

Minnesota Academy of Science Newsletter



MINNESOTA ACADEMY OF SCIENCE

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Your Support Can Make a Difference

By Celia Waldock, Executive Director

Innovation is widely recognized as a driver of economic growth with STEM professions the basis for a successful, globally competitive and innovative US and Minnesota economy. By 2018, Minnesota will need to fill 188,000 STEM and STEM-related jobs.¹ During the next decade, overall U.S. demand for scientists and engineers is expected to increase at four times the rate for all other occupations.¹

And STEM education is the essential element. Everyone needs to have the fundamental STEM skills that form the basis for lifelong learning – inquiry, observation, analysis, synthesis and reinvention.

Yet in 2011, 8th-graders in 11 other countries achieved higher averages in mathematics scores than in the US, performing at or above the Advanced international mathematics benchmark. At the same time, 8th-graders in 12 other countries achieved higher averages in science scores than in the US, performing at or above the Advanced international science benchmarks.²

Notably, only one in five STEM college students felt that their K–12 education prepared them extremely well for their college courses in STEM.³ And the number of U.S. companies reporting difficulty in filling positions because of a lack of skills grew from 14 percent in 2010 to almost 40 percent by 2013.⁴

MAS programs such as State Science & Engineering Fair, Junior Science & Humanities Symposium, High School and Middle School Science Bowls, and the High School STEM Communicator Award provide opportunities for students to delve deeply into subjects that interest them and solve real-world problems.



Your Support Can Make a Difference (Cont.)

Your membership, your volunteer hours and your financial support allow us to provide the programs that have our students saying:



Elisa Villafaña presents Photo by Dave
at JSHS Newell

Participating in the fair was probably one of the best experiences of my high school career. I really enjoyed being able to present my hard work from the summer in an environment where it was greatly appreciated and valued.

—Elisa B. Villafaña

I sincerely hope that schools and districts across the state and nation will realize that science fair projects are the best form of STEM education we can offer.

—Connor Klemenhausen

The rewarding side to science fair greatly depends on how good your project is. This is ultimately based off of time and commitment. The most rewarding thing of all to me is being awarded certificates, which I can include in my college resume. Science fair has also improved my confidence level as I present in front of others, helping

me with physical presentation skills, speaking skills, as well as, analytical skills. I truly believe that what I have gained from doing science fair will benefit me as I go on to college.

—Madison Pallin

For high schoolers and perhaps even more so for middle schoolers, Science Bowl encourages studying subjects to a depth and sophistication that they wouldn't otherwise get through their regular school courses. It furthermore forces students to think and get along cooperatively, an essential skill in any environment. The fact that it combines these with the advantage of practical scientific education is great. Science Bowl also helps [student] coaches develop their leadership skills through strategizing with and teaching their teams. This double benefit (for students and coaches alike) makes it unique among academic competitions... Science Bowl is additionally clearly helping to train our nation's future scientists...

—Duligar Ibeling

I initially joined Science Bowl out of my interest for science. Of course, I wanted to learn new concepts in addition to what I already knew. But playing questions also helps cement and extrapolate on what I have already learned in class, making me a better student. After attending a few practices, though, it's not just the science that makes me want to come back to practice every week. When I'm at Science Bowl practice, I'm surrounded by other kids (many of whom I now call my friends), who also love science. Such an environment makes it possible to learn from each other and grow together as a team... In the future, I plan on studying engineering, because through practice, I realized I like physics. In addition, participating at the Science Bowl state competition this year gave me the opportunity to meet many adults working in fields of my potential interests. Hearing them talk about what they do is a good experience, because I am exposed to the real world and know the applications of what I am learning.

—Sruti Paladugu

Message from the Executive Director (Cont.)

Please help us provide these incredible programs by joining the Minnesota Academy of Science as a member, volunteering to judge and staff our student programming and by lending your financial support. You can make a great deal of difference! Please join us today at <http://www.mnmas.org/memberships> and make a donation at <http://mnmas.org/content/contribute-mn-academy-science>.

