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Minnesota Academy of Science Newsletter

MINNESOTA ACADEMY OF SCIENCE

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Input Wanted for Science Salon

By Celia Waldock, Executive Director

Since launching our new Science Salon, we've conducted two well-attended, cross-disciplinary networking events, the first at historic Pracna-on-Main with speaker Dr. Philip Pardey and the second a tour of the Century College Fabrication Laboratory (Fab Lab). On these two events, MAS has partnered with the American Association for the Advancement of Science (AAAS) to offer fun and interesting activities, good speakers, tasty food and drink and an opportunity to join both organizations' membership at a significantly discounted rate.

Coming up in 2014, we will be planning several more activities. And we'd like your input. Is food and drink important to you? Do you like the variety – speakers, tours, movies, etc.? What is a reasonable fee to offset our costs? $25, $35, $45? Would you attend a day-long event with Nobel Prize winning speakers or nationally recognized speakers? What speakers or subjects would you like to hear? Are you interested in a scientist networking event with other topics or tours such as art, history, current affairs?

We will be conducting a survey in early January to help us with our planning. When you get the Science Salon Survey Monkey please take a few minutes to tell us what you think.

We would love to hear from you. See you at Science Salon!

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Save the Date: Minnesota Technical Symposium

The 12th Annual Minnesota Technical Symposium (MinnTS) will be held March 27, 2014 at Medtronic Headquarters. MinnTS is an annual meeting of scientific and technical societies in Minnesota. Because the Minnesota Academy of Science is one of the sponsors for the event, MAS members receive discounted registration. At MinnTS, participants attend lectures on emerging topics and network with other professional scientists.

The featured speaker at the 2014 MinnTS will be Dr. Alex Khoruts from the Department of Medicine at the University of Minnesota. Dr. Khoruts researches gastrointestinal immune disorders and will be lecturing on his research on fecal transplant and its emerging applications.

Visit www.mnmas.org for details and registration information.

Novel Wind Turbine Technologies Presented at 2013 Minnesota Technical Symposium

By Eliza Grames, Communications Specialist and Annual Meeting Coordinator

"It's a different way to make a motor," explained Matt Jore, developer of CORE Technology at the 2013 Minnesota Technical Symposium (MinnTS). The technology that Jore and his company developed allows motors to perform at a higher level while reducing their weight and number of moving parts.

CORE technology works by decreasing the distance between magnets, which increases the flux and therefore the torque in the motor. "Not only does the flux increase cause the torque increase, it causes more efficient power generation in the generator," said Jore. By manufacturing the technology in printed circuit board labs, Jore and his company have optimized conductor potential. "We use the printed circuit board processes to layer multiple layers of copper," he said.

Jore's technology has been applied to wind turbines whose gearboxes typically fail every four years. With his technology and emerging magnet technology, Jore is hopeful that a sustainable wind energy future is within reach.

Matt Jore explains CORE Technology *Photo by Eliza Grames*

Developing High-Performance Magnets from Abundant Elements

By Eliza Grames, Communications Specialist and Annual Meeting Coordinator

"If you look at all these materials, their saturation potential was already fixed," explained Dr. Wang in his lecture on emerging magnetic research at the 2013 Minnesota Technical Symposium. "Today's story is something tremendous that breaks through that."

Magnets have fascinated scientists and inventors for centuries because of their seemingly magical abilities and for their practical applications in medicine, solar technology, transportation, and national defense. Academic researchers tend to avoid magnets, because they are not treated as high technology and are not attractive as a research subject.

Dr. Jian-Ping Wang from the University of Minnesota, is one of the few academic researchers in the world who believes in the power and importance of ongoing research on magnets. In April, he spoke to an audience of scientists, researchers, and innovators at the 2013 Minnesota Technical Symposium (MinnTS), hosted at the Medtronic Headquarters in Fridley.

"Ten years ago, we picked up work on a controversial material (a specific iron nitrogen compound), for which quantum theory couldn't explain its behaviors, based on my personal curiosity and physics instinct," said Dr. Wang. "Years later, my students and I have proposed a new theory,

Dr. Jianping Wang presents his research at MinnTS *Photo by Eliza Grames*

provided convincing physics evidence in electron level and successfully synthesized this material repeatedly." Dr. Wang's research group focuses on developing iron-nitrogen permanent magnet technologies

"IT'S JUST IRON AND NITROGEN. THOSE ARE TWO OF THE MOST ABUNDANT ELEMENTS IN THE WORLD; IRON AND NITROGEN ARE EVERYWHERE."

and high-performance magnets composed of non-rare earth metals.

