



IGB NEWS

Achievements, awards, and information about the IGB community

Volume 5, Number 2



Featured News

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{Upcoming Events}

Pioneers in Genomic Biology Lecture Series

March 27, 2012

12:00 p.m.

612 Institute for Genomic Biology

Patricia Babbitt, Ph.D.

Professor, Department of Bioengineering & Therapeutic Sciences

Department of Pharmaceutical Chemistry

California Institute for Quantitative Biosciences

University of California, San Francisco

“Creating a Global Context for Prediction of Functional Properties in Enzyme Superfamilies”

Special Seminar

April 3, 2012

12:00 p.m.

612 Institute for Genomic Biology

Robert Chapkin, Ph.D.

Regents Professor and Senior University Faculty Fellow, Department of Nutrition and Food Science

Director of Genomics and Bioinformatics, Center for Rural and Environmental Health

Co-Director—Texas Cancer Microbiota Repository & Humanized Animal Core

Texas A&M University, College Station, TX

“Teaming Up with Engineers to Make Sense of Nutrition Genomic Data”

Art of Science 2.0: Images from the Institute for Genomic Biology



Opening Reception
April 12, 2012

6:00 p.m.—8:30 p.m.

Indi Go Artist Co-Op

9 E. University Ave., Champaign, IL 61820

Exhibit hours:

Friday, April 13: Noon to 8:00pm

Saturday, April 14: Noon to 8:00pm

Innovation and Commercialization Seminar

April 17, 2012

12:00 p.m.

612 Institute for Genomic Biology

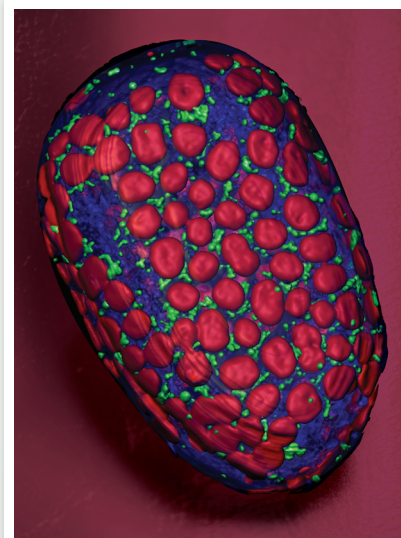
Xiaomin Yang, Ph.D.

Technology Transfer Manager

BP Biofuels North American, LLC

“Technology and Business Integration”

{Image of the Month}



This month's image, “Live palisade mesophyll cell of Arabidopsis” was submitted by Cody Markelz of the Andrew Leakey lab. This was taken with the Zeiss LSM 700 Confocal Microscope

Within the Arabidopsis cell are visible Chloroplasts (red), Cytoplasm (blue) and Mitochondria (green).

IGB News

Share your news with the IGB. Send your story ideas to nvasi@illinois.edu

Caught in the act: Team discovers microbes speciating



» Microbiology professor Rachel Whitaker. Photo by L. Brian Stauffer

Not that long ago in a hot spring in Kamchatka, Russia, two groups of genetically indistinguishable microbes parted ways. They began evolving into different species—despite the fact that they still encountered one another in their acidic, boiling habitat and even exchanged some genes from time to time, researchers report. This is the first example of what the researchers call sympatric speciation in a microorganism.

The idea of sympatric speciation (one lineage diverging into two or more species with no physical or mechanical barriers keeping them apart) is controversial and tricky to prove, especially in microbes, said IGB faculty member and University of Illinois microbiology professor Rachel Whitaker, who led the study.

“One of the big questions, from Darwin on, is how do species diverge if they are living together?” she said. “That question really hasn’t been answered very well, even in the macro-organisms that we’ve studied for hundreds of years.”

Bacteria and their distantly related microbial cousins the archaea are even more difficult to study because they have so many ways to share genetic information, Whitaker said.

The microbes divide to conquer, producing exact or near-exact clones of themselves. If this were their only way of getting established, their genetic diversity would be quite low, the result of a few random copy errors and mutations, Whitaker said. But they also can link up with each other to pass genes back and forth, suck up random genetic elements from the environment and acquire new genes from the viruses that infect them and their neighbors.

Before scientists were able to dissect the genetic endowment of individual microbes, they had a

hard time telling the bugs apart—so much so that they once confused bacteria and archaea. Researchers now know that the archaea belong to a third domain of life—as different from bacteria as plants and animals are.

“Every time we look, everywhere we look we see variation in microbial populations using these molecular tools,” Whitaker said. “You have to use these molecules, these DNA sequences, to tell the difference between species.” But even with new sequencing technologies, the task of studying microbial evolution is daunting.

