Nov.–Dec. 2014
Volume 23
Number 6

Sigma Xi Today

A NEWSLETTER OF SIGMA XI, THE SCIENTIFIC RESEARCH SOCIETY

From the President

Sigma Xi in Transition

The initial few months of my Sigma Xi presidency have witnessed innumerable, often unexpected, changes in both the organizational structure and leadership of Sigma Xi headquarters. Under my chairmanship, the Executive Committee, representing the Board of Directors, has worked diligently to address these issues, some requiring immediate decisions to stabilize Society operations and others requiring ongoing discussions concerning decisions that can impact the overall mission of Sigma Xi.

In all cases, we have focused on the critical organizational, personnel, financial, and membership challenges now facing Sigma Xi. Our attention has been on efforts to enhance the existing Society programs that have served the scientific research community for decades as well as to ensure the relevance of the Society's mission long into the future.

Among the most prominent decisions are those concerning the publications and public engagements supported by Sigma Xi, both in print and through social media. The potential role for the initiatives and programs pioneered by the Institute on Science for Global Policy (ISGP) are also being reviewed as part of Sigma Xi's current relationship with the ISGP. An example of these ISGP programs will be demonstrated at the Sigma Xi Annual Meeting in Arizona scheduled for November 6–9.

The potentially transformational nature of these changes will require the continuing patience on the part of all Sigma Xi members, but I can assure you that the leadership is hard at work, focused on finding practical and timely ways forward. In the near future, I will prepare a full presentation of these changes for your review, first at the Annual Meeting and then in print and through social media. In the meantime, thank you for your continuing involvement in, and support for, Sigma Xi.

George H. Atkinson

Crystallizing a Career

Dr. Jenny Glusker will accept Sigma Xi's 2014 William Procter Prize for Scientific Achievement on November 7 at the Society's 2014 Annual Meeting in Glendale, Arizona. She is a professor emeritus at Fox Chase Cancer Center in Philadelphia. One of her primary interests is chemicals that cause cancer and how they work. She also investigates enzyme mechanisms involved in growth and how the enzymes control these mechanisms. Glusker has coauthored textbooks on crystallography, a method that is used to determine molecular structures. She has been a Sigma Xi member since 1956.

The following are excerpts from an interview with her about her career.

To hear the full interview, visit http://bit.ly/1q8ENx0

On crystallography:

"You have to grow quite a small crystal … and you shoot an x ray beam at it … When it hits the crystal—the crystal is made up of multiple little building blocks, each the same that contain molecules that you're interested in—so as the x ray is scattered from the molecules in the crystal, you will get an x ray diffraction pattern … and that is what we try to analyze and see if we can find out what molecular structure gives those extra dots on the diffraction pattern."

On research:

"You just have to decide to tackle one area and then when you finish finding out how that works, you can go on to another."

(continued on page 476)

Join Our Community

Sigma Xi's new online community, The Lab: Members to Members, is giving members the opportunity to interact like never before. It is their own space to have discussions about science and engineering as well as job opportunities and other useful topics.

Recent popular discussions included innovative teaching methods and the relationship between science and religion. If you've paid annual dues or if you're a life member of Sigma Xi, you are eligible, and already have access, to join in the conversation at community.sigmaxi.org. We look forward to your participation!

From: A Sigma Xi Member*
Subject: Innovative Teaching

I teach undergraduate mathematics at a small private liberal arts school. As a new faculty member, I see a great program that can be MUCH BETTER if we can create deeper learning experiences than just the classic lecture format. I am looking for ideas for problems that upper level undergraduates could handle that would excite their interest in math and science. I would like to create a problem solving / modeling course that pulls in some of the important mathematical concepts and techniques along with any other discipline. The beauty of our small school is that it would be very feasible to work cooperatively with faculty from any other discipline. My ultimate hope is to help reshape the curriculum to include interactive problem solving at all levels. Any ideas, or anyone with some experience to share?

From: A Sigma Xi Member
Subject: RE: Innovative Teaching

I would suggest that you find real-world problems by consulting with some of the businesses and social agencies in your community to see what problems they would like to have solved. Then have your students meet with the business or agency to develop a thorough understanding of the problem, develop solutions, and present the results back to the clients.