Magnets are considered to be high-performance if they have a high magnetic energy product, which is proportional to the saturation magnetization and high coercivity. The magnetic energy product of a magnet describes the maximum capacity of its magnetic field to store magnetic energy. Depending on the material composition of a magnet, it will have a different magnetic energy product.

For decades, magnetic energy product increased steadily as new materials were used to produce magnets, however this slowed after the year 2000 and researchers believed they had reached the peak of magnet performance. "The latest magnet product is NdFeB with rare-earth-element Nd and other rare earth doping elements. Till 2010, all kinds of magnets we use are not expensive and their magnetic energy product is reasonably high," said Dr. Wang. Then a crisis in the rare-earth supply chain forced researchers to consider alternative means of producing magnets. "More importantly, rare-earth magnets are environmentally unfriendly.

Producing those magnets causes a large damage to the environment in China. The US has stopped this product many years ago," explained Dr. Wang.

Dr. Wang was a student when he picked up the topic of iron nitride. "At the time, the topic had already been dropped by the majority of researchers in the world," he said. In his research, he came across an experiment that proved saturation magnetization could jump out of the traditional series to unheard of levels. After years of research on the topic, he developed a high performance magnet composed of entirely non-rare earth elements with a high magnetic energy product.

"If you look at the material compositions, we don't have rare-earth elements. We don't have materials like cobalt," said Dr. Wang. "It's just iron and nitrogen. Those are two of the most abundant elements in the world; iron and nitrogen are everywhere."

Dr. Wang and his students have filed seven patents on this technology and a university startup on this technology has been planned. As a result of Dr. Wang's research, high-performance magnets can be mass produced in the US in the near future from non-rare earth elements. Most importantly, according to Dr. Wang, is that his findings not only show how to make new materials, but show people new directions to research materials in other fields.

Dr. Jian-Ping Wang is a Distinguished McKnight Professor in the Department of Electrical and Computer Engineering at the University of Minnesota. He is the Director of the Center for Spintronic Materials, Interfaces, and New Architectures and the Associate Director for the Center for Micromagnetics and Information Technologies.

Science Salon Featuring Dr. Philip Pardey

By Barbara Donoho

The first Science Salon, sponsored by the Minnesota Academy of Science (MAS) in partnership with the American Association for the Advancement of Science (AAAS), was held August 22, 2013 at Pracna on Main in Minneapolis. The featured speaker for the event was Dr. Philip Pardey, Director of the University of Minnesota's International Science and Technology Practice and Policy Center and a professor in the Department of Applied Economics. Dr. Pardey's presentation topic for the evening was "Wheat Stem Rust: Right Sizing Research Investments to Deal with a Disease of Global Food Security Consequence."

Dr. Pardey answers further questions
Photo by Dave Newell

Many of the guests commented that they liked having the event at Pracna. Housed in a historic building in the St. Anthony Main River District, Pracna on Main is the oldest restaurant on the oldest street in Minneapolis. The event was complimentary for guests and registrants received free parking vouchers for the St. Anthony Parking Ramp. The event took place in the back two adjoining historic dining rooms of Pracna on Main. In the front room guests could mingle and network while having dessert, cheeses and beverages. The guests attended Dr. Pardey's presentation in the back room.

The first Science Salon event was a great networking activity, providing an interesting and engaging evening for guests. As a new program, Science Salon is being more clearly defined as participants express what venues they want to attend and what types of activities they would like to participate in.

Barbara Donoho is the Science Salon Program Coordinator and Program Manager for the Middle School and High School Science Bowls.

Board Perspective: The First Science Salon was a Successful and Exciting Event

By Karen Newell

The first Science Salon opened with a social that was characterized by lively networking and visiting for the guests and hosts from the Academy's Board of Directors. Business cards were flying among the attendees as snacks and beverages were served. Event host and Academy Vice President Dr. Ned Tabat began the proceedings with a lively Quiz Bowl-type activity, soliciting responses to complex questions regarding food production and Minnesota's role in this industry—with great humor and laughter in the audience. He introduced Dr. Pardey, who gave an engaging presentation regarding the connection between research and economics with the areas of food production.

