IGB NEWS

Upcoming Events
Monthly Profiles
Happenings at IGB

Image Of The Month
IP @ IGB
Department Announcements

Volume 8, Number 3

UPCOMING EVENTS

IGB & Center for Nutrition, Learning, and Memory Seminar

How Stem Cells Make Decisions
April 21, 2015, 12:00 p.m.
612 Carl R. Woese
Institute for Genomic Biology

Stephen Dalton, PhD
University of Georgia
Department of Biochemistry and Molecular Biology

Art of Science 5.0

Images from the Carl R. Woese Institute for Genomic Biology
April 23, 2015, 6:00 p.m. reception
Exhibit on display through April 27
indi go Artist Co-Op
9 E. University Ave, Champaign, Illinois 61820

Human Sociogenomics Lecture

Risk and Resilience: Gene-Environment Interactions in Human Health
April 24, 2015, 2:00 p.m.
612 Carl R. Woese
Institute for Genomic Biology

Jaime Derringer
Assistant Professor of Psychology
University of Illinois at Urbana-Champaign

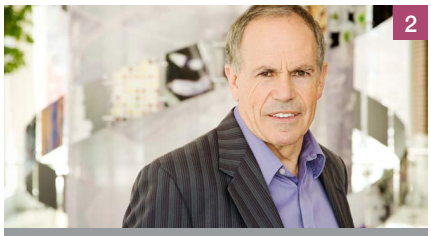
2015 IGB Fellows Symposium

Bacterial Quorum Sensing and Its Control
May 7, 2015, 8:30 a.m. - 3:00 p.m.
612 Carl R. Woese Institute for Genomic Biology

Bonnie L. Bassler, PhD
Princeton University
Department of Molecular Biology

Register for free at:
http://conferences.igb.illinois.edu/fellows/

FEATURED NEWS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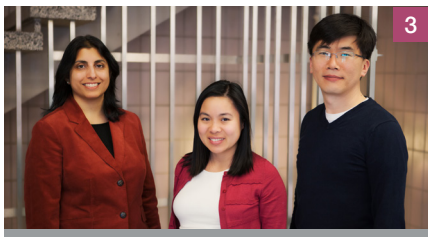
Photosynthesis Hack Needed to Feed the World by 2050


3

Scientists Find DNA is Packaged Like a Yoyo

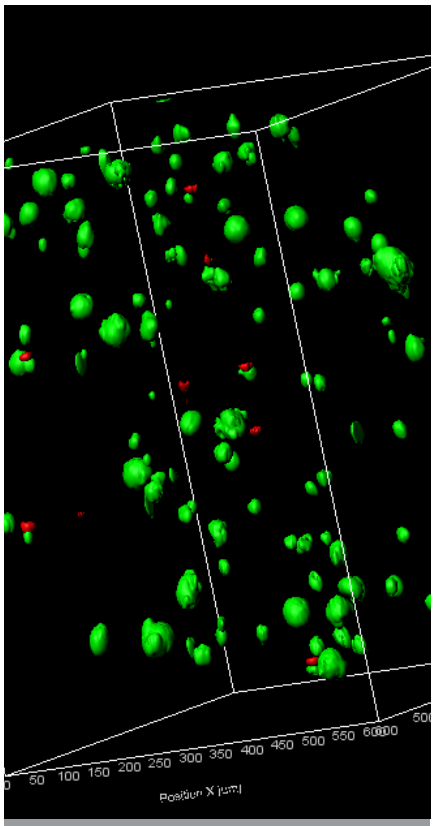

4

Profile: Klaus Schulten


5

On the Grid: Happenings at IGB

IMAGE OF THE MONTH



This month's image features brain cancer cells and was imaged using the Zeiss Lightsheet Z.1.

This image is provided courtesy of Sara Pedron and Bhushan Mahadik, of the Brendan Harley Lab.