¹ Minnesota's STEM Report Card 2014, http://www.usinnovation.org/state/pdf_cvd/CVD2014Minnesota.pdf

² Trends in International Mathematics and Science Study (TIMSS) 2011 http://nces.ed.gov/timss/results11_science11.asp

³ The Case for STEM Education as a National Priority: Good Jobs and American Competitiveness. STEM Education Coalition. <http://www.stemedcoalition.org/wp-content/uploads/2013/10/Fact-Sheet-STEM-Education-Good-Jobs-and-American-Competitiveness-June-2013.pdf>

⁴ Brookings Institution, Still Searching: Job Vacancies and STEM Skills, 2014. <http://www.brookings.edu/research/interactives/2014/job-vacancies-and-stem-skills/#/M10420>

Donate Stock and Gain Major Tax Relief

By Celia Waldock, Executive Director

In a recent article in Sunday's StarTribune, writer Joe Carlson notes, "Longtime holders of stock in Fridley's medical technology giant were stunned to learn earlier this year that they'll face potentially large tax bills when Medtronic moves its legal headquarters to Ireland, which is expected to happen early next year...In order to wipe out the 30% tax on the gain in value of Medtronic stock, a donor would have to give it to charity before the company closes its proposed deal."¹

If you hold Medtronic stock or other stock and would like to make a donation of any kind to the Minnesota Academy of Science this year, it would make a great deal of difference to the students who participate in our programming. Please contact your financial advisor to decide on a donation that is right for you. Please contact me at ed@mnmas.org with questions or for more information on how to transfer stock.

Together, we can better prepare Minnesota students for STEM programs in college and exciting careers in STEM disciplines, and create a strong workforce that will be our country's next generation of great scientific leaders!

¹ Carlson, Joe (2014, November 2) Medtronic deal driving donations, StarTribune, pp. D1, D8



7th grade student Avni Jain presents her science fair project

Photo by Dave Newell



Dr. Williams welcomes attendees to Science Salon Photo by Eliza Grames

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Celia Waldock, Executive Director
Minnesota Academy of Science

Message from the President

By Mike Williams, President of the Board of Directors

We have been excited to see a growing number of scientists and science enthusiasts participating in Science Salon, a program initiated by the Minnesota Academy of Science a little over a year ago. The events have included tours hosted by the Century College Fabrication Center of Excellence (“Fab Lab”), the University of Minnesota Biotechnology Resource Center (“Biodale”), and 3M Company’s Innovation Center.

Our primary intent for launching Science Salon was to create a forum that helps professional scientists make connections. The topic of each event is intentionally chosen to appeal to a broad variety of professional scientists and engineers. We hope that participants will use the forum to reconnect with former colleagues and/or meet new people that have similar or different backgrounds but share a common interest in the topics. I was pleasantly surprised to see one of my former colleagues at the Biodale Science Salon event in September. In addition, I spent some time talking with Dr. Pratik Jagtap, the director of the Mass Spectrometry facility (see photo next page). He told me about the variety of research projects they support and the promise that mass spectrometry technology holds for the future of personalized medicine. I hope to meet you at one of our upcoming Science Salon events.