Whitaker and her colleagues focused on *Sulfolobus islandicus*, a heat-loving organism from the archaeal domain of life, because it is one of few microorganisms that live in distinct “island” populations created by geothermal hot springs.

“We’re looking at an environment that’s not very complex in microbial terms,” Whitaker said. “There are not that many organisms that can handle it, and the ones that can don’t successfully move around very often.”

The researchers sequenced the genomes of 12 strains of *S. islandicus* from a single hot spring in the Mutnovsky Volcano region of Kamchatka. By comparing sequences at multiple sites on the microbes’ single (circular) chromosome using new software programs ClonalFrame and ClonalOri-

gin, the researchers were able to reconstruct the genetic history of each of the strains.

The analysis revealed two distinct groups of *S. islandicus* among the 12 strains. The microbes were swapping genes with members of their own group more than expected, but sharing genes with the other group less than expected, Whitaker said. And the exchange of genetic material between the two groups was decreasing over time.

This indicates that the two groups are already separate species, even though they share the same habitat, Whitaker said. The differences between the two groups were slight, but speciation was clearly under way, she said.

Peering more closely at the patterns of change, the researchers saw a mosaic of differences along the chromosome, with vast “continents” of variation and smaller “islands” of stability. Those islands likely represent regions that are under selective pressure, Whitaker said; something in their environment is weeding out the microbes that don’t have those genes or sets of genes. The variable regions are more fluid, with genes coming and going (a process called recombination) and mutations increasing diversity.

The findings provide the first evidence that sympatric speciation occurs in a microbe, Whitaker said.

“We caught them speciating,” she said. “They do exchange some genes—just not very many. So now we know you don’t have to have a (geographic or mechanical) barrier to recombination for speciation to occur. All you have to have is selection pulling the two groups apart, which nobody knew before.”

This study provides a glimpse of the profound genetic diversity that likely occurs everywhere in wild microbial populations, Whitaker said.

“What we see as two different species are 0.35 percent different across the chromosome; that’s about one-third of the distance between human and chimp,” she said. The two distinct groups of microbes are “orders of magnitude” more similar to each other than groups normally considered separate species, she said.

“That means there are orders of magnitude more species of microbes than we ever thought there were,” she said. “And that’s kind of mind-boggling.”

The study appears in the journal PLoS Biology. The research team included scientists from Arizona State University, the University of California at Davis, and the University of Oxford. ■

—story by Diana Yates

Researchers Aim to Make Sugarcane and Sorghum Into Oil-Producing Crops



With the support of a \$3.2 million grant from the U.S. Department of Energy, researchers will take the first steps toward engineering two new oil-rich crops. They aim to boost the natural, oil-producing capabilities of sugarcane and sorghum, increase the crops' photosynthetic power and—in the case of sugarcane—enhance the plant's cold tolerance so that it can grow in more northerly climes.

The initiative, led by researchers at the University of Illinois in collaboration with scientists at the University of Florida, the University of Nebraska and the Brookhaven National Laboratory, will make use of recent advances in plant biotechnology and computer modeling to produce high-yielding, cold-tolerant, photosynthetically

efficient crops that can be used in the production of biodiesel and jet fuel.

"Plants already have all the genetic apparatus to make oils," said Illinois crop sciences and Institute for Genomic Biology professor Stephen Long, who leads the initiative. "It's in their genomes."

Once they have matured, sugarcane and sorghum spend much of their energy making and storing sugars, he said.

"We are proposing to subvert that mechanism in the plant to, instead of making sugar, use the products of photosynthesis to make oils and deposit those in the stems."

These natural plant oils, known as triacylglycerols, can be converted into diesel and jet fuel by a chemical process known as hydro-treatment.

"Ethanol is somewhat problematic in that we don't have any pipelines for distributing it around the country," Long said. "And we have to deal with the blend-wall—that is, most current cars cannot deal with more than 10 percent ethanol, setting a limit on the amount of gasoline we can replace at present."

Traditional oil-producing plants, such as soybeans, can't produce enough oil per unit of land to make this approach cost effective in the long-term without subsidies, Long said. But sugarcane and sorghum, which are among the most productive plants in agriculture, could feasibly produce

more than 10 times the amount of oil per acre of crops such as canola and soybean, Long said.

The new work will build on previous studies that have identified genes that enhance oil production in plants and genes that boost their photosynthetic efficiency.