IGB News

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

FEATURE

Report: Photosynthesis Hack Needed to Feed the World by 2050

Using high-performance computing and genetic engineering to boost the photosynthetic efficiency of plants offers the best hope of increasing crop yields enough to feed a planet expected to have 9.5 billion people on it by 2050, researchers report in the journal *Cell*.

There has never been a better time to try this, said University of Illinois Professor of Crop Sciences and Plant Biology Stephen P. Long, who wrote the report with colleagues from Illinois and the CAS-MPG Partner Institute of Computational Biology in Shanghai.

"We now know every step in the processes that drive photosynthesis in C3 crop plants such as soybeans and C4 plants such as maize," Long said. "We have unprecedented computational resources that allow us to model every stage of photosynthesis and determine where the bottlenecks are, and advances in genetic engineering will help us augment or circumvent those steps that impede efficiency."

Substantial progress has already been made in the lab and in computer models of photosynthesis, Long said.

"Our lab and others have put a gene from cyanobacteria into crop plants and found that it boosts the photosynthetic rate by 30 percent," he said.

Photosynthetic microbes offer other clues to improving photosynthesis in plants, the researchers report. For example, some bacteria and algae contain pigments that utilize more of the solar spectrum than plant pigments do. If added to plants, those pigments could bolster the plants' access to solar energy.

Some scientists are trying to engineer C4 photosynthesis in C3 plants, but this means altering plant anatomy, changing the expression of many genes and inserting new genes from C4 plants, Long said.

"Another, possibly simpler approach is to add to the C3 chloroplast the system used by blue-green algae," he said. This would increase the activity of Rubisco, an enzyme that catalyzes a vital step of the conversion of atmospheric carbon dioxide into plant biomass. Computer models suggest adding this system would increase photosynthesis as much as 60 percent, Long said.

Computer analyses of the way plant leaves intercept sunlight have revealed other ways to improve photosynthesis. Many plants intercept too much light in their topmost leaves and too little in lower leaves; this probably allows them to outcompete their neighbors, but in a farmer's field such competition is counterproductive, Long said.

Studies headed by U. of I. plant biology professor Donald Ort aim to make plants' upper leaves lighter, allowing more sunlight to penetrate to the light-starved lower leaves.

Computer modeling of photosynthesis also shows researchers where the traffic jams occur – the steps that slow the process down and reduce efficiency.

"The computer model predicts that by altering this system by up-regulating some genes and down-regulating others, a 60 percent improvement could be achieved without any additional resource – so 60 percent more carbon could be assimilated for no more nitrogen," Long said.

"The next step is to create an *in silico* plant to virtually simulate the amazingly complex interactions among biological scales," said U. of I. plant biology professor Amy Marshall-Colon, a co-author on the report. "This type of model is essential to fill current gaps in knowledge and better direct our engineering efforts."

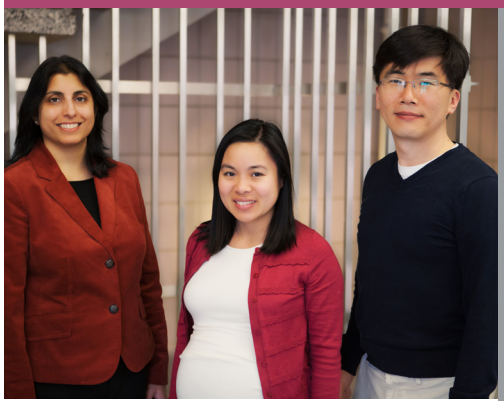
While many scientific, political and regulatory hurdles remain for plants engineered to do a better job of converting the sun's energy into biomass, the work should be undertaken now, Long said.

"If we have a success today, it won't appear in farmers' fields for 15 years at the very earliest," he said. "We have to be doing today what we may need in 30 years."

Stephen Long is also a faculty member in the Carl R. Woese Institute for Genomic Biology at Illinois.

Funding for this work was provided by the Bill & Melinda Gates Foundation, the U.S. Department of Agriculture, the National Science Foundation and the Chinese Academy of Sciences. ■

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



Pictured left to right: Jaya Yodh, Research Assistant Professor and CPLC Director of Education and Outreach, Thuy Ngo, graduate research assistant, and Taekjip Ha, Gutgsell Professor of Physics.