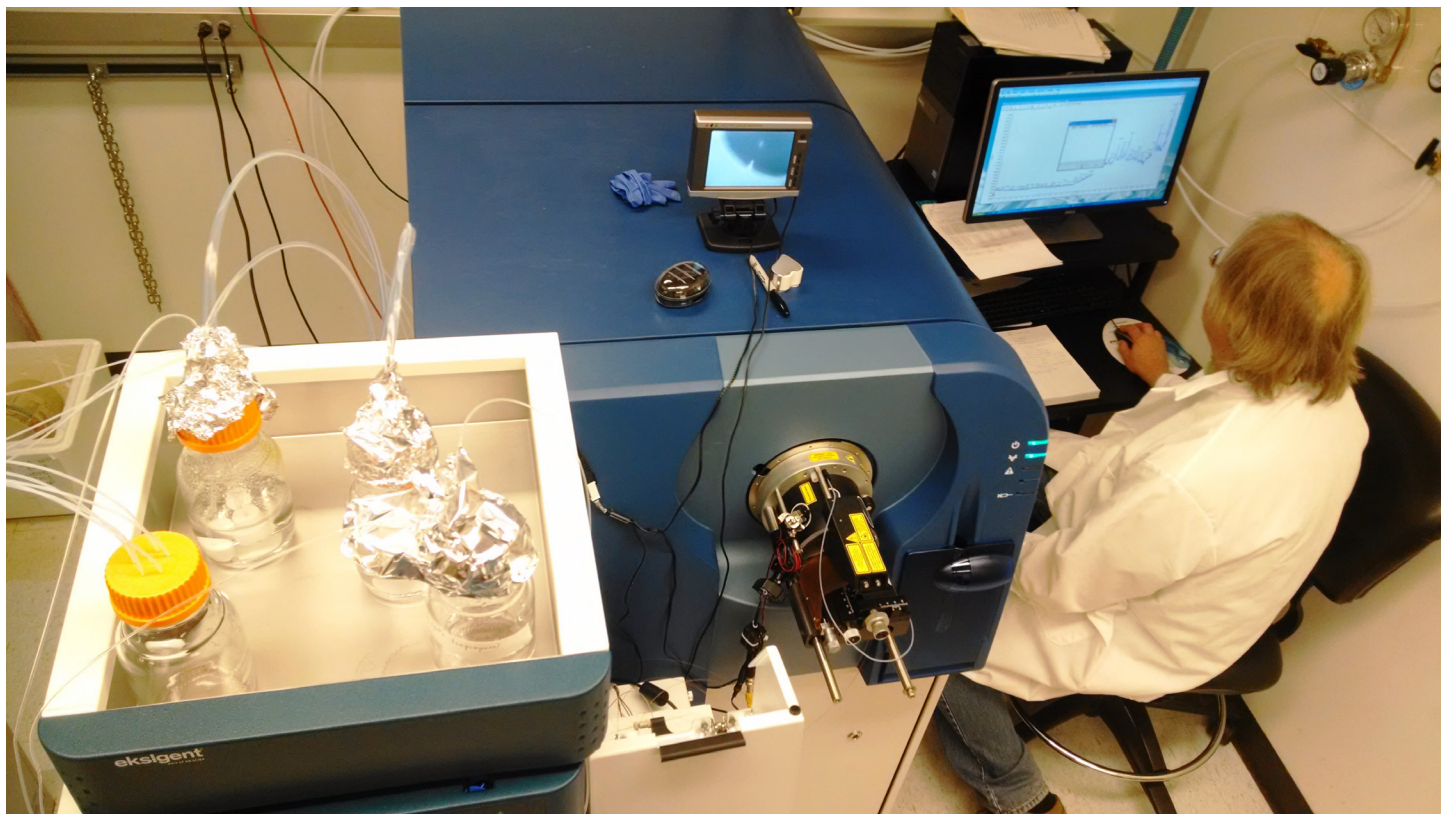
Because of the success of Science Salon, we are expanding our membership program. We will concentrate on facilitating connections between professional scientists. We are also exploring opportunities to increase the participation of future professional scientists and engineers (i.e., undergraduate students) in our Science Salon events.

Even though we are expanding our membership program, we don’t want to lose focus on the member benefits we’ve offered for years. The biggest benefit of being a member of MAS is knowing that you are helping to provide opportunities for the innovators and scientific leaders of tomorrow who seek to develop skills and gain recognition for their research efforts. Your membership gives students the opportunity to experience science in ways that will excite their interest in lifelong learning. Our programs such as State Science & Engineering Fair, Junior Science & Humanities Symposium, High School and Middle School Science Bowls, the High School STEM Communicator Award, and the Winchell Undergraduate Research Symposium provide opportunities for students to delve deeply into subjects that interest them and solve real-world problems.