Long and his colleagues also will make use of their knowledge of *Miscanthus x giganteus*, a perennial grass already used as a biofuels feedstock. The use of this new crop was first pioneered in the U.S. at the U. of I. *Miscanthus* can grow up to 13 feet (3.9 meters) tall and is closely related to sugarcane but is much more tolerant of cold weather. The researchers hope to introduce the genes that enhance its cold tolerance into sugarcane, which today can survive only in the hottest parts of southern U.S. states.

Another project will look at engineering bacteria to produce diesel directly and, once the process is streamlined in the bacterium, transfer the critical genes to sugarcane and sorghum.

"Sorghum and sugarcane will grow on quite poor land, so this should be doable without competing with food-crop production," Long said. "The amount (of oil) we can get per unit (of) land area really makes this economically very viable as well, so I think it has the potential to give significant energy security to the country."

Long said he expects to have early "proof of concept" results within 18 months. ■

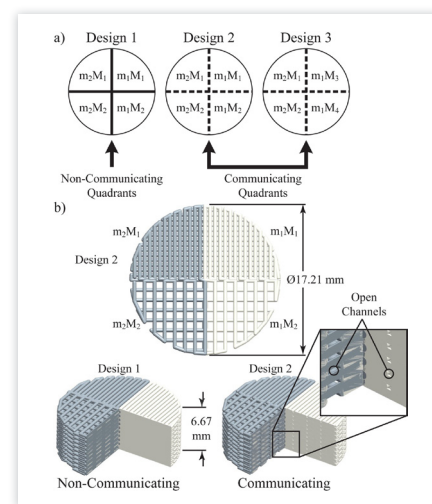
Efficient Design, Manufacture Key to Optimal Bone Scaffolds

Amy Wagoner Johnson, Assistant Professor, Mechanical Science and Engineering, and affiliate in the Regenerative Biology & Tissue Engineering research theme, had her group's work chosen as the cover feature of the Journal of Biomechanical Engineering, and was the top downloaded article for that month.

The paper, "Design and Manufacture of Combinatorial Calcium Phosphate Bone Scaffolds," discusses among other topics new manufacturing methodologies for advanced scaffolds, and the ability to introduce tailored functionality into the design process. Co-authors include Andrew Alleyne, Professor in Mechanical Science and Engineering in the area of controls, and students David Hoelzle, currently doing postdoctoral work UCLA and soon to join the faculty at Notre Dame, and Shelby Svientek, a senior in Bioengineering.

From the abstract: It is well known that pore design is an important determinant of both the

quantity and distribution of regenerated bone in artificial bone tissue scaffolds. A requisite feature is that scaffolds must contain pore interconnections on the order of 100–1000 μm (termed macroporosity). Within this range, there is not a definitive optimal interconnection size. Recent results suggest that pore interconnections permeating the scaffold build material on the order of 2–20 μm (termed microporosity) drive bone growth into the macropore space at a faster rate and also provide a new space for bone growth, proliferating throughout the interconnected microporous network. The effects of microstructural features on bone growth has yet to be fully understood. This work presents the manufacture and characterization of novel combinatorial test scaffolds, scaffolds that test multiple microporosity and macroporosity designs within a single scaffold. Scaffolds such as this can efficiently evaluate multiple mechanical designs, with the advantage of having the designs colocated within a single defect site and therefore less susceptible to experimental variation. This paper provides the manufacturing platform, manufacturing control method, and demonstrates the manufacturing



capabilities with three representative scaffolds.

"Design and Manufacture of Combinatorial Calcium Phosphate Bone Scaffolds," David J. Hoelzle, Shelby R. Svientek, Andrew G. Alleyne, and Amy J. Wagoner Johnson, J. Biomech. Eng. 133, 101001 (2011), DOI:10.1115/1.4005173 ■

{Around the IGB}

Symposium

IGB Fellows Symposium

Join us on May 3, 2012 for the IGB Fellows Symposium. Hear about current issues in the life sciences and connect with other students, while learning about IGB research during this day-long event.



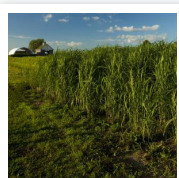
Nancy Moran, William H. Fleming Professor of Biology, Yale University, will be the keynote speaker with her talk titled "Genome Evolution in Symbiotic Bacteria".

And don't forget to share your own research at the popular poster session at the end of the day.

For more details and to register, please visit <http://conferences.igb.illinois.edu/fellows/> ■

Conference

EBI Biofuels Law and Regulation Conference



The Fourth Annual EBI Biofuels Law and Regulation Conference, "Focusing in on the Renewable Fuel Standard (RFS2)," will be held at the I-Hotel in Champaign, Illinois on

April 25, 2012, sponsored by the EBI Biofuels Law and Regulation Project.