Scientists Find DNA is Packaged Like a Yoyo

To pack two meters of DNA into a microscopic cell, the string of genetic information must be wound extremely carefully into chromosomes. Surprisingly the DNA's sequence causes it to be coiled and uncoiled much like a yoyo, scientists reported in *Cell*.

"We discovered this interesting physics of DNA that its sequence determines the flexibility and thus the stability of the DNA package inside the cell," said Gutgsell Professor of Physics Taekjip Ha, leader of the Cellular Decision Making in Cancer research theme at the Carl R. Woese Institute for Genomic Biology. "This is actually very elementary DNA physics. Many people thought we should have known this many decades ago, but there are still surprises in the physics of DNA."

The DNA is packaged into chromosomes, which resemble beaded bracelets. The string of DNA is coiled around beads, called histones, to create nucleosomes. These nucleosomes are braided together into beaded strings that are intricately woven into chromosomes.

Scientists knew the DNA could be uncoiled from the nucleosome, but it was assumed that the two ends were symmetric, meaning uncoiling the DNA would be like untying a shoe. University of Illinois researchers found that the DNA is actually very asymmetric, like the string wrapped around a yoyo. Pulling on one end of DNA will simply tighten the coil while pulling on the other will cause it to uncoil like a yoyo.

The physics of this nucleosome packaging is determined by the DNA's sequence, which makes the strand of DNA flexible enough to satisfy two conflicting principles: it has to be stable enough to compact DNA, but dynamic enough so the strand can be uncoiled and read to make proteins.

"There are many good studies that show that if you change the sequence of the gene, then it will affect other things. Different proteins may be created because they require certain sequences for binding and so on," said Ha. "But no one had really thought about sequence changes having an effect on DNA physics, which in turn cause changes in the biology."

Ha's research has shown that it is easier for the cell's protein-making machinery to read from the "weak" end of the nucleosome that uncoils more easily.

> *"Different proteins may be created because they require certain sequences for binding and so on. But no one had really thought about sequence changes having an effect on DNA physics, which in turn cause changes in the biology."*

They believe that genetic mutations related to diseases, like cancer, alter the stability of the nucleosome.

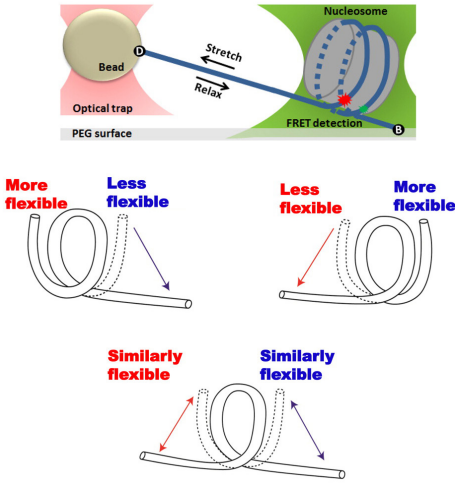
"This could have a major impact on how the information is read out and how different proteins are produced," Ha said. "For example, cancer-fighting proteins or cancer-causing proteins may be made differently depending on the changes in DNA flexibility and stability caused by mutations."

Ha plans to use next generation sequencing to determine the flexibility of an entire genome. He hopes to create the first genome-wide map of physical properties. He also wants to find out if mutations can make the DNA easier or more difficult to read.

This work was supported by the National Science Foundation, the National Institutes for Health, and the Howard Hughes Medical Institute. Ha's research team included Thuy Ngo, a graduate research assistant; Jaya Yodh, Research Assistant Professor and CPLC Director of Education and Outreach; Qiucen Zhang, a postdoctoral research associate; and graduate student Ruobo Zhou.

