Signals

U of M students and staff share the excitement of STEM subjects with middle and high school students



In collaboration with the University of Minnesota Building Resources and Innovative Design for Global Energy (BRIDGE) Project, Winnie Lindstrom, Department of American Indian Studies' community outreach coordinator, travels once a month with the BRIDGE student team to the White Earth Reservation - Circle of Life School. Thanks to the financial support from the Center for Compact and Efficient Fluid Power, the BRIDGE team was able to introduce science and engineering concepts and projects to Circle of Life high school students.

"For me the importance of this collaboration is bringing the presence of higher education to the Circle of Life students and letting them know that college is an option for them," says Lindstrom, who grew up on the White Earth reservation. "I want to bring the message that attending college is attainable for them. The BRIDGE program helps kindle that interest by introducing scientific discovery experiences. In a couple of years, I hope we will see Circle of Life students attending the University."

Lindstrom, who graduated from the University of Minnesota-Morris in May, 2013, joined the University of Minnesota-Twin Cities as an employee last August. "I had heard of the BRIDGE project from American Indian Science and Engineering Society (AISES) members after I began working on the Twin Cities campus. I called Prof. Paul Imbertson, BRIDGE's faculty advisor, and he told me about BRIDGE's goals. He also mentioned that the group had been somewhat inactive during the past year. He was delighted to have someone who could rekindle the interest."

The team of four BRIDGE students (and sometimes as many as eight) began driving 220 miles north with Lindstrom, spending a half day working with the students, and then driving back to the Twin Cities. The BRIDGE team would explain the science behind each project, set up the experiment, and let the high school students explore. This year's projects included making Silly Putty, crystals, ice cream, and participating in an Egg Drop contest.



In addition, the ninth grade class learned about wind turbines and constructed anemometers. All the high school students made small battery engines and simple robots.

"It's been a great experience for both groups," Lindstrom says.

"The U students said that they enjoy teaching the young students and that it helps them review what they have learned from their University classes. The Circle of Life Students look forward to the visits and when the U students enter the school the questions begin with "What are we going to be doing today?"

For many of the Circle of Life students, science has become their favorite subject. During project time, University students help when necessary but allow the high school students to work through project problem solving.



One of the University on-campus student groups-National Society of Black Engineers (NSBE)-was created to provide tutoring services, resources for professional and academic development, and encouragement to youth to consider careers in science and engineering fields. NSBE's members have been busy this past year introducing local high school students to share the possibilities of a science career.

Abenet Shibeshi, a senior majoring in Electrical Engineering who

will graduate in August 2014, is a member of NSBE and the leader in a seven-member group that conducted a STEM Alliance outreach project with Washburn Public High School students in Minneapolis, Minn.

Teaching is not a new experience for Shibeshi, who taught math to eighth-grade students in his home country of Ethiopia. "This opportunity to teach students about electricity through handson projects has shown me how to encourage the



Abenet Shibeshi

students to try new things. It is my way of paying it forward. When I arrived at the U of M, I was assigned a mentor who encouraged me; now, I can encourage others."

The NSBE volunteers worked with Washburn instructor Angela Osuji (right, in white jacket) by preparing a topic that fit her lesson plan for the unit titled "How to Make a Homemade Generator and a Motor." Working with Osuji, Shibeshi and

continued on page 2



his NSBE team were able to introduce 90 students to the process of building a generator that could light an LED bulb.

The first week, Shibeshi brought supplies for students to construct a simple 30-second motor. Each student was asked to build a motor using a magnet, screw, AA battery, and wire. Then, the high school students worked in teams experimenting with magnets and how to make the motor spin faster.

"Some of the students asked me what I was paid to do this project," Shibeshi says. "I told them I did it for free. They couldn't believe it, but they paid more attention after that conversation."

The second week Shibeshi bought additional small motors as well as U of M notebooks. Osuji asked her students to document their experiment observations in their new notebooks as this would be part of their grade for the unit. During the second class, the student teams investigated the similarity between the pre-made motor and the simple 30-second motor they made. They also learned that by adding additional batteries and magnets, the motor would spin faster.