Message from the President (Cont.)

Your membership entitles you to receive our newsletter, journals, and email alerts about science in the news and local science events and activities. Members also receive discounted tickets and special offers for Science Salon and to the Minnesota Technical Symposium. Lastly, our voting members help to shape the future of MAS by voting on Board leadership and bylaws changes.

If you are not already a member, I encourage you to join MAS in recognizing, influencing, and promoting excellence in science. To become a member, visit www.mnmas.org/memberships. If you have any questions about membership with the Minnesota Academy of Science, please contact our Executive Director, Celia Waldock, at ed@mnmas.org.



CMSP researcher acquiring and analyzing data on the new AB Sciex 5600+ instrument housed at the Center for Mass Spectrometry and Proteomics (CMSP) at the University of Minnesota Photo courtesy of Pratik Jagtap

Gaining Career Inspiration: A Student Participant's Perspective on Science Salon

By Jacquelyn Bongard, St. Mary's University of Minnesota

My main goal when participating in the Science Salon sponsored by the Minnesota Academy of Science and the BioTechnology Institute was to become more informed about cutting-edge research techniques used in the field of biotechnology. As a senior undergraduate biology major at Saint Mary's University of Minnesota, I thought I had my post-college career figured out. But the Science Salon event turned out to be more informative than I had expected. It reconfirmed my desire to pursue a career in laboratory science.

Participating in the Science Salon made me realize how sophisticated scientific instrumentation has become and how this equipment can be used to better society. Dr. Larry Wackett, distinguished McKnight Professor of Biochemistry at the University of Minnesota, described research in his lab that

Gaining Career Inspiration: A Student Participant's Perspective on Science Salon (Cont.)

dealt with the purification of water used in the process of sand fracking. His presentation showed me how biotechnology can help us resolve current and pressing public issues.

While I have always realized that scientific research is competitive, I also learned from the Science Salon event that scientific research can be collaborative in nature. I had the opportunity to tour the University Imaging Centers (UIC) in the BioTechnology Institute. The program director, Dr. Mark Sanders, spoke about how the laboratory shares its facilities and expertise with University research laboratories as well as external organizations. I found the extent of collaboration between the BioTechnology Institute and the general scientific community to be impressive.

After participating in the Science Salon I realized the interconnectedness of the scientific community. It made me realize that scientific research does not occur in a vacuum; scientists are not alone when completing their research. As a future laboratory researcher, it is reassuring to know that I will be working in a collaborative environment including individuals who are enthused by innovation and using their problem solving skills to resolve present-day issues.

About the BioTechnology Institute

By Michael Winikoff, BTI Communications Specialist

The University of Minnesota's BioTechnology Institute (BTI) provides advanced research and training in biotechnology and bioprocess engineering. Research at BTI encompasses biological, chemical, and engineering aspects of biotechnology. The faculty works in a broad spectrum of disciplines including microbial physiology, metabolic pathway engineering, functional genomics, molecular evolution, bioremediation, natural product synthesis, and green chemistry.

Since 1990, the Institute has been the recipient of the prestigious NIH Training Grant in Biotechnology. Reflecting its cross-disciplinary nature, BTI also offers a Master of Science degree in Microbial Engineering. BTI is home to the President's Initiative on Biocatalysis and the bioremediation initiative of MnDRIVE, a landmark partnership with the State of Minnesota to support groundbreaking research at the University. BTI also serves as a catalyst for University-Industry interaction, hosting symposia, seminars, and listening sessions.

THE UNIVERSITY OF MINNESOTA'S BIOTECHNOLOGY INSTITUTE (BTI) PROVIDES ADVANCED RESEARCH AND TRAINING IN BIOTECHNOLOGY AND BIOPROCESS ENGINEERING.