The paper, "Asymmetric Unwrapping of Nucleosomes under Tension Directed by DNA Local Flexibility," is available online (**http://dx.doi.org/10.1016/j.cell.2015.02.001**). ■

Written by Claire Sturgeon. Photo by Kathryn Coulter.



This graphical abstract shows how the nucleosome unwraps asymmetrically and directionally under tension, and that opening one end helps to stabilize the other end.

PROFILE

Klaus Schulten holds the Swanlund Chair in Physics and directs the theoretical and computational biophysics group at the Beckman Institute for Advanced Science and Technology. His research focuses on the structure, dynamics, and function of biopolymer aggregates.

Klaus Schulten:
Seeing with the Quantum Biology of Vision

Klaus Schulten drafts blueprints of life—not with a pen, but with a computer program that his group developed over the last two decades. Using this program like a computational microscope, he can peer deep inside the smallest units of life, and he says the view is "absolutely gorgeous."

"Experiments often cannot give you the detailed view that you need in order to understand a system," said Schulten, a Swanlund Chair Professor of Physics at the University of Illinois. "A computational microscope functions when many other microscopes don't work. It gives us a very unique picture of the details in living systems that can only be viewed with our type of microscopy."

Schulten's software reveals the amazing machinery that enables a bacterium to harness the energy of the sun. In *Photosynthetic Membrane of Purple Bacteria – A Clockwork of Proteins and Processes*, Schulten illustrates how 101 protein complexes and 16,000 lipids make up the bacterium's powerhouse, called chromatophore. "It is a beautiful movie that shows a microscopic view, a very close look down to the level of atoms and electrons, within the bacterial cell," he said.

More than 95 percent of life on earth gets its energy from the sun, Schulten said. As a member of the Energy Biosciences Institute, he is interested in unlocking the secrets behind photosynthesis in bacteria, algae and plants to find ways to utilize sunlight, an abundant renewable resource, for human energy needs.

"We have to use industrial ways to take something men cannot use, like agricultural waste, and turn that into fuel," Schulten said. "That is absolutely the right way to go, and I believe in it."

Using his computational microscope, Schulten and his co-workers are collaborating with EBI experimental researchers to begin to understand and improve the enzymes that generate biofuels and the polymers that could accelerate biofuel generation. Schulten hopes to adopt many bacterial tricks for bioenergy production, including their ability to employ many enzymes at the same time to turn waste into valuable chemical compounds.

With more than 300,000 registered users, Schulten's software (called Nanoscale Molecular Dynamics, or NAMD, and Visual Molecular Dynamics, or VMD) remains the premier program to simulate how proteins and other biomolecules carry out critical biological functions that can also serve as clean and sustainable tools for the chemical industry.

"We have to use industrial ways to take something men cannot use, like agricultural waste, and turn that into fuel. That is absolutely the right way to go, and I believe in it."

Thanks in part to this program, Schulten is one of the most highly cited scientists in the world. But this metric is also an indication of his reputation within the scientific community as an insightful, interdisciplinary, and tenacious scientist.

Early in his career, Schulten decided to combine the fields of physics and biology to understand quantum biology of vision. "It was an unusual activity at the time, not held in high regard even though there were great opportunities," he said. "Basically, people thought I was too stupid to do real physics, but I knew the field of biological physics had a great future, and its development has proved me right."

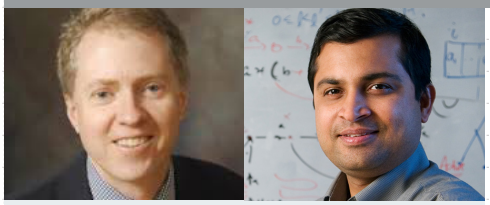
Schulten encountered resistance when his group discovered how animals can navigate through the Earth's magnetic field using a sixth sense that is apparently vital for migratory animals. He first proposed the idea that this sensory capability is due to a biochemical reaction in 1978. *Science* rejected his hypothesis with a note that read, "A less bold scientist would have designated this idea to the waste paper basket." He published the idea in a more open-minded journal, and today his group's work on the topic, stretching from 1978 to 2014, is highly cited.