"The high school students were enthusiastic during the classes,"



says Shibeshi. "They would take photos and short videos about what they were learning and what they had accomplished to send to their friends and families."

Once the student groups had a grasp of how small motors were built and worked, the NSBE mentors and Ms. Osuji challenged each class to build their own homemade generators from scratch. Each class was

Washburn High School students record their experiment observations in notebooks and send friends photos of what they work on.

shown a generator design that required wind power but the student teams were told that they would have to power their generators by spinning it with their hand. Each of the motors had to light an LED bulb.

For the next few Fridays, the NSBE team members would take turns observing and helping the student teams to build the generators. Shibeshi made sure he was in every class to answer questions and to guide the work of his fellow NSBE members and the high school students' project work. Each Thursday evening, Shibeshi would lead a prep session with the NSBE members to discuss what key points they would impart the next day to the groups.

On the last day, the high school students' generator designs were displayed. NSBE members voted for the best designs. Osuji agreed to give bonus points to the teams who won the competition.

Shibeshi is creating a document that contains a shopping list of supplies, a methodology, and teaching tips for this unit in the future. He will pass this document on for use by future NSBE members. "When I graduate, I'd like to continue my volunteering in the public school once I get a job," he says.

CEMS student **Hardisha White** (right) joined NSBE as a freshman in 2010. Since that time she has held a variety of leadership roles in the group, and now is finishing out her senior year as president of the organization.

"Currently we have 40 members in our group with up to 40 more in attendance at some of our events," she says. "Of our active members nearly 20 are involved in STEM Alliance outreach activities.



Hardisha White

In addition to the volunteer work at the Washburn Public High School, NSBE also will do another outreach project at **Wellstone Elementary School** in St. Paul, Minn., in collaboration with Innovative Engineers and University Mad Scientists student groups.

The program "Think like an Engineer" allows NSBE volunteers to work with fifth grade students to increase the students' observation of a problem, to develop ways to solve the problem, to interact as a team, and to evaluate the problem-solving process.



A Wellstone Elementary student tests the height and speed of golf balls for this experiment. "Using PVC plumbing pipe and golf balls, we invited students to see what they could do to get the ball to roll the highest or the farthest," White says. The NSBE volunteers then discussed with the students how they achieved the goal, how they made decisions as a team, and what aspects of their interactions were most effective and efficient as a group.

For the second part of the session, the fifth grade class was divided into two groups to conduct a "Rube Goldberg" type of experiment using the PVC pipe pieces and the golf balls in a more complicated activity. This

experiment tested multiple goals of working together.

"We also collaborated with the Society of Asian Scientists and Engineers in a trip to **Bruce Vento Elementary School** to work with fourth grade students on the "Think Like an Engineer" project," White says.

"From these outreach projects, I've learned the importance of getting students interested in STEM fields at an early age and showing them that it is definitely a career path they could consider," White says. "It also has helped my personal skills in thinking like an engineer. All of the questions we ask the students, we first need to ask ourselves and make sure we fully comprehend the concepts as well. It has helped me learn about topics in different areas that aren't directly associated with my specific major.

One of the benefits to NSBE members is the chance to attend the National NSBE Conference. This year's conference was held in Nashville, Tenn., and 40 students from throughout Minnesota colleges and universities attended. The conference offers an opportunity for NSABE members to network with professional engineers, to attend academic and personal development workshops, and to interview with corporations for future jobs.

Faculty news



Prof. Beth Stadler was invited to speak at the International Magnetics Conference 2014 in Dresden, Germany on "Magnetic Sensor Arrays for One-Pass Two-Dimensional Magnetic Recording." INTERMAG is the premier conference on all aspects of applied magnetism, reviewing the latest developments in magnetism ranging including fundamental magnetism, advances in magnetic recording, and the emerging applications of magnetism to energy and power technologies and biomagnetism fields. Stadler's technology demonstrates

Prof. Stadler at CERN

the world's smallest giant magnetoresistive sensors, synthesized as nanowires with 10nm diameters. These sensors also can be made in arrays with only 20nm sensor-sensor spacing for adjacent track sensing to increase signal-to-noise ratios in magnetic hard drives. On the way back to Minnesota, Stadler stopped in Switzerland to visit the CERN particle accelerator (above left). Her research group also is synthesizing optical modulators that may be included in the next round of sub-atomic collisions to begin in 2015. Her collaborators are ECE Prof. Anand Gopinath and Physics Prof. Roger Rusack.

