenesis and osteogenesis of porcine mesenchymal stem cells: Dynamics of pathways, biological processes, up-stream regulators, and gene networks. *PLoS ONE.* 2015;10(9).

Sivaguru M, Fried G, Sivaguru BS, et al. Cardiac muscle organization revealed in 3-D by imaging whole-mount mouse hearts using twophoton fluorescence and confocal microscopy. *BioTechniques.* 2015;59(5):295-308.

Bhate A, Parker DJ, Bebee TW, et al. ESRP2 controls an adult splicing programme in hepatocytes to support postnatal liver maturation. *Nat Commun.* 2015;6.

Baldwin J, Collins B, Wolf PG, et al. Table grape consumption reduces adiposity and markers of hepatic lipogenesis and alters gut microbiota in butter fat-fed mice. *J Nutr Biochem.* 2015.

Li Z, Nair SK. Structural basis for specificity and flexibility in a plant 4-coumarate:CoA ligase. *Structure.* 2015;23(11):2032-2042. ■



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www.igb.illinois.edu 15.141