Because of Dr. Pardey's experiences with food production and the economic impact of disease on crops in Africa, he had unique perspective to share with the audience. In addition to his work at the University of Minnesota, Dr. Pardey currently co-directs a Gates Foundation project, HarvestChoice (www.HarvestChoice.org), designed to inform and guide investments intended to stimulate productivity growth in African agriculture. Attendees were captivated by his description of the Wheat Stem Rust issues that have a major impact of the world food supply. Impressive data showed the huge cost of disease and the lengthy process for eradication and control of wheat germ rust in the world's food-producing countries, and Africa in particular. Originally scheduled for a short presentation and a Q/A session, the depth of Pardey's presentation led to a dialogue throughout an hour.

Board Member Stephanie Yancey (right) and guests *Photo by Dave Newell*

The Academy's Board termed the first Science Salon an exciting evening and successful collaboration with the local section of the American Association for the Advancement of Science (AAAS). We look forward to the next Science Salon event.

Future Science Salon events will be announced on our website at www.mnmas.org/science-salon

Karen Newell is the Secretary of the Board of Directors of the Minnesota Academy of Science and Program Manager of the High School STEM Communicator Awards. She is also the Fermi Math Coordinator for Intermediate District 287.

Karen Newell at Science Salon
Photo by Dave Newell

Wheat Stem Rust Lecture by Dr. Philip Pardey at Science Salon

By Eliza Grames, Communications Specialist and Annual Meeting Coordinator

The co-evolutionary arms race between crops and pests is never won. Pests and fungal diseases take a severe toll on world crop yields, particularly for staple grains like wheat and rice. Because of this co-evolutionary arms race, between 40 and 70% of research and development investments in agriculture are simply to sustain crop yields, not increase yields.

One of the largest concerns for wheat is stem rust, a fungal disease caused by *Puccinia graminis*. Stem rust threatens global food supply of wheat; it persists in the United States, India, China, Australia, and throughout Sub-Saharan Africa. Worldwide, 66% percent of land where wheat is grown is susceptible to stem rust, although the disease only persists on 11% of wheat area. Scientists have determined that stem rust would be an even more threatening disease if resistant cultivars were not grown alongside susceptible cultivars. More research is needed to fully understand stem rust and sustain wheat crop yields.

To maintain crop yields for wheat in the face of stem rust, Dr. Pardey estimates that a sustained yearly investment of $51.1 million in research and development is needed. Currently, less than half that amount is being invested.

To read more about research and development investments in agriculture and wheat stem rust, please read Dr. Pardey's article published in *Science* and found online at www.sciencemag.org.

Dr. Pardey concluded his lecture on wheat stem rust by answering questions from guests *Photo by Dave Newell*

MAS Welcomes New Board Members

By Michael Williams, Board President

We are pleased to welcome three new and one returning member to the Board of Directors. As President of the Academy, I am excited about the enthusiasm and experience our new members bring to the Board and the vision they have to expand our program offerings.

Michael Kautzky has been a volunteer with MAS judging at the Minnesota State Science & Engineering Fair for 13 years. Dr. Kautzky is the Managing Technologist of Advanced Materials and Process Group in Advanced Transducer Development at Seagate Technology. His research and development interests include: novel thin film materials development for recording heads, wafer-level recording head integration, heat-assisted magnetic recording materials reliability, thin film deposition hardware and equipment development, and novel thin film characterization techniques.

"I have enjoyed seeing the energy and innovative spirit of Minnesota's young scientists and engineers in the annual MAS science fair over the years," said Dr. Kautzky, "As a proponent of STEM education and of the need to continue cultivating national-level technical talent in Minnesota, I wanted to offer my services and industrial perspective to MAS to help them continue the growth of their already-strong roster of programs. I am very much looking forward to serving on the board for these next years."

Dr. Kautzky holds a Ph.D. in Materials Science and Engineering and an M.S. in Materials Science and Engineering from Stanford University, and a B.S. in Materials Science and Engineering from the University of Notre Dame.

William Heidcamp returned to the Board of Directors in 2013 after a five-year absence due to work in the United Arab Emirates. He will take on the role of Treasurer. Dr. Heidcamp sat on the Board of Directors from 2002-2008, serving as the Treasurer from 2003-2004 and as President from 2005-2006. He brings a wealth of experience to the Board and emphasized his ongoing commitment to the mission of MAS. "I wholly endorse the goal of MAS," said Dr. Heidcamp, "and am ready and willing to add my expertise and energy to that goal."