From: A Sigma Xi Member
Subject: RE: Innovative Teaching

A few years ago, the Provost at the university at which I worked polled the past engineering graduates to find out what they learned that was most useful in their professional careers … To his surprise he found that the 'Professional Method' of problem solving was the best preparation for their careers rather than any specific courses … a philosophy in which "students were taught to apply fundamental knowledge to solve practical problems and were required to learn about and appreciate academic disciplines outside their primary area of study."

One popular discussion in The Lab has been about teaching methods.

Watch video tutorials to learn how to get started in the community at www.youtube.com/user/sigmaxisociety

**Names have been removed.*

Crystallizing a Career

(continued from page 475)

On her current research:
"I retired a while ago, but I'm still working in collaboration with people at Los Alamos National Lab and Oak Ridge National Lab who are now working on neutron diffraction. And neutron diffraction is interesting because it can give you different information about atomic arrangements than x ray diffraction gives you … The other thing that I've been doing lately is trying to figure out what various metals do in enzymes and looking at all the hundreds of thousands of crystal structures that have now been done, looking to see how the metal might bind oxygen and nitrogen and sulfur atoms around it … The goal is to characterize what kind of binding a particular metal has because you might say, 'well, this enzyme uses a particular metal but if I change the metal I might get a different result.'… That's also another line that might lead to some new medical discoveries of reactivity of metals in various systems."

Oh, [the change in technology] takes my breath away. I mean, the first electron-density map that I calculated took me six months and I worked day and night.

On the difference in technology between the start of her career and today:
"Oh, it takes my breath away. I mean, the first electron-density map that I calculated took me six months and I worked day and night and I had a whole room to myself with a machine that could only add … Now the whole thing could be done in seconds if not less time than that."

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

YouTube Host Michael Stevens Will Speak at Sigma Xi's Annual Meeting

Michael Stevens describes his educational YouTube channel Vsauce as social ammunition. With videos that answer questions such as "What Is the Earth Worth?" Stevens explains interesting information that viewers can pass on to their friends. At the same time, he is teaching his 7.7 million subscribers about science, history, math, and geography.

For his service to science, Stevens has been named an honorary member of Sigma Xi, The Scientific Research Society, and will speak at the Society's Annual Meeting, which will be held November 6–9 in Glendale, Arizona.

Below are excerpts from a Google Hangout that Sigma Xi hosted with Stevens to discuss what he has learned about communicating science topics.

What do you think scientists can do to help the public's understanding of science?

With the Internet democratizing public outreach, you can do a lot of things. It doesn't just have to mean make a YouTube show and be comfortable on camera. I think that what we see on forums, what we see in the comment sections on pop science articles and also what happens on websites like Reddit, where the public can all come in and a comment system, a sort of public forum, has been built—that's actually quite awesome. By joining those types of communities and lending your expertise, your voice, I think you can add a lot. I'll tell you, the Ask Science subreddit on Reddit.com is full of some really smart people and very reasonable and very inspiring. They're not being paid to do this, but what they are doing is helping answer people's questions and they do it in a very clear and fair way. So I would say get involved. If you have the time, get involved online and find what medium is right for you.

What do you think that you do in your videos that scientists could apply to what they might put in a blog post or a Reddit community as far as the way they get their message across?

Some of the best advice I ever heard about this was from C.G.P. Grey [of YouTube] … He said, "Overestimate their knowledge but underestimate their vocabulary." Don't treat them like they're dumb but they don't always know what words you're throwing out mean. And I see a lot of people communicating science just throwing out "inertia" … and it's good to take a step back and to say "look, is everyone watching really going to know exactly what 'buoyancy' means?" and taking the time to show what buoyancy is to get to your other point is very important.

How do you know when you have all the pieces that you need to get your point across?

I write down the story points, the facts I want to get to. I need to feel like I've got enough of them, and I also need to feel like I know what the title is going to be and that I provide enough answers that people won't be entirely angry that the title was not answered … A lot of it is just what's cool and what do I think people haven't been talking about enough. We've all heard about such-and-such experiment, but what's the next layer that I can add so that the next time people talk about it, people can say, "oh, you know Vsauce actually took that a little further" or "Vsauce took a different perspective on it"?

Watch the full recordings at https://www.youtube.com/user/sigmaxisociety/videos

Cast Your Vote in Sigma Xi's Election

Active and life members of Sigma Xi are eligible to cast their votes in the 2014 Officer Elections. They will receive an email when the polls open with instructions on how to vote online. The voting period opens November 10 and closes December 9, 2014.

