

# Sigma Xi Today

A NEWSLETTER OF SIGMA XI, THE SCIENTIFIC RESEARCH SOCIETY

## Congratulations to Our Chapter Award Winners

Sigma Xi has bestowed [Chapter of Excellence Awards](#) to the following chapters for exceptional chapter activity, innovative programming, and true community leadership during 2014–2015:

- University of New Mexico
- San Diego
- Eastern Illinois
- Calgary
- Saint Louis University
- Kansas State University

The following chapters received [Chapter Program Awards](#) for organizing and/or hosting an outstanding program during 2014–2015:

- National Institute of Standards and Technology for a variety of activities, such as an annual meeting, seminar series, awards, and guest speakers
- University of Notre Dame for the Northern Indiana Science & Engineering Fair and the Sensing our World event
- Weber State University for research seminars

Nominees for Chapter of Excellence Awards and Chapter Program Awards were chosen by the regional and constituency directors based on chapter annual reports, and the winners were selected by the Committee on Qualifications and Membership.

The following chapters are recognized for [initiating the most new members](#) in 2014–2015: Brown University, Washington University, Carleton College, Princeton, Ohio State University, Fordham University, Union College, Williams College, Smith College, Amherst College, Oberlin College, Delta, Swarthmore College, Southern Maine, and Georgetown University.

## From the President

### Sigma Xi Annual Meeting Delivers a Punch



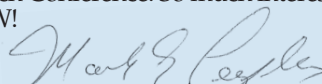
President Mark E. Peeples

WOW. That's my best description of our Sigma Xi Annual Meeting in Kansas City, Missouri, October 22–25. I truly wish that more of our members could have attended. I think that all of us there got the Sigma Xi bump. If your chapter's representative was there this year, I bet s/he felt it too. Ask them.

Our theme was "Science Lifts the Light," and we saw that in so many excellent talks from Sigma Xi award winners such as the Young Investigator Award winner, Melissa Kenny, who inspired us with her environmental science work that involved many different stakeholders as she enjoined us to be the "arrows" in the flow chart, not just the boxes, by working with others across disciplines; our newest honorary member Miles O'Brien, who joined us by Google Hangout to discuss his passion and one of Sigma Xi's missions—communicating science to the public, telling us how he has made a career of explaining science to TV audiences by filming his search for an understanding of a problem and letting the science speak for itself; our John P. McGovern Science and Society Award winner, May Berenbaum, who led us on an exploration of a bee's life and problems as well as the joy of her annual Insect Fear Film Festival at University of Illinois at Urbana-Champaign; Larry Johnson, our Evan Ferguson Award winner, who showed us his approach for reaching and teaching science to students through YouTube videos and live connections with multiple classrooms; and the Proctor Prize winner David Williams, who showed us groundbreaking methods to correct our vision imperfections.

Was that enough? No. We had two nights of extraordinary Science Cafés, three each night: Our own Mark Schneegurt landed us on Mars and flew us past Pluto looking for life; Eric Martens, the chemistry-trained brewer behind Border Brewing Company, led us through several pints of chemistry; our Vijay Kowtha gave us hands-on robotics training to teach and test engineering and design; and my favorite, Jerry and Nancy Jaax, led us through the terrifyingly true story of the first Ebola outbreaks nearly 30 years ago, and their central roles in controlling the Reston, Virginia, monkey colony outbreak that was terrifyingly captured in *The Hot Zone*.

But we also took care of your Society's business, introducing our new interim executive director, John Nemeth. John was a high school science teacher, then became a research administrator and professor at Georgia Institute of Technology for 15 years before he went on to be vice president of Oak Ridge Associated Universities. We explored many ideas for strengthening the value of our chapters, approaching potential new members with an attractive message, and using our new online communities for both communicating chapter activities and discussing science. Our caucuses discussed several ideas for improving Sigma Xi's infrastructure and I'll be sharing these with you in future letters. And finally, our delegates discussed their science in the newly revived Professional Research and Chapter Poster Session, and provided feedback on student science at our Student Research Conference. So much interesting science, so many interesting scientists. WOW!

  
Mark E. Peeples

## A Celebration of Research Accomplishments

Sigma Xi members met October 22–25 in Kansas City, Missouri, to share their research, give students feedback on their projects, hear from their award-winning peers, and attend workshops for career development and chapter improvement.

Approximately 200 people attended Sigma Xi’s Annual Meeting and Student Research Conference. During the meeting, professional scientists and engineers volunteered to judge approximately 80 student research presentations. Medals were awarded to students with the highest scores by research category in high school, undergraduate, and graduate divisions. These students were invited to join Sigma Xi, with their first year of membership dues and initiation fees paid for by the Board of Directors. Students also selected their peers for Student Choice Awards. The student poster session and Student Choice Awards were sponsored by the District of Columbia Chapter.

Through panels and workshops, participants learned about topics such as entrepreneurship in science and how to communicate and teach controversial science subjects.