Dr. Heidcamp is an Emeritus Professor in the Department of Biology at Gustavus Adolphus College where he was the Department Chair for over 20 years. Formerly, he served as the Dean of the College of Arts and Sciences at the American University of Sharjah in the United Arab Emirates. Dr. Heidcamp holds a Ph.D. from the University of Pittsburgh in Developmental & Cell Biology.

Jennifer Bankers-Fulbright has been involved with MAS since 2000. In that time, she has helped plan the Minnesota State Science & Engineering Fair and the Rochester Regional Science Fair, served as a judge at the Intel International Science and Engineering Fair, sat on the REAP Scholar Award Selection Committee, and served as the Chair of the Winchell Undergraduate Research Symposium Planning Committee. "After having been involved with the Minnesota Academy of Science for several years in various roles, I am honored to be nominated as a MAS Board Member," she said. "I know MAS's strengths and can see many opportunities for sustainable improvement and expansion."

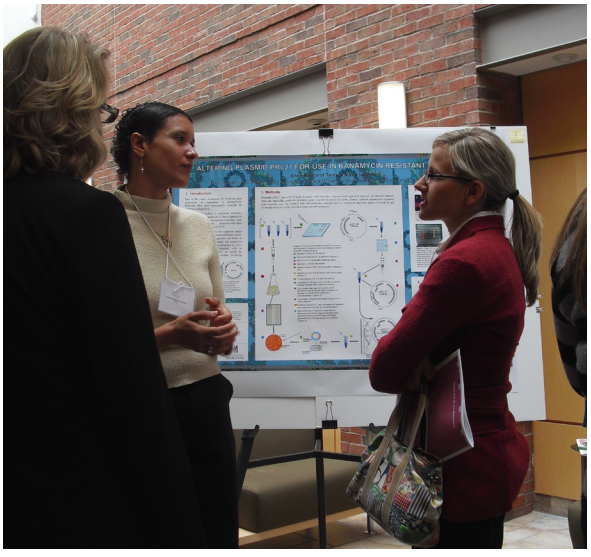
Dr. Bankers-Fulbright is an Assistant Professor of Biology at Augsburg College, where she is responsible for teaching introductory biology and microbiology and mentoring student research projects. She has advised more than 15 undergraduate student research projects, including five summa honors projects. Prior to teaching, Dr. Bankers-Fulbright conducted research with the Allergic Diseases Research Laboratory through the Mayo Clinic. Dr. Bankers-Fulbright holds a Ph.D. in Immunology from the Mayo Clinic.

Ihsuan Li brings a unique background in economics to the Board of Directors. She holds a Ph.D. in Applied Economics from Clemson University and is an Associate Professor of Economics at Minnesota State University, Mankato. Dr. Li has won numerous awards for her outstanding teaching and advising for undergraduate students. She has supervised undergraduate research papers that have won awards at state level (sponsored by the Minnesota Economic Association), multi-regional level (sponsored by the Federal Reserve Banks of Minneapolis, Atlanta, St. Louis, and Dallas) in undergraduate essay, regional level (sponsored by the Federal Reserve Bank of Minneapolis) undergraduate essay competition, and international level (sponsored by the International Atlantic Economic Society) undergraduate research paper competition. Dr. Li has advised more than twelve undergraduate and graduate research projects, including four research abstracts accepted for presentation at the National Council on Undergraduate Research (NCUR).

Dr. Li is the author of a course pack on undergraduate research in economics. She also serves as the Vice President of Finance and a member of the Board of Directors of Omicron Delta Epsilon, International Honor Society in Economics, and is a current member of the Council on Undergraduate Research (CUR). She hopes to work with the Winchell Undergraduate Research Symposium to expand the event to include more undergraduate economics research projects.

The Academy's focus on excellence is what attracts Dr. Li to commit her volunteer time to serve on the Board of Directors. She is dedicated to providing undergraduate students with opportunities to strive for excellence in all their endeavors. "It is a great honor to serve as a member of the Board of Directors of the MAS. MAS is a unique venue for students of different disciplines to meet and discover what unites them—excellence in research, and what each can contribute towards progress in science. I hope to contribute to the promotion of this shared value," she said.