For information about candidates, please visit https://www.sigmaxi.org/about/leadership/society-elections. Please participate in choosing these leaders for the Society.

Positions included in this election will be:

President-Elect Designee

Directors: Representing the Baccalaureate Colleges Constituency Group; Canadian/International Constituency Group; Northwest Region; and Southeast Region.

Associate Directors: Representing the Baccalaureate Colleges Constituency Group; Canadian/International Constituency Group; Comprehensive Colleges and Universities Constituency Group; Research and Doctoral Universities Constituency Group; Mid-Atlantic Region; North Central Region; and Southwest Region.

Members of the Committee on Nominations: Representing the Area Groups, Industries, State, and Federal Laboratories Constituency Group; Comprehensive Colleges and Universities Constituency Group; Research and Doctoral Universities Constituency Group; North Central Region; Northeast Region; and Southwest Region.

Meet Your Fellow Companion: Megan E. Wilhelm

Sigma Xi's motto is the Greek "Spoudon Xynones," or "Companions in Zealous Research." With that thought in mind, we like to highlight fellow companions to learn more about their work. Megan E. Wilhelm, who joined Sigma Xi in 2010, is a sociology doctoral student. She is studying educational settings in the hope that her findings can be used to produce more equitable learning environments for all students.

Tell us about your educational background, including your doctoral research.

I graduated from Kenyon College in Gambier, Ohio, in 2010 with a BA in psychology and classics. I taught first grade in New Haven, Connecticut, for two years as a Teach For America corps member, an experience that inspired me to pursue a doctoral degree in social science. During the 2012–2013 academic year, I received a Fulbright Research Grant from the U.S. Department of State and Institute of International Education for the purpose of conducting social psychology research about contact in school environments between different ethnic groups in conflict on the island of Cyprus. I am currently working toward a doctoral degree in sociology with a focus on social psychology and stratification at the University of Maryland—College Park. My long-term research goal is to study stereotypes and bias in different educational settings and, by extension, to determine what can be done to reduce their negative effects.

What is the focus of your current research?

My research focuses on stereotypes, bias, and intergroup contact in schools with an emphasis on the ways that these processes influence educational inequality. As the U.S. student population is becoming increasingly diverse, the teacher population is remaining racially and ethnically homogeneous. My general research question is: How does the lack of teacher diversity in U.S. public schools affect teacher–student interactions? Currently, I am studying how school diversity matters for teachers' views on problems in schools (such as low student achievement or lack of resources) and whether the racial and ethnic composition of the student body influences teacher perceptions of the root causes of these problems.

One broader goal of my research is to cultivate a clearer understanding of what school environments best help students learn and develop. Another goal is to illuminate ways in which policy makers, administrators, and educators can respond to issues of educational inequality through programs and interventions that facilitate productive, positive student–teacher interactions in schools. The results of this research could provide valuable information to strengthen the case for nationwide initiatives to recruit and retain more diverse teachers.

Tell us about something we might see in our daily lives that directly correlates to your work.

My work is focused on interactions between groups that differ in race, ethnicity, socioeconomic status, gender, etc., and the effect of school environments on this intergroup contact. If you follow the current media conversations about education reform in the United States, you will find that issues of academic inequality, school desegregation, and teacher diversity are popular topics, all of which are related to contact between different groups in the U.S. education system.

What are your thoughts on the future of STEM education?

The lack of diversity among those pursuing STEM careers is beginning to capture the attention of many scientists and researchers, and my hope for the future of STEM education is that women and members of underrepresented racial and ethnic groups will be equally able to share in and contribute to the success of STEM fields. I believe that the current inequality can be addressed in part by school curricula that encourage all students to explore STEM opportunities as well as a concerted effort to change the stereotypes that can inhibit women and members of other underrepresented groups from pursuing careers in STEM fields.

What advances do you see in your field of research over the next 100 years?

I see social psychology research having more of an impact on shaping public and social policy. I think that a great deal of the research in my field has the potential to make meaningful contributions toward reducing inequality and improving intergroup relations, both domestically and globally. As we learn more about human interaction, we become better equipped to determine what actionable steps can be taken to create positive and productive intergroup relations.

Read the full interview with Megan E. Wilhelm at www.sigmaxi.org. Go to "News" then "Meet Your Fellow Companions."