"I can put my experience and all of my knowledge into my research, but I rely on other people who collaborate with me and do a major part of the work," Schulten said. "That is what makes it fun—it is nice to work as a team, and that is also what makes us successful. There is no substitute for a really great team, and we have such team, particularly for our second generation biofuel efforts. With our experimental EBI colleagues at Illinois and the University of California in Berkeley, we can do so much more together than what our computational scientists could do alone." ■

Written by Claire Sturgeon. Photo by L. Brian Stauffer.

ON THE GRID
HAPPENINGS AT THE IGB

AWARDS



BRIAN CUNNINGHAM
SAURABH SINHA

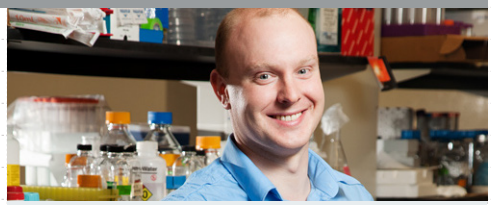
Brian Cunningham, Professor of Electrical and Computer Engineering (Mining Microbial Genomes) and Saurabh Sinha, Associate Professor of Computer Science (Gene Networks in Neural & Developmental Plasticity) have been named Donald Biggar Willett Professors in the College of Engineering.

JIANJUN CHENG

Jianjun Cheng, Associate Professor of Materials Science and Engineering (Regenerative Biology & Tissue Engineering) has been chosen as an American Institute for Medical and Biological Engineering (AIMBE) Fellow for outstanding contribution to the development of polymeric biomaterials and translational nanomedicine.

WEN-TSO LIU

Wen-Tso Liu, Professor of Civil and Environmental Engineering (Biocomplexity) has been appointed the Arthur C. Nauman Endowed Professor in the Department of Civil and Environmental Engineering.



DOUGLAS MITCHELL

Douglas Mitchell, Assistant Professor of Chemistry (Mining Microbial Genomes) received the 2015 Pfizer Award in Enzyme Chemistry from the American Chemical Society Division of Biological Chemistry, for outstanding work in enzyme chemistry where the presence of enzyme action is unequivocally demonstrated.

DIPTI NAYAK

Dipti Nayak, IGB Fellow (Biocomplexity) has been chosen as a 2015 Life Sciences Research Foundation Fellow, an organization which funds outstanding postdoctoral fellows in all areas of the life sciences.

BLOOD DRIVE

IGB BLOOD DRIVE RETURNS

The next IGB blood drive will take place on May 11, 2015. Please note this is in place of the original April 22, 2015 drive, due to scheduling conflicts.

The blood drive will take place in the lower concourse area of IGB, near Array Cafe.

FELLOWS

IGB FELLOWS SYMPOSIUM

Registration now open - visit: http://conferences.igb.illinois.edu/fellows/

Learn about IGB research, hear about current issues in the life sciences, and connect with other students on campus at the annual Fellows Symposium. This full-day event, sponsored by the Carl R. Woese Institute for Genomic Biology, is also your chance to share your research at the popular poster session and reception.

The keynote speaker this year is Bonnie Bassler, Squibb Professor in Molecular Biology and Chair, Department of Molecular Biology at Princeton University. Her talk, "Bacterial Quorum Sensing and Its Control," concerns bacteria and how they communicate with one another via the production and detection of secreted signal molecules called autoinducers. This cell-to-cell communication process, called "Quorum Sensing," allows bacteria to synchronize behavior on a population-wide scale. Behaviors controlled by quorum sensing are usually ones that are unproductive when undertaken by an individual bacterium acting alone but become effective when undertaken in unison by the group.

As always, we will hold a poster session for your chance to share your work with your peers in the life sciences. The poster session is a great way to practice your presentation skills, and prizes will be awarded for the top three posters. The poster session is open to everyone, and posters can be submitted during registration.