The conference will focus on the multitude of issues surrounding the implementation of the federal Renewable Fuel Standard (RFS2), with unique sessions discussing:

- Current economic evaluations of the RFS2
- Industry perspectives on the RFS2
- Feedstock availability and agricultural impacts of the RFS2

The conference will involve leading academic, scientific, government, and industry experts, with opportunities for in-depth discussion between and among speakers and audience members. The organizers have structured the program to appeal to business, law, government, academia, biomass producers, students, and the public generally.

Detailed information can be found on the Conference website, www.biofuellawconference.org. Cost of attendance is free, but registration is required. Registration questions should be directed to Elizabeth Stull, Conference Administrator, at estull@illinois.edu ■

Award

Alfred P. Sloan Research Fellow



Congratulations to Professor Sheng Zhong, IGB faculty member, who has been selected as a 2012 Alfred P. Sloan Research Fellow.

The Sloan fellowship is awarded yearly to 126 researchers across the United States and Canada in recognition of distinguished performance and a unique potential to make substantial contributions to their field. ■

Genomics

Archon Genomics X PRIZE



Beginning in January 2013, teams will compete to accurately sequence the genomes of 100 healthy centenarians within 30 days for less than \$1,000 per genome. A \$10 million prize will be either awarded to a single winner or divided among successful teams in the Archon Genomics X PRIZE presented by Medco.

Victor Jongeneel, senior research scientist at both IGB and the National Center for Supercomputing Applications (NCSA), was among the experts who defined the validation protocol for the competition.

To learn more, or to nominate a centenarian, visit <http://genomics.xprize.org/medco-100-over-100> ■

Social Committee

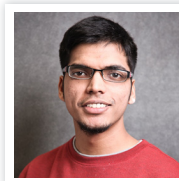
Student Social Committee Recruiting Party

Thursday, March 29
4:00pm to 5:30pm
1st Floor Breakroom

Do you want to help determine what social events will take place here in the building? Come join the fun and help plan the events that build the community at IGB! ■

Finalist

Lemelson-MIT \$30,000 Illinois Student Prize



Congratulations to Sriram Chandrasekaran, a PhD student in the Nathan Price lab, for becoming a Lemelson-MIT \$30,000 Illinois Student Prize Finalist. Finalists were

chosen by a distinguished panel of entrepreneurs as well as faculty members and professionals from across Illinois campus. ■

Winners

Bake-off & Culinary Competition Winners

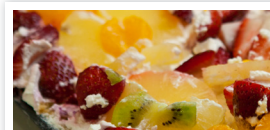
Overall Theme Winner
Energy Biosciences Institute

Overall Best Savory Winner



Fiona Groninger-Poe, MMG
Veggie Pizza

Overall Best Sweet Winner



Blessing Sokoya, Admin
Fruit Pizza

Best Cake (tie)
Jessica Kirkpatrick, EBI
Chocolate Almond

and

Ayano Sakai, EFI-MMG
Matchu Castella

Best Cookie
Jessica Kirkpatrick, EBI
Black Walnut & Chocolate Chip

Best Cupcake
Nick Vasi, Admin
Chocolate Ganache Toffee

Best Other Sweet
Justin Man-Yin Ma, EBI
Baklava

Congratulations to all who participated! ■

{IP @ IGB}

What is Intellectual Property?

Creations of the mind:

- Inventions
- Literary works
- Artistic works
- Symbols, images, and designs
- Used in commerce

Types of IP:

- Trade Secret: Recipe for Coca-Cola
- Trademark: Google
- Tangible Property: Antibodies
- Patents: Tissue Scaffold
- Copyrights: Books, poems, software, music, notes, sound recordings, plays, dances, films, paintings, sculptures



Questions about intellectual property? Contact Jen Rice at jenrice@illinois.edu at the Office of Technology Management: www.otm.illinois.edu ■

ADMINISTRATIVE NEWS

{Safety}

Tornado Events: Know What To Do



Tornado Watch: If the national weather service issues a tornado watch, this means weather conditions are right for the development of tornadoes. Remain alert for approaching storms and be prepared to seek shelter.