In addition to the faculty laboratories, BTI has established the Biotechnology Resource Center (BRC), a process scale pilot plant unique in the state, which is accessible to industrial and academic scientists for collaborative and contract research. The BRC is part of the University's Biodale cluster, which also houses the University Imaging Center, the Center for Mass Spectrometry and Proteomics, the BioMedical Genomics Center, the High Throughput Screening and Analysis Facility, and the Computational Biology Centers and the Center for Computational Biology and Bioinformatics. Like the BRC, Biodale's services and resources are available to the business community in addition to researchers within the University community.

For more information about the Biotechnology Resource Center or BTI, please contact Dr. Michael Sadowsky, Director of the BioTechnology Institute, at sadowsky@umn.edu.

In Photos: Science Salon at Biodale

Photos by Eliza Grames



Attendees network over refreshments in the Cargill Building Atrium before Dr. Wackett's lecture



Tim Tripp show attendees the fermentation vats at the Biotechnology Resource Center



Students from St. Mary's University of Minnesota in Winona attended Science Salon



Board Member Stephanie Yancey and Executive Director Celia Waldock network with attendees at Science Salon



Tim Tripp led one group of attendees on a tour of the Biotechnology Resource Center where researchers cultivate and develop strains of bacteria, yeast, and fungi for academic and industry groups.

Dr. Larry Wackett Presents Bioremediation of Fracking Wastewater Research at Science Salon

By Eliza Grames, Communications Specialist

One frack of one well uses 1.5 billion gallons, which is equivalent to about 10 Olympic size swimming pools worth of water. The chemicals contained in this water are the focus of Dr. Larry Wackett's research. Dr. Wackett is a Distinguished McKnight Professor of Biochemistry at the University of Minnesota and researcher in the BioTechnology Institute.

At a recent Science Salon, Dr. Wackett spoke to members and associates of the Minnesota Academy of Science about his research on bioremediation of fracking wastewater to reclaim contaminated sites and reuse the water.

Even as nations move towards renewable energy sources and focus on conservation efforts, about 90% of our energy still comes from oil. "There is going to be a need, for the foreseeable future, for oil and gas," Dr. Wackett told attendees at Science Salon. Because of this energy need, the oil industry is driven to seek new sources of fuel using hydraulic fracturing (fracking) technologies. Fracking is the process of injecting water into oil-rich shale to fracture the rock and release the oil and gas contained in small pockets.

The water that is injected into fracking wells contains chemicals, and currently the oil industry is not required to disclose which chemicals

they inject. Although most people tend to focus on the chemicals being injected into the shale, Dr. Wackett says he cares more about what's in the water that comes back up. "Most chemicals in the water that is sent into the shale will be filtered and purified before getting into groundwater," he said.

Dr. Wackett's lab wanted to figure out how to clean the wastewater generated at fracking sites and reuse it at new sites. Specifically, he wanted to discover an organism that would consume dangerous chemicals in the wastewater to purify it for use. He obtained water from several different fracking sites in Pennsylvania, Texas, and North Dakota to find out what chemicals were present. After 2D mass spectrometry analysis, his lab found many benign chemicals but also several known human carcinogens.

After analyzing the chemicals contained in the fracking wastewater, Dr. Wackett set out to find organisms that are adept at consuming the compounds contained in the wastewater. "What we're doing is looking at organisms that can eat large numbers of compounds," he said. Ultimately, they found an organism that contained an enzyme which reacted with about 150 different chemical structures. "We're looking to try to find these organisms that



Dr. Wackett presents his research Photo by Eliza Grames

have very wide specificities of what they consume and then try to use it in some intelligent way to remove chemicals."