Lunch will be provided. If you have any questions or problems regarding registration, or if you would like more information, please contact us at *fellows-symposium@igb.illinois.edu*.

ON THE GRID
HAPPENINGS AT THE IGB

ART EXHIBIT

ART OF SCIENCE 5.0

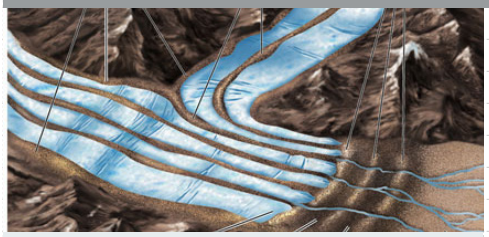
Don't miss the IGB's next Art of Science exhibit, celebrating five years of common ground between science and art. Showcasing imagery from the Core Facilities at the IGB, the Art of Science highlights cutting-edge research that is addressing significant problems in the environment, medicine, energy use and production, and fundamental research.

Opening Reception
Thursday, April 23, 6:00 - 8:00 p.m.

Exhibition Hours
Friday, April 24, 6:00 - 8:00 p.m.
Saturday, April 25, 12:00 - 4:00 p.m.
Sunday, April 26, 12:00 - 4:00 p.m.
Monday, April 27, 6:00 - 8:00 p.m.

Indi Go Artist Co-op
9 E. University Ave., Champaign

ADVANCED HEALTHCARE MATERIALS COVER STORY



GLACIAL MORAINES INFLUENCE NEW TECHNIQUES IN BIOMEDICINE

A recent piece of **biomedical research** has drawn extensively from an unexpected source, glacial moraines. Moraines form as glaciers advance across landscapes over hundreds or even thousands of years, pushing rocks and boulders along their way. As glaciers recede, they leave behind those piles of rocky materials, which we call moraines.

This phenomenon caught the attention of researchers at the IGB, who want to deliver micro-therapies with more precision, by controlling both the speed with which a drug is released and the spatial pattern it takes inside the body.

Associate Professor of Chemical and Biomolecular Engineering Hyunjoon Kong and his team suggested using a "microparticle-loaded hydrogel" to deliver microdrug therapy, which in their case was vascular endothelial growth factor (VEGF) that helps stimulate cell growth for regeneration of blood vessels. Their goal is to introduce the VEGF in precise locations at the cellular level in a hydrogel substrate, where it could help repair damaged tissue.

Moraines provided a model of spatial organization. Shear tension in the ice, a product of the increasing weight of the glacier as it grows, drives minerals and sediment trapped inside and next to the glacier outward to its edges, resulting in the pile of soil, rock and debris that makes up a moraine. The researchers realized that the sediment becomes oriented in a very specific way in relation to the movement of the glacier. If they could replicate that behavior inside their hydrogel, they might be able to correctly orient the VEGF inside the host.

Freezing the hydrogel with the VEGF inside it allowed them to orient the drug into uniform channels. They tested it in mice and found the host's blood cells more easily migrated into the gel, where they came into contact with the VEGF and grew more blood vessels.

This article was adapted from "**Glacial Moraines Influence New Techniques in Micro Biomedicine**," by **Paul Chakalian** on **Glacier Hub**. The publication was highlighted as the cover image of Volume 4, Issue 2 of *Advanced Healthcare Materials*, January 28, 2015.

GIVING

WALK OF LIFE

Walk of Life pavers are the perfect way to commemorate a special event, like graduation. For a paver to be installed, please contact Melissa McKillip at mmckilli@illinois.edu.

More information can be found at **www.igb.illinois.edu/about/giving**.

SUMMER CAMP

POLLEN POWER! CAMP

Monday, July 6 through Friday, July 10
9 a.m. to 5 p.m.

Registration for the third Pollen Power camp at IGB is now open! It is a week-long day camp for girls entering 7th and 8th grade in the fall of 2015 to learn about the biological sciences.