In addition, **Prof. Stadler** (below left), Prof. Jamie Modian (Veterinary Clinical Science, below center) and Prof. Allison Hubel (Mechanical Engineering, below right) have been awarded a MnDRIVE grant for their project "Probing Internal Cancer Cell Mechanics via Magnetic Nanobots."





Charles Babbage Institute (CBI) under the direction of **Prof. Tom Misa** has received two grants. The first award is from Alfred P. Sloan Foundation to support "Tripling Women's Participation in Computing (1965-1985)." This 18-month research effort will examine and help document a critical but little studied period in computing, the years when women flooded into the computing professions.

Prof. Tom Misa

In the mid-1960s women collected about 12 percent of computer science bachelor's degrees

in the U.S., while at the peak in the mid-1980s women collected 37 percent of computer science bachelor's degrees. Since then, women's participation rate in computing has dramatically fallen off, and women's share of computer science bachelor's degrees is hovering around 15 percent. Women's participation in the workforce roughly parallels these educational figures.

The second award is for a multi-year research collaboration between CBI and the high-performance computing division of Los Alamos National Laboratories (LANL). The celebration of the seventieth anniversary of Los Alamos in 2013 prompted the highperformance computing division to inquire more deeply into its storied history. CBI plans to make a thorough survey of archival materials at LANL, to conduct a set of oral history interviews, and to develop a research plan to document the history of HPC at LANL.

Begun in March, this project welcomed **Nicholas Lewis** (right), a second-year Ph.D. student in the HSTM program, who has been compiling publicly accessible materials on the history of high-performance computing (HPC) at Los Alamos. He will be supported by LANL during the academic year, taking classes and working at the University of Minnesota, with an internship this summer at Los Alamos.



Nicholas Lewis



ECE Prof. Jian-Ping Wang, current Institute on the Environment Fellow, and his research students and a collaborator have developed a way to detect pathogens and heavy metals in liquids.

In an article published in the *Journal of Analytical Chemistry*—"Magnetic Detection of Mercuric Ion Using Giant Magnetoresistance-Based Bionsensing

Prof. Jian-Ping Wang

System" by Wei Wang, Yi Wang, Liang Tu, Todd Klein, Yinglong Feng, Qin Li, and Jian-Ping Wang—Wang and his team reported on their research that blends spintronics and nanomagnetics to detect pathogens and heavy metals that are often difficult to detect due their size or the dilution of the samples.

The team demonstrated the sensing strategy that uses a giant magnetoresistive (GMR) biosensor, magnetic nanoparticles and DNA chemistry for the detection of the mercuric ion. This GMR biosensing method could become a contender in the areas of environmental monitoring and food safety testing.

Mercury contamination has been a key environmental and health concern for several decades. Because the mercury ion is stable and soluble, it is known to cause damage to the nervous system and kidneys. methyl mercury can accumulate in the body and cause brain damage and chronic diseases, sometimes even paralysis and death.

According to a recent article in the *Star Tribune* (03/12/2014): "Minnesota's mercury concerns bring new test for newborns," in Minnesota, ten percent of tested newborns had mercury concentrations above the reference dose.

Current methods of mercury detection are costly and not portable, requiring specialized labs in which to test for the chemical. Wang's GMR biosensing method is low cost and enables real-time signal read outs.

"Most important to note is that the GMR biosensor is immune to background interference from environmental water samples," says Wang. "In addition, because of its compatibility with Systems on a Chip technology, it has great potential for portability as well to allow family-based usage in near future."