To engineer a usable product to clean fracking wastewater, Dr. Wackett partnered with Dr. Alptekin Aksan from the Department of Mechanical Engineering. Together, they created a silica gel ball that contains the organism. The silica gel balls stabilize the organism and allows them to be shipped to contamination sites, where the silica gel is dissolved and the organism is released. The process they developed for creating the balls can be scaled up to an industry level to produce enough product to clean up an entire contamination site.

To learn more about Dr. Wackett's research on bioremediation of fracking wastewater, please visit <http://www.bti.umn.edu/faculty/biowackett.html>.

The World of 3M Innovation

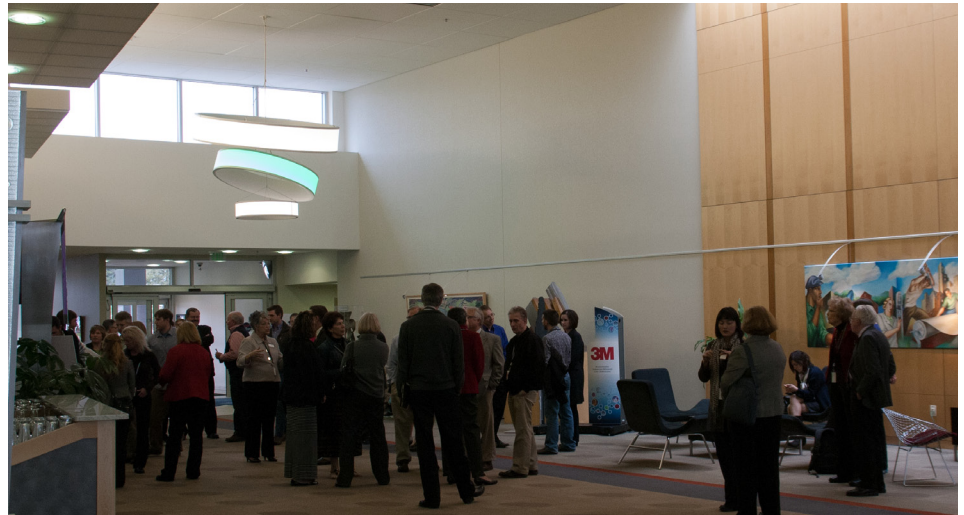
By Eliza Grames, Communications Specialist

More than 70 people attended Science Salon in May at the 3M Innovation Center to tour the World of 3M Innovation and to hear from Matt Scholz, Corporate Scientist. What attendees learned was that collaboration is at the core of 3M's innovation process.

The first product that 3M made was sandpaper. "What's interesting is that all of our technologies relate back to that original sandpaper process," said Del Kauss, Communications Manager for the 3M Innovation Center. The sandpaper backing formed the foundation for tape, which was invented by Dick Drew outside of the projects assigned by his supervisor, McKnight.

When McKnight realized what Drew had accomplished by pursuing his own interests, he developed principles that guide the culture of 3M innovation today. "We encourage our technical employees to spend 15% of their time working on projects outside of their defined roles," said Kauss. This 15% time has resulted in some of 3M's most successful products, including Scotch Tape, Post-It Notes, and other core products.

In the World of 3M Innovation, attendees got to peruse what Kauss described as a "science museum of 3M technologies." The center houses displays for 27 of 46 technical areas in 3M. At the Microreplication station, attendees could learn about the process of repeating



Science Salon attendees network at the 3M Innovation Center Photo by Dave Newell

small patterns on films to create useful technologies. Microreplication was first invented as a way to focus light to reduce the cost of projectors used in school classrooms. "The way the company works is we invent this technology, and now it doesn't just stay in that division," said Kauss. "It now becomes property of the whole company and all divisions can look at it and say 'How can we use microreplication in our products?'" Other areas that attendees could browse included Adhesives, Microbial Detection & Control, Abrasives, Nanotechnology, or Dental & Orthodontic Materials.