Pollen Power will provide an opportunity for girls to study plant responses to climate change. Campers interact with university professors and female grad student counselors. The cost per camper is $350 and scholarships are available. The cost is $25 if the camper meets NSF's requirement of being a member of an underrepresented population as defined by the NSF or qualifies for a reduced/free lunch.

More information and registration is available at **http://pollensummercamp.illinois.edu/** or contact Sara Haag, Camp Coordinator, at *pollenpower@igb.illinois.edu*.

DEPARTMENT ANNOUNCEMENTS

BUSINESS

UNIVERSITY OF ILLINOIS TAX EXEMPT STATUS

The University of Illinois is an instrumentality of the State of Illinois, and as such it is exempt from federal income tax under Section 115 of the Internal Revenue Code. The Internal Revenue Service also recognizes the University as exempt from federal income tax under Section 501(c)(3).

In addition, the University is exempt from the following Illinois state and local taxes:

- Income Tax
- Real Property Tax
- Retailers' Occupation Tax
- Service Occupation Tax
- Use Tax and Service Use Tax

When making purchases on behalf of the University, please present suppliers with the University's sales tax exempt letter to avoid paying sales tax on purchases. The State of Illinois Tax Exempt Letter can be found at the following url: **https://www.obfs.uillinois.edu/common/pages/DisplayFile.aspx?itemId=93238**.

For additional information, see the OBFS Policies and Procedures Manual Section 18.6, Sales and Use Tax found at the following url: **https://www.obfs.uillinois.edu/bfpp/section-18-taxes/section-18-6**. ■

UNIVERSITY LIBRARY

MORE PUBLIC ACCESS PLANS RELEASED BY FUNDERS

In the February IGB newsletter, the University Library piece outlined some highlights of the public access plans released that month by three federal agencies – Agency for Healthcare Research and Quality (AHRQ), United States Department of Agriculture (USDA), and National Aeronautics and Space Administration (NASA). These plans are in response to the White House's Office of Science and Technology Policy (OSTP) memo "Increasing Access to the Results of Federally Funded Scientific Research," which applies to publications and data.

Since then, more federal agencies have released public access plans, including:

- Assistant Secretary for Preparedness and Response (ASPR)
- Centers for Disease Control (CDC)
- Department of Defense (DOD)
- Food and Drug Administration (FDA)
- National Institutes of Health (NIH)
- National Science Foundation (NSF)

If you have questions about or would like guidance on how these developments affect your research or grant proposals, please contact Sarah Williams, the Life Sciences Data Services Librarian (*scwillms@illinois.edu*), or the Research Data Service, headquartered in the University Library (**http://researchdataservice.illinois.edu/**). ■

SAFETY

PLAY IT SAFE WHEN WORKING WITH ELECTRICITY IN THE LAB

Safe work practices must be used to prevent electrical shock or similar injuries when working with electricity in the laboratory. Some of the hazards associated with the use of electricity include electrical shock and electrical fires caused by shorts and overloaded circuits or wiring. In addition, sparks from electrical equipment can serve as an ignition source for flammable or explosive vapors or combustible materials. Most incidents are a result of unsafe work practices, improper equipment use, and faulty equipment.

Prior to using electrical equipment, you should first determine if it is safe by checking the following:

- Make sure the electrical equipment is not located in a hazardous environment such as a damp/wet location or where it is exposed to high temperatures and flammable liquids and gases
- Make sure current and safety devices such as fuses, breakers and ground fault circuit interrupters (GFCI) have not been tampered with and are working correctly
- Make sure the power cord and plug do not have any defects such as cuts in the insulation exposing bare wiring
- Know if the equipment has an emergency shutoff switch and where it is located prior to use
- Make sure there is sufficient space around the electrical equipment or circuit so that it can operate safely
- Ensure that all electrical outlets have a grounding connection requiring a three-pronged plug. All electrical equipment should have three-pronged, grounded plugs or be double-insulated
- Keep corrosive chemicals and organic solvents away from electrical cord—these can easily erode the insulation on wires
- Never handle electrical equipment when hands, feet, or body are wet or perspiring or when standing on a wet floor
- Electrical outlets, wiring, and other electrical equipment integral to the building may only be serviced and repaired by qualified trades personnel or other qualified electricians ■

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.