Save the Date: 2014 Annual Meeting & Winchell Undergraduate Research Symposium



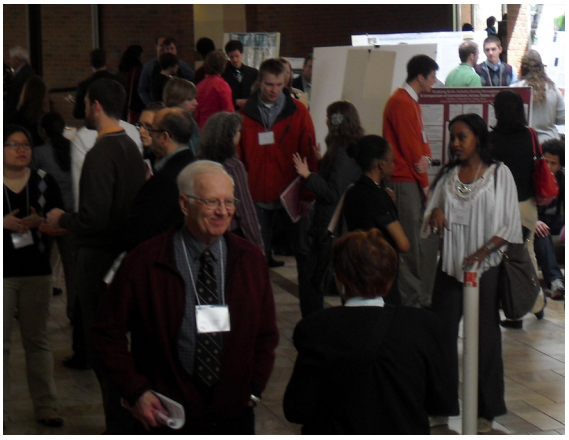
The 2014 Annual Meeting & Winchell Undergraduate Research Symposium will be held April 14, 2014 at St. Mary's University of Minnesota in Winona.

The Annual Meeting & Winchell Undergraduate Research Symposium prepares undergraduate students to enter the fields of science, technology, engineering, and mathematics (STEM) by providing them with a venue to showcase their scientific research, receive feedback from professional scientists and their peers, and network with professionals in the fields they aspire to enter. For more information about the event, visit www.mnmas.org or email egrames@mnmas.org.

Membership on the Planning Committee for the MAS Annual Meeting/Winchell Symposium

By Wayne Wolsey

I have been an MAS member since 1965, when I arrived in Minnesota to start a teaching position at Macalester College. It turns out that the Minnesota Academy of Science was scheduled to meet at Macalester in the spring of 1966, to help dedicate the new Science Building (Olin Hall of Science).



Wayne Wolsey at the 2013 Annual Meeting at Augsburg *Photo by Eliza Grames*

As will happen with junior members of a department, I was soon appointed as Chemistry department representative to the Planning committee for the MAS Annual Meeting—and ended up as Co-Chair of the committee. (I also ended up as Co-Chair of the 1978 Annual meeting and Chair of the 2006 Annual meeting, both held at Macalester College.)

I have attended most of the Annual Meetings, excluding a few while out of state on sabbatical leaves. Twice I had the honor of presiding over the Annual Meeting in the role of MAS President (1982 and 2000). The Winchell Undergraduate Science Research Symposium became a feature of the Annual Meetings starting in 1988.

The Minnesota Section of the American Chemical Society started an Undergraduate Chemistry Research Symposium in 1965. Like the Annual Meetings of the MAS, this event went from one Minnesota college/university to another each spring—sometimes even meeting on the same campus as the MAS meeting. The ACS chemistry symposium was well attended until one was cancelled due to insufficient registration in about 1999. I proposed that the ACS join forces with the MAS Winchell Symposium, which still continues. The MN ACS Section is now a co-sponsor and covers the registration fees for undergraduate chemistry and biochemistry presenters, up to a maximum of seven for a given institution.

In 2005, the MAS Board agreed to once again sponsor an Annual Meeting/Winchell Symposium (after a one year hiatus due to financial problems). With short notice, Macalester College was able to schedule space for the 2006 meeting. As I was phasing off the MAS Board and entering full retirement, I decided to assume near-complete responsibility (the MAS office staff was of considerable support) for the meeting and operated without a planning committee.

I have continued to serve on the MAS Annual Meeting/Winchell Symposium planning committee as a liaison with the Executive Committee of the Minnesota ACS Section, as sort of a senior advisor. Having arranged for the food order; setups with campus facilities management; selecting a keynote speaker; arranging for registration, nametags, etc.; arranging for editing of abstracts, getting copy to the printer of the special issue of the Journal of the Minnesota Academy of Science; recruiting judges for the student presentations; and other miscellaneous tasks; I am familiar with the responsibilities of planning committees.

It is rewarding at each Winchell Symposium to see the quality of the research which comes from the student/advisor teams. There are other forums available, at national meetings for students to present results, but the MAS/Winchell format permits more students to present at reasonable costs. Health permitting, I expect to continue as Liaison between the Minnesota ACS Section and the planning committee for these annual spring events.