Meet Your Fellow Companion: Satish Lakhapatri

Satish Lakhapatri is a chemical engineer in San Francisco, California, investigating ways to get the most value out of natural gas—a domestically produced energy source. He joined Sigma Xi in 2013.

Tell us about your educational background, including your doctoral research.
My interest in both chemistry and engineering began as a high school student, which eventually culminated in my admittance to the bachelor's program at the Institute of Chemical Technology in Mumbai, India. Following my bachelor's degree, I worked in the chemical industry for about a year before moving to the United States for my PhD in chemical engineering. My doctoral research was centered on maximizing the efficiency of a fuel cell system operating on a liquid fuel. In particular, I was researching the mechanism of how a catalyst deactivates, the knowledge of which can then be used in formulating a better catalyst for producing hydrogen used in a fuel cell–powered system.

Some of the key results from my doctoral research, elucidating mechanisms of catalyst deactivation, were published in the journals *Applied Catalysis A: General* and *Catalysis Science and Technology*. I expect this research to benefit others in designing more stable heterogeneous catalysts for application in energy conversion processes.

What is the focus of your current research?
I currently work in a field where my primary focus is in extracting maximum value from one of the most abundant resources in the United States, natural gas, which is predominantly methane. It is estimated that there may be more than a 100-year supply of natural gas in the United States in the form of shale gas. Currently, ethylene, the building block of the chemical industry, is produced in a highly energy-intensive, multistep process starting from ethane or crude oil. A more efficient but not yet commercialized alternative to this method is to convert methane directly into ethylene by a process called oxidative coupling of methane (OCM). In OCM, as the name suggests, two molecules of methane are coupled to make one ethylene molecule. More than 30 years of research in OCM failed to produce a technology that is commercially viable. My research addresses the challenges involved in commercialization of OCM technology and essentially makes the process of making ethylene feasible, both operationally and economically. Ethylene, in turn, can be converted to liquid transportation fuels.

Where do you think your field is heading?
The next big thing in the oil and gas industries is the tremendous growth in extraction techniques for unconventional sources of oil and gas, mainly shale oil and gas. As we transition into shale energy sources, which we already are, breakthroughs in renewable sources of energy including solar, wind, and biomass will be expected to lead us into a more carbon-neutral economy. Between shale and renewable energy sources, I expect energy conversion devices such as fuel cells and batteries to become more efficient and their prices to go down.

Give us an example of how multidisciplinary research directly contributed to your work.
Multidisciplinary research is an essential driver to successfully launch a product from concept to consumer. Today's problems are complex and usually need to be broken down into subdisciplines. In my short research career so far, I have frequently interacted with chemists, biochemists, material scientists, mechanical engineers, and the business development sector.

Has Sigma Xi helped further your career?
I am a newly elected full member of Sigma Xi and have already seen the potential for networking. I believe Sigma Xi is a great place to expand your network of research collaborators, both nationally and internationally. It is also a great place to connect with researchers from outside your field of research, thereby creating opportunities for interdisciplinary research.

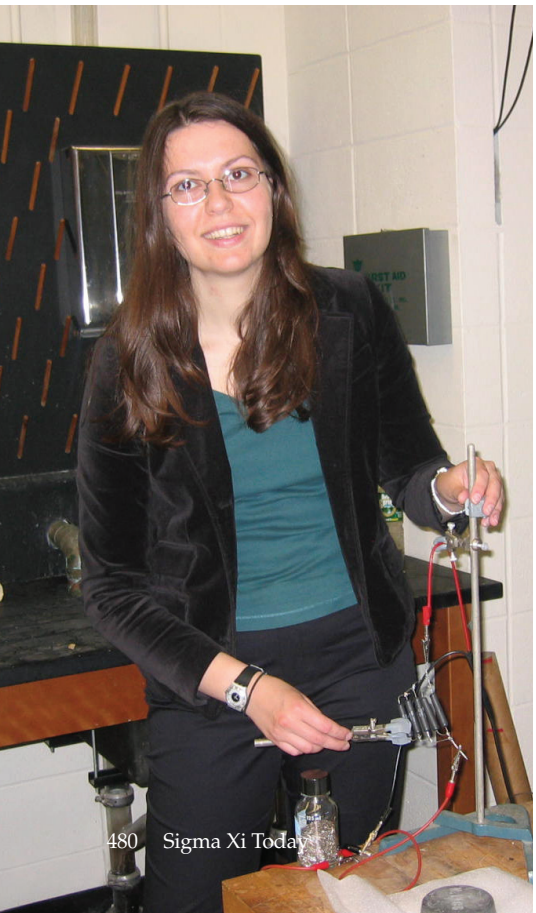
What advice would you give a young researcher just starting out in your field?
If you haven't found what you truly love doing, then keep looking. If you've already found something that you enjoy doing, then don't be afraid to fail.