Fei J, Singh D, Zhang Q, Park S, Balasubramanian D, Golding I, et al. Determination of in vivo target search kinetics of regulatory noncoding RNA. *Science*. 2015;347(6228):1371-4.

Hortensius RA, Becraft JR, Pack DW, Harley BAC. The effect of glycosaminoglycan content on polyethylenimine-based gene delivery within three-dimensional collagen-GAG scaffolds. *Biomater Sci*. 2015;3(4):645-54.

Peng P-, Hassan Samee MA, Sinha S. Incorporating chromatin accessibility data into sequence-to-expression modeling. *Biophys J*. 2015;108(5):1257-67.

Zhang X, Kumar R, Vetting MW, Zhao S, Jacobson MP, Almo SC, et al. A Unique cis-3-Hydroxy-L-proline Dehydratase in the Enolase Superfamily. *J Am Chem Soc*. 2015;137(4):1388-91.

Hussain MZ, Saraswathi G, Lalrammawia C, Otieno D, Paliwal K, Tenhunen J. Leaf and Ecosystem Gas Exchange Responses of Buffel Grass-Dominated Grassland to Summer Precipitation. *Pedosphere*. 2015;25(1):112-23.

Abil Z, Xiong X, Zhao H. Synthetic Biology for Therapeutic Applications. *Mol Pharm*. 2015;12(2):322-31.

Lowe SR, Meyers JL, Galea S, Aiello AE, Uddin M, Wildman DE, et al. And Posttraumatic Stress Trajectories: Main Effects and Interactions with Childhood Physical Abuse History. *Brain Behav*. 2015 Mar 8:e00323.

Ngo TTM, Zhang Q, Zhou R, Yodh JG, Ha T. Asymmetric unwrapping of nucleosomes under tension directed by DNA local flexibility. *Cell*. 2015;160(6):1135-44.

Lee MK, Rich MH, Baek K, Lee J, Kong H. Bioinspired tuning of hydrogel permeability-rigidity dependency for 3D cell culture. *Sci Rep*. 2015;5.

Peck SC, Chekan JR, Ulrich EC, Nair SK, Van Der Donk WA. A common late-stage intermediate in catalysis by 2-hydroxyethyl-phosphonate dioxygenase and methylphosphonate synthase. *J Am Chem Soc*. 2015;137(9):3217-20.

Mcneill MS, Robinson GE. Voxel-based analysis of the immediate early gene, c-jun, in the honey bee brain after a sucrose stimulus. *Insect Mol Biol*. 2015.

Kim J-, Seo S-, Zhang G-, Jin Y-, Seo J-. Expression of Lactococcus lactis NADH oxidase increases 2,3-butanediol production in Pdc-deficient *Saccharomyces cerevisiae*. *Bioresour Technol*. 2015.

Kim S-, Jin Y-, Choi I-, Park Y-, Seo J-. Enhanced tolerance of *Saccharomyces cerevisiae* to multiple lignocellulose-derived inhibitors through modulation of spermidine contents. *Metab Eng*. 2015;29:46-55.

Chandrasekaran S, Rittschof CC, Djukovic D, Gu H, Raftery D, Price ND, et al. Aggression is associated with aerobic glycolysis in the honey bee brain1. *Genes Brain Behav*. 2015.

Caetano-Anollés K, Mishra S, Rodriguez-Zas SL. Synergistic and antagonistic interplay between myostatin gene expression and physical activity levels on gene expression patterns in triceps brachii muscles of C57/BL6 mice. *PLoS ONE*. 2015;10(2).

Kemp BM, Lindo J, Bolnick DA, Malhi RS, Chatters JC. Response to comment on "Late Pleistocene human skeleton and mtDNA link paleoamericans and modern Native Americans". *Science*. 2015;347(6224):835b.

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