Wayne Wolsey is a Professor Emeritus in the Department of Chemistry at Macalester College. He has served as President of the MAS Board of Directors for two terms and is a Lifetime member of MAS.

Student Perspective on the 2013 Minnesota State Science & Engineering Fair

By Karina Skov

Ariel Keller and Karina Skov (right) Photo by Ken Mann

I would like to begin by thanking you for all of the great experiences that I have been able to endure because of Science Fair and JSHS. This was my first year of participating, and I loved it! I was able to experience things that without Science Fair I would not have been able to. The whole adventure was rewarding beyond measure, and though I regret not beginning my Science Fair career earlier, I am looking forward to participating next year.

I became interested in Science Fair and JSHS by listening to the stories that my classmates and science teacher would tell. They always spoke so fondly of their trips, at all levels of competitions and I wanted to get involved, so I was thrilled when my best friend and I came up with a project we could carry out. For our project we designed a car seat sensor that would be able to alert a driver if they left a child unattended in a vehicle.

I learned throughout Science Fair many valuable lessons. For example, during JSHS, I had to focus on my public speaking skills. The JSHS program really helped me learn how to effectively and efficiently convey my ideas with confidence. The process of conducting a Science Fair project taught me how to reach out to others, or network with people. I learned to accept people's help and use their ideas to further my own.

I believe that other students would also thoroughly enjoy the Science Fair and JSHS experience. It is important for kids to take part in something that may be outside their comfort zone at first. Being a part of a group of people that all share a passion for science is a feeling like no other. It is empowering and inspirational to know that you are a part of a group of people that could change the world!

All of my correlations with Science Fair and JSHS have definitely fueled my desire to choose a STEM career. The situations I have been involved in with Science Fair and JSHS have shown me how to enjoy science while having fun, what more could you possibly want in a career?! I personally am taking all the science and math my high school can offer so that when I graduate in the spring I am fully prepared to enter college and pursue a major in biology, specifically genetics.

Everything I have described above would not have been possible without you and all the support of your colleagues and sponsors. I think it is amazing when students are given such great opportunities to succeed. I appreciate all your support on our JSHS trip, and all of the hard work you put into making JSHS and Science Fair a reality.

Karina Skov is a senior at Alden-Conger High School and lives in Alden, MN.

Volunteer at the 2014 Minnesota State Regional Science Bowl Tournament

Hundreds of Minnesota high school and middle school students are in the midst of forming teams, testing their knowledge in all areas of science and mathematics, practicing and preparing to participate in the 2014 Minnesota State Regional Science Bowl! Students work in five-person teams for months, preparing for the tournament in the hopes of qualifying to compete in the U.S. Department of Energy National Science Bowl in Washington D.C.

The 2014 Minnesota State Regional Science Bowl for High School Students will be held on Friday, January 24, 2014 at Macalester College. The 2014 Minnesota State Regional Science Bowl for Middle School Students will be held on Saturday, February 15, 2014 at the University of St. Thomas.

Volunteers are at the core of implementing a successful Science Bowl tournament. The two tournament days require more than a hundred volunteers to be moderators, scientific judges, scorekeepers, timekeepers, "runners" (no actual running involved!) and to be role models for young scientists. If you are interested in volunteering for a full day or half day at either of the 2014 Minnesota State Regional Science Bowl tournaments, please contact Barbara Donoho at bdonoho@mnmas.org.

Volunteers Needed for 2014 Minnesota State Science & Engineering Fair

We are looking for volunteer judges and general volunteers for the Minnesota State Science & Engineering Fair and the North Central Regional Junior Science & Humanities Symposium (JSHS). This is a great way to get involved and impact the lives of emerging scientists! The Minnesota State Science and Engineering Fair will be held March 30-April 1, 2014 and JSHS will be held March 29-30, 2014 at the DoubleTree Hotel in Bloomington.

More details and registration information will be available soon. For additional details please visit our website, or contact volunteers@mnmas.org.

Call for Abstracts - Minnesota High School STEM Communicator Awards

Do you know a high school student engaged in an investigative research project relating to science, mathematics, technology, and society? The Minnesota High School STEM Communicator Awards competition is open to individuals and teams of up to two students. The first submission deadline for students is January 15, 2014. Please direct interested students to www.mnmas.org or email karennewell@mnmas.org with questions about the program.