Currently, the system monitors up to 64 sensors on 16 mm x 16 mm chip in real-time and records 64 data points each minute. Results are ready in 5-30 minutes.

For the complete article, go to http://pubs.acs.org/doi/ipdf/10.1021/ac404015j

Faculty Awards

ECE faculty and staff awarded top U of M Faculty Teaching and Advising Honors



Prof. Ned Mohan was awarded the University of Minnesota Graduate and Professional Teaching Award by the Senate Committee on Education Policy (SCEP).



Prof. Paul Imbertson received the Horace T. Morse University of Minnesota Alumni Association Award for Outstanding Contributions to Undergraduate Education.



Kyle Dukart, Department of Electrical and Computer Engineering Department Administrator and former Undergraduate Academic Advisor, has been awarded the University of Minnesota John Tate Award for Excellence in Undergraduate Advising.

Prof. Randall Victora receives IEEE Magnetics Society Achievement Award



Prof. Randall Victora received the IEEE Magnetics Society Achievement Award on May 6 at the INTERMAG Conference in Dresden, Germany. The honor is awarded to Victora for his contributions to the theory and simulation of magnetic materials, particularly magnetic recording media.

Prof. Rhonda Franklin named to NSF Committee of Visitors to judge merit of proposals



Prof. Rhonda Franklin has been named to serve on the Committee of Visitors for the Division of Electrical, Communications and Cyber Systems for the Directorate for Engineering of the National Science Foundation. The committee provides NSF with their judgments on the quality and integrity of the merit review process, program operations and

program-level technical and managerial matters pertaining to proposal decisions.

Prof. Ned Mohan receives IEEE PES Nari Hingorani FACTS Award



Prof. Ned Mohan has been awarded the IEEE Power and Energy Society (PES) Nari Hingorani Flexible AC Transmission Systems (FACTS) Award. The award recognizes individuals who have made a major contribution to the state of the art of FACTS (Flexible AC Transmission System) technology and its applications. The IEEE defini-

tion of FACTS is: Alternating Current Transmission Systems incorporating power electronics-based and other static control-

lers to enhance controllability and power transfer capability. By this definition, the FACTS concept, in addition to the hardware, software and applications work carried out since its introduction, incorporates considerable prior work done on Static Var Compensators and other static Controllers.

The IEEE Power & Energy Society sponsors twenty-eight society-level awards. The IEEE PES and PES Governing Board will recognize Mohan at the Awards Dinner on July 29 at the IEEE PES General Meeting in National Harbor, MD (Washington, DC Metro Area).

Prof. Sachin Saptnekar receives 2013 Semiconductor Industry Association University Research Award



Prof. Sachin Sapatnekar received the Semiconductor Industry Association (SIA) University Research Award for his "trailblazing work in the field of semiconductor research." This award, created in 1995, recognizes lifetime achievements. The Semiconductor Research Corporation members select the recipient.



Profs. Oh and Wittenberg receive grant from MnDRIVE Initiative

Sang-Hyun Oh (PI, Associate Professor) (upper left) and **Nathan J. Wittenberg** (co-PI, Research Assistant Professor) (lower left) have been awarded an Exploratory Grant as part of the MnDRIVE Initiative in Robotics, Sensors and Advanced Manufacturing (RSAM). Their proposal is titled "Integrating Surface Plasmon Resonance with Nano-Topographic Control of Lipid Raft Formation."



Physics and Nano Building Open House held Apr. 24

The staff of the University of Minnesota Physics and Nano building offered tours for the public during the open house on Thursday, Apr. 24. The building serves the U's School of Physics and Astronomy and the Minnesota Nano Center.