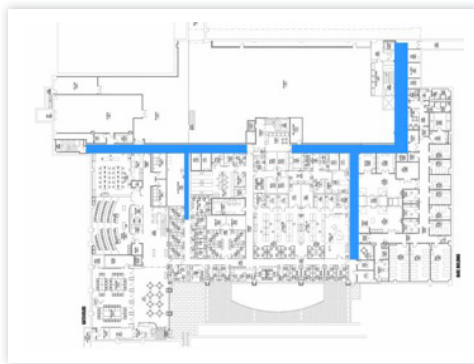
Tornado Warning: If the national weather service issues a tornado warn-

ing, this means that a tornado is imminent or has been indicated by Doppler radar or reported by storm spotters.

Tornado Sirens: Tornado sirens are sounded for those areas in the path of the tornado. These sirens are intended to be heard outside of the building but may not be audible to personnel inside of some buildings. The Illini alert system will send out an alert to all subscribed members if a tornado warning is issued for the University of Illinois campus area.

What to do if a tornado warning is issued for the U of I campus:

- Move to the designated tornado shelter area (see map). Assist those with special needs in getting to the shelter area.
- Put as many walls as possible between you and the outside. Use arms and hands to protect your head and neck. Stay away from windows and other sources of glass (large amounts of lab glassware).

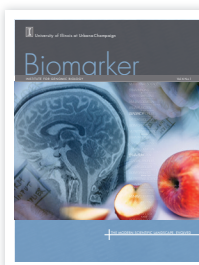


» IGB designated tornado shelter area [Concourse level IGB]

- If you cannot get to the basement, go to an interior room on the lowest level away from windows and other glass.
- Get out of vehicles, trailers and mobile homes immediately. Go to the lowest floor of a sturdy nearby building or storm shelter.
- If caught outside with no shelter, lie flat in a nearby ditch or depression and cover your head with your hands. Be aware of potential flooding.
- Never try to outrun a tornado in a car or truck, leave the vehicle immediately for safe shelter. Tornadoes are erratic and can move swiftly.
- Watch out for flying debris. Flying debris from tornadoes cause the most fatalities and injuries. ■

{Communications}

Biomarker Vol. 6 Available



The newest issue of Biomarker, the IGB magazine, is now available. This issue features a cover story on the Center for Nutrition, Learning, and Memory, a joint project between IGB and the Beckman Institute to create the first-ever multi-disciplinary nutrition and cognition research center. The Center is supported by a five-year commitment from Abbott. The issue also features the story of an Illinois grain farmer who is expanding his operations into energy crops, and a member of the Citizen Scientist program from the Osher Lifelong Learning Institute.

If you have any key contacts or interested parties and would like them to be added to the list to receive an issue of Biomarker, please contact Nicholas Vasi at nvasi@illinois.edu ■

{Business}

University of Illinois Tax Exemption Status

The Illinois Department of Revenue has granted the University of Illinois a governmental exemption from sales and use taxes on purchases for University use. A copy of the University's sales tax exempt letter (PDF) is available for printing at <http://www.obfs.uillinois.edu/cms/one.aspx?portalId=909965&pageId=912272#exemption>.

When making purchases on behalf of the University, please present vendors with the University's sales tax exemption letter to avoid paying sales tax on purchases. The University's sales tax exemption number is also printed on University P-Cards. When making purchases, the enduser should emphasize the University's tax exempt status and exemption number when placing orders. If a vendor does not honor the University's tax exempt status, it should be noted on the employee reimbursement form or the comment section of the P-Card transaction report.

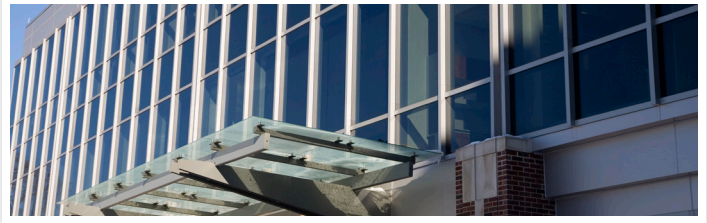
Purchases from vendors outside of Illinois may or may not be exempt. The University has reciprocity in the following states: Indiana, Michigan, Minnesota, Ohio, and Wisconsin. Tax should not be charged for purchases for University use from these states.

For additional information, see Section 18.6, Business and Financial Policies and Procedures manual at <http://www.obfs.uillinois.edu/cms/one.aspx?portalId=909965&pageId=913978>.

For questions, please contact Dale Johnston in the IGB Business office, 217-244-5595, or dkjohnst@uillinois.edu ■

{Operations and Facilities}

Window Washing



The exterior windows of the IGB lab building and gatehouse will be washed during the week of March 19. You will notice workers on the roof and outside of your windows.

If you have any questions or concerns, please contact IGB Operations and Facilities at 244-2999. ■



I L L I N O I S

IGB News is published every month by the IGB Communications Office
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