Keynote speakers were Sigma Xi’s 2015 award winners: 2014 National Medal of Science recipient May Berenbaum of the University of Illinois at Urbana-Champaign; National Academy of Sciences member David Williams of the University of Rochester;

Larry Johnson, professor of veterinary integrative biosciences at Texas A & M University; and Melissa A. Kenney, a research assistant professor in environmental decision science and indicators at the University of Maryland. The Society inducted its 49th honorary member, science journalist Miles O’Brien.

The meeting included the 116th Assembly of Delegates, recognition of chapter award winners, and an induction ceremony for new members.



George Humphrey of the University of Mississippi presents his engineering research poster to judge Jorge Rodriguez in the Student Research Conference.



The 2015 award winners from the Student Research Conference.



Participants gather for a keynote lecture at the Annual Meeting.



Linda Mantel, left, president of the Columbia-Willamette chapter, presents the John P. McGovern Science and Society Award to May Berenbaum.



District of Columbia Chapter President Cristina Gouin-Paul, left, with Omokaro Obire of Nigeria. The D.C. Chapter and Sigma Xi’s Young International Scientist Dues Fund will pay for Obire’s membership dues as she establishes a Sigma Xi chapter in Nigeria. The D.C. and Nigeria groups will be sister chapters.



From left: Sigma Xi President Mark Peeples, Procter Prize for Scientific Achievement recipient David Williams, Sarah Walters, and executive director John Nemeth. As part of his prize, David Williams selected Sarah Walters, a PhD student at University of Rochester, to receive a \$5,000 grant for her research. (Photos by Cristina Gouin-Paul and Heather Thorstensen.)



## Sigma Xi Hosts Online Q & A Sessions

Sigma Xi members, chapters, and the public are getting together online for question-and-answer sessions about research. These sessions are moderated by *American Scientist* editors and feature Sigma Xi's distinguished lecturers. To date, the topics have included the hunt for exoplanets, biosensors and food pathogens, air pollution, diversity in science, and how insects use their sense of smell.

The sessions are held through Google Hangouts, a free teleconferencing service. You can watch these hangouts and ask questions during the live broadcasts or you can watch recordings of the hangouts when it's convenient for you.

Sigma Xi chapters are encouraged to get involved by hosting an event that coincides with a hangout, either by watching a live broadcast together, contributing to the live conversation on Twitter using #AmSciGHO, or by watching a recording and having a follow-up conversation. Recent hangouts have been supported by the Research Triangle Park Chapter, the University of Arkansas-Fayetteville Chapter, the North Carolina State University Chapter, and the University of North Carolina-Chapel Hill Chapter. Chapters can also use these Google Hangouts to decide which lecturer to bring to their local area for an in-person presentation.

Additionally, Sigma Xi members are invited to use our online community, The Lab: Members to Members, at [community.sigmaxi.org](http://community.sigmaxi.org) to send in their questions before the hangouts or to continue the conversation afterwards.

The Distinguished Lectureship program is supported by Sigma Xi members with additional support from partnership organizations, such as the American Meteorological Society and the National Cancer Institute.

Upcoming hangouts will focus on the potential environmental health and human safety risks of engineered nanomaterials and the anthropology of the first people of the New World.

*The schedule of upcoming hangouts and recordings of past hangouts are available at <https://www.sigmaxi.org/programs/lectureships>. Chapters who wish to get involved may contact [chapters@sigmaxi.org](mailto:chapters@sigmaxi.org).*



Screenshots of Google Hangouts with Sigma Xi Distinguished Lecturers, from top: Debra Fischer of Yale University, John G. Hildebrand of University of Arizona, and Omowunmi Sadik of State University of New York at Binghamton.

## Sigma Xi Member Wins Nobel Prize

Sigma Xi member Satoshi Ōmura was awarded one-fourth of the 2015 Nobel Prize in Physiology or Medicine. He is a distinguished emeritus professor at Kitasato University in Japan, the Max Tishler Professor of Chemistry at Wesleyan University, and president emeritus of Joshibi University of Art and Design in Japan. Ōmura was inducted into Sigma Xi in 1972.

He shares half of the prize with William C. Campbell of Drew University for their discoveries concerning a novel therapy against infections caused by roundworm parasites. The other half of the prize was awarded to Youyou Tu of the China Academy of Traditional Chinese Medicine in China for her discoveries concerning a novel

therapy against malaria.

To have fun as we waited for the Nobel Prize announcements, Sigma Xi ran its inaugural prediction contest, October Madness, on our new blog, *Keyed In*. After crowdsourcing nominations, we had four rounds of voting to try to predict the winners of the prizes in chemistry, physics, and physiology or medicine. For his participation, Alexis Verger won the raffle prize of a free year of membership in Sigma Xi's Affiliate Circle. October Madness returns next year, so start thinking about your nominations.

*To see the results of October Madness, visit <https://www.sigmaxi.org/news/keyed-in>.*

## Detecting Single Molecules to Improve Disease Diagnostics

For this installment of the Meet Your Fellow Companion series, Sigma Xi's manager of communications, Heather Thorstensen, spoke with member Dhruvajyoti Roy, a senior scientist at Nanogea Corporation in Culver City, California. He is on a team that is developing technology for biomedical applications. One way this technology could be used is to improve the process for diagnosing illnesses such as cancer and Alzheimer's disease.