Student Awards

Ph.D. student Ashish Kumar Sahoo receives Best Paper presentation award at IEEE APEC



Ph.D. student Ashish Kumar Sahoo, has received the 2014 Best Paper presentation award at IEEE Applied Power Electronics Conference (APEC) in Fort Worth, Texas, for "LCL Filter Design for Grid-Connected Inverters by Analytical Estimation of PWM Ripple Voltage." (Prof. Ned Mohan, advisor)

John Tranter (BS'14) places third for Best Paper award at IEEE ICASSP



ECE undergraduate student John Tranter was selected as a 2014 IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP) Best Paper finalist (a rare distinction for undergrads) and then placed third at the conference for "Blind Spectra Separation and Direction Finding for Cognitive Radio Using

Temporal Correlation-domain ESPRIT." The paper's authors include Tranter, visiting student Xiao Fu of China University-Hong Kong, and Profs. Ken Ma and Nikos Sidiropoulos (Tranter's advisor.) Tranter also is an affiliate faculty in the U of M Department of Music.

Two ECE students honored at IEEE Twin Cities Awards Banquet



Jeff Adolf (upper left) won first place in the IEEE Twin Cities Section Student Paper Contest for his "Path Planning of a Rotary Crane for Time Optimal Load Transfer." He also placed second in the IEEE Project Showcase Contest. Adolf is a student member of IEEE Student Branch at the University and a senior with double majors in Electrical and Computer Engineering.



Essam Elnashar (lower left) won the Outstanding Student Award for his efforts in the successful 2013 IEEE Region 4 Student Leadership Conference. Elnashar was the 2013-2014 President for the IEEE Student Branch at the University of Minnesota and is a senior majoring in Electrical Engineering.

Ph.D. student Daniel Klemme receives NSF Graduate Fellowship



First-year ECE Ph.D. student, Daniel Klemme, has been awarded the National Science Foundation (NSF) Graduate Fellowship, which is one of the most prestigious national awards for graduate students. (Prof. Sang-Hyun Oh, advisor)

Eight ECE Graduate students are recipients of the 2014-2015 Doctoral Dissertation Fellowship Award

The Doctoral Dissertation Fellowship (DDF) program gives the University's most accomplished PhD candidates an opportunity to devote full-time efforts to an outstanding research project by providing time to finalize and to write a dissertation during the fellowship year. The award includes a stipend of \$22,500 for the academic year beginning September 2014 through May 2015, tuition for up to 14 thesis credits each semester (fall and spring), and subsidized health insurance through the Graduate Assistant Health Plan. Summer 2015 health insurance will be included for those who remain eligible.

This year's recipients from the Department of Electrical and Computer Engineering are:

Xiaoshu Chen Bongjin Kim Yingjie Lao Morteza Mardani Kyle Olson Eric Severson Ruoyu Sun Bo Yuan Advisor: Sang-Hyun Oh Advisor: Chris Kim Advisor: Keshab Parhi Advisor: Georgious Giannakis Advisor: Joey Talghader Advisor: Ned Mohan Advisor: Zhi-Quan Luo Advisor: Keshab Parhi



(I to r) WIE Officers Stephanie Wilson (membership, junior), Sera Shane (treasurer, senior), Melissa Neumann (president, senior) and Kellie Ryan (secretary, senior). Not present: Sandra Arnold (vice president, senior).

IEEE Women in Engineering chapter celebrates first year

Graduating seniors Melissa Neumann, Sandra Arnold, Kellie Ryan, December 2014 graduating senior Sera Shane, and junior Stephanie Wilson celebrated the first year of the IEEE Women in Engineering (WIE) chapter established during the 2013-2014 academic year. With goals of project learning, connecting with industry, supporting other women engineers on campus, and helping each other connect with women engineers in the community, WIE made progress in all their goals.

Among their completed projects the first year were participating in the CSE Expo where nearly 2,000 middle school students attended; hosting a presentation by engineer Pamela Dougherty of NetApp, and meeting with Carlson School's women students. Newly elected WIE officers will be recruiting heavily for new members during welcome week in September.

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- More timely delivery of ECE information to you
- A cost savings in printing and postage charges Currently one issue of Signals costs \$7-7.5K for postage, labor, and printing. We will dedicate this savings to student labs.
- Green operations less paper and ink waste

Please send your name, current street address, and current email to UMNECE ENewsletter@umn.edu

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