After touring the World of 3M Innovation, Science Salon attendees heard about invention and innovation from Matt Scholz, Corporate Scientist. "There is no invention or innovation without imagination," began Scholz, explaining that children are innovative because they are supported, unaware of the consequences

of their ideas, and are given time to dream. Beyond just imagination, innovators need to be motivated and willing to take risks. "Academia and industry need researchers who aren't just imaginative - they're determined," said Scholz.

"At 3M, we truly have a culture of sharing, and we even have a formal program called Ask an Expert," explained Matt. They also host Technical Forums for employees and outside experts to share their knowledge about specific topics. Just the week before Science Salon, 3M welcomed Peter Agre, Nobel Laureate in Chemistry, to a Technical Forum. Dr. Scholz closed out his talk by answering questions from the audience and encouraging them to be relentless in their pursuit of innovation.

For more information about the World of 3M Innovation, please visit <http://solutions.3m.com/innovation/>.

Smith Hall Becomes an ACS National Historic Chemical Landmark

By Wayne Wolsey, Minnesota Local Section of the American Chemical Society

Smith Hall is the oldest Chemistry Building at the University of Minnesota, being dedicated in 1913. In 1972, the University of Minnesota Chemistry Department opened an annex to the 1913 Chemistry Building. The new annex was named Kolthoff Hall and the unnamed main building was officially named Smith Hall, in honor of former Professor Lee Irvin Smith.

On September 12, 2014, this building was recognized by the National American Chemical Society (ACS) as a National Historic Chemical Landmark (NHCL), in tandem with celebrating the centenary of Smith Hall. In 2007, the 3M Company received a similar designation, coinciding with the 75th anniversary of the introduction of Scotch Tape.

NHCL designation must be initiated by a local Section of the ACS; accordingly the Minnesota ACS Section cooperated with the University of Minnesota Chemistry Department's committee (chaired by Professor George Barany) in preparing a nomination packet. This designation must be justified on the basis of unique, significant work done within the building, not just because an old building exists. A focus upon the outstanding career-long research and educational contributions of legendary Professor Izaak Marurits Kolthoff, often called the father of modern analytical chemistry, was used in the nomination process. After appropriate screening, the ACS Board of Directors gave its endorsement of the national NHCL committee's recommendation.

The commemorative plaque reads: "Izaak Maurits Kolthoff (1894-1993) is widely regarded as the father of modern analytical chemistry. His research transformed the ways by which scientists separate, identify, and quantitate chemical substances and built the field upon solid theoretical principles and experimental techniques. Today, analytical chemistry is an essential branch of chemistry used in disciplines ranging from clinical medicine to environmental studies, forensics, food and drug safety and other fields. As a faculty member at the University of Minnesota from 1927 to 1962, Kolthoff was a world-renowned educator, author of nearly 1,000 papers and numerous textbooks, advisor to more than 50 doctoral chemistry students, and an international leader in advancing analytical chemistry as a modern scientific discipline."

Immediate National ACS Past-President Dr. Marinda Wu, Chair of the Minnesota ACS Section Dr. Rebecca Guza (HB Fuller Co.), a Regent of the University of Minnesota, the Senior Vice President of Academic Affairs, the Dean of the College of Science and Engineering, and Dr. William Tolman, Chair of the Chemistry Department, participated in the official ceremony on Friday, September 12.

On Saturday, September 13 a Kolthoff Legacy Symposium was held in the Smith Hall Lecture Room, attended by ca.400 scientists, alumni, and students from throughout the state. Five nationally known professors (all members of the National Academy of Sciences) gave presentations in which they related their work to analytical techniques inspired by Professor Kolthoff. Professor Peter Carr (University of Minnesota) reflected on his interactions with I.M. Kolthoff over a several year period.

Smith Hall Becomes an ACS National Historic Chemical Landmark (Cont.)