**The technology that you're developing can be used to diagnose diseases by detecting biomarkers. Could you explain what a biomarker is?**

A biomarker is a measurable indicator of some biological state or disease condition. An ideal biomarker has certain characteristics that make it appropriate for checking the severity of a particular disease or a particular disease state.

**How will the technology that you're developing find these biomarkers?**

We are focusing on commercializing the industry's most sensitive single molecule detection platform based on our company's proprietary NanoCone™ chemistry and NanoCone Enabled Atomic Force Microscopy (NE-AFM™). In the case of protein biomarkers, our approach combines two key features: the specificity determined by a probe antibody on the microarray platform and the label-free AFM (atomic force microscopy) readout.

Let me explain briefly how the technology works. Typically, to detect a target protein biomarker, a matched pair of antibodies is selected. One of these antibodies is known as the capture antibody and it is spotted on a substrate with a conventional microarray spotter. This is a spatial array of microscopic spots of biological material attached to a solid surface. The other antibody is the detection antibody and it is immobilized on an AFM probe. The capture antibody on a microarray platform specifically captures the target biomarker present in a biological sample from a patient. After capturing, the substrate is washed and then we do a cross-linking step to secure the biomarker on the antibody spot. At this point, the substrate is ready to scan. We employ a force-

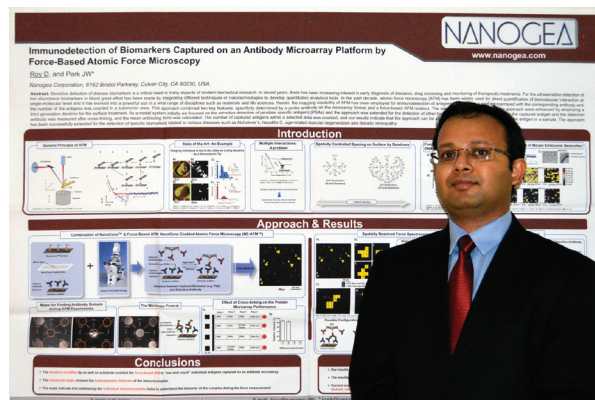
based AFM approach to detect the captured biomarker directly where the controlled surface architecture allows a single molecular interaction between the detection antibody on an AFM tip and the target biomarker on a substrate. The high-resolution force-based mapping capability of AFM enables us to "see and count" them in a sub-micrometer designated area. The technology can also be utilized for other forms of biomarkers such as DNA, RNA, and small molecules.

**How would this technology be used if commercialized?**

The early and accurate detection of the presence of certain biomarkers would enable physicians to diagnose cancer and other diseases much earlier. And remarkably, our AFM-based technology can detect a wide range of disease biomarkers and open a new avenue to analyzing low levels of biomarkers, particularly in biological samples, which is quite challenging for existing technologies today. We have successfully utilized this technology for various applications including many forms of cancer, hepatitis C, and Alzheimer's disease, among others. The approach has great potential in ultrasensitive biosensing assays that can be applied in biomedical laboratories for routine analysis. We are also focusing on utilizing the technology to detect and measure genetic mutations for accurate monitoring of disease progressions and treatment effectiveness, leading to personalized medicine and healthcare. In addition to that, we are working to utilize our technology for noninvasive assessment of the best-quality embryos for *in vitro* fertilization.

**This isn't the first technology to detect biomarkers. How would your technology improve diagnostics?**

Most commonly, to detect certain disease-related biomarkers we usually use the conventional enzyme-linked immu-



Dhruvajyoti Roy and his colleagues are developing technology that would help doctors diagnose diseases earlier than what is possible today. (Image courtesy of Dhruvajyoti Roy.)

nosorbent assay (ELISA). However, the sensitivity of ELISA is quite limited, and the persistent challenge in this area is the lack of [highly] sensitive readout technologies. In addition, the level of biomarkers for cancers, infectious diseases, and biochemical processes is present at a very low concentration at early stages, so detecting those particular low-level concentrations is important and essential for early diagnosis of diseases, drug screening, and monitoring therapeutic treatments. The AFM tool is evolving from an imaging instrument to a multi-functional toolbox, and it has great potential as an analyzing tool. In a break from the other diagnostic methods, our approach uses that high-resolution AFM-based force spectroscopy mapping to distinguish between the molecules captured on the surface and quantify them. In this aspect, our highly sensitive detection approach can be useful for analyzing biomarkers from very few cells, or even from a single cell, so it can be of great use to detect very low copy number targets.

To learn more about how Nanocone Enabled Atomic Force Microscopy™ works, how it could be applied to *in vitro* fertilization, and its progress toward commercialization, watch the full interview at <https://www.sigmaxi.org/news/meet-your-fellow-companions/dhruvajyoti-roy>.

Sigma Xi Today is edited by Heather Thorstensen and designed by Spring Davis.