Read the full interview with Satish Lakhapatri at www.sigmaxi.org. Go to "News" then "Meet Your Fellow Companions."

Meet Your Fellow Companion: Šeila Selimović

Šeila Selimović, elected to Sigma Xi in 2004, has used microfluidics technology to investigate tissue regeneration and particle organization. She hopes gaining a better understanding of macromolecules and cells can lead to improved medical diagnostics and treatments.

Tell us about your educational background.
I received my PhD in condensed matter physics from Brandeis University in Waltham, Massachusetts. I decided to explore soft matter in graduate school and was assigned to a project involving microfluidics. For my dissertation research, I studied the phase behavior of proteins and polymers using microfluidics. Microfluidic technologies are a highly interdisciplinary field, combining physics, chemistry, biology, and various engineering disciplines. These microscale technologies are used to control minuscule amounts of fluids and suspensions inside a miniaturized system. Microfluidic devices are often compared to computer chips, but with liquids and particles being pushed around instead of electrons.



What research have you done since then?
The interdisciplinary nature of my PhD thesis led me to a postdoc position in biological engineering at Harvard Medical School, where I focused on organ-on-a-chip projects: I developed long-term viable mammalian tissues (liver and cardiac tissues) inside microfluidic devices containing biochemical sensors and tried to understand their functional response to drugs and toxicants. I am also interested in the biological response of stem cells to chemical gradients and have developed high-throughput microfluidic platforms that facilitate these studies.

However, for the moment I am working on science diplomacy and policy issues at the U.S. Department of State as a AAAS Science & Technology Policy Fellow and, hence, conducting a different type of research.

Tell us about something we might see in our daily lives that directly correlates to your work.
My goal is to gain results that could potentially contribute to the development of new or improved medical diagnostics and treatment approaches. For example, studying the behavior of functional tissues *in vitro* could help us design more effective drugs and vaccines that have fewer side effects, even before the stage of animal testing and clinical studies. The topic of my PhD work—protein crystallization—is relevant for a similar reason: Understanding the behavior of various proteins in our body is essential to understanding disease development. For example, eye cataracts can develop when proteins in the eye lens go from a single-phase state to a liquid-liquid state—for example, due to misfolding. Hence, our experiments are designed to test the response of proteins to elevated temperature and other physiological changes. This knowledge will hopefully aid in the development of cataract treatments.

What are your thoughts on the future of STEM education?
Having attended schools in several countries—Bosnia and Herzegovina, Austria, Germany, and the United States—I think that the current STEM education, or at least science education before college, could be greatly improved without large financial investments. While having access to the most modern equipment in lab classes is a great benefit for students, I think that being exposed to science as much as possible in our daily lives is as important, if not more. This can easily be accomplished by teachers relating the class material to everyday objects and events, rather than simply sticking to textbook-based rote learning, especially in early education. For example, the science and engineering behind much of today's technology are fascinating to me, yet most cell phone or tablet users do not seem to be aware of, or interested in, what makes these devices work.

What has the honor of induction into Sigma Xi meant to you?
The induction into, and association with, Sigma Xi generates a feeling of pride in me. I consider this a comment on my accomplishments and encouragement to continue contributing to our collective knowledge of science. It also means following an ethical code of conduct in research, and responsibility to our society and future generations.

What advances do you see in your field of research over the next 100 years?
I envision biological engineering making great strides in enabling personalized medicine, from affordable point-of-care diagnostics and treatment to perfecting a drug for the needs of each individual patient. Further, I hope that the research in tissue engineering will lead to *in vitro* development of cell-based, implantable vital organs (for example, kidney or lung). In the context of soft matter physics, I believe that some general principles behind the statics and dynamics of biological matter (for example, cell interaction, formation of biological networks) will be uncovered.

Read the full interview with Šeila Selimović at www.sigmaxi.org. Go to "News" then "Meet Your Fellow Companions."