Dr. Izaak Marurits Kolthoff

Kolthoff, who came to Minnesota from Holland in 1927 was a pioneer in developing and standardizing analytical methods and is well known for his early work in electroanalytical chemistry. A textbook he co-authored with a former student, E.B. Sandell, *Quantitative Chemical Analysis* in 1936, set the tone for undergraduate analytical chemistry courses throughout the world. He and other former students wrote major analytical chemistry reference works, which are still regarded as major authoritative sources for doing background reading in many areas of analytical chemistry. During World War II, he played a major role in the development of synthetic rubber. Even though he officially retired in 1962, he continued to publish research papers well into his 90s. He was the recipient of numerous major awards, both within the U.S. and also from several foreign countries, being knighted by his native Netherlands as a Commander in the Orange-Nassau in 1947. He was inducted into the U.S. National Academy of Sciences in 1964.

Dr. Lee Irvin Smith

Lee Irvin Smith (1891-1973) played an important role in the development of Organic Chemistry within the U.S. following World War I. Born in Indianapolis, IN, he did his undergraduate work at The Ohio State University, receiving both a B.S. in Chemistry and a M.A. in Industrial Chemistry in 1915. He received an M.A. in Chemistry at Harvard in 1917. After service with the Chemical Warfare Service, he returned to Harvard, and completed his Ph.D. in 1920 under Professor E.P. Kohler. The same year, he began as an Instructor in Chemistry at the University of Minnesota. In 1931, he became a full professor and Head of the Division of Organic Chemistry. For the next three decades he built up the Organic sector (in parallel with what Professor Kolthoff was doing in the Analytical Division).

Smith was a very creative synthetic organic chemist, investigating tocopherols, polyalkylated hydroquinones, polyalkylated benzenes, the reactions of benzoquinone derivatives and metal enolates, and the Jacobsen rearrangement. He is probably best known for the synthesis of Vitamin E. In 1944, he was elected to the National Academy of Sciences. He had 245 publications and 22 patents. He also was the recipient of several medals.

Professor Smith was active with professional societies. He was President of the Association of Harvard Chemists in 1939, Chairman of the Organic Division of the ACS in 1941, and the President of the Minnesota Academy of Science in 1945. He held long-term consulting appointments with Merck and Company and with General Mills.

Presentations at the Kolthoff Legacy Symposium

Richard Zare (Stanford University)

“Chemical Modification of Plastic Blood Collection Tubes”

Laura Kiessling (University of Wisconsin-Madison)

“Us Versus Them: Distinguishing Human and Microbial Cells by Their Glycans”

Allen Bard (University of Texas-Austin)

“The Possibilities and Problems of Stochastic Analytical Chemistry: Can Single Molecule Detection Approaches Be Applied to Determinations at Ultralow Concentrations”

Judith Klinman (University of California-Berkeley)

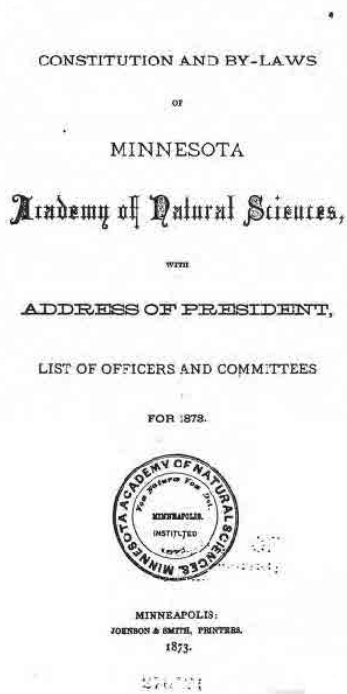
“Tunneling and the Role of Barrier Width in Enzymatic C-H Activation Reactions”

Harry Gray (California Institute of Technology)

“The 21st Century Solar Army”

Preserving, Digitizing, and Archiving 141 Years of Scientific Research

By Eliza Grames, Communications Specialist



It might surprise you to learn that the *Journal of the Minnesota Academy of Science (JMAS)* is older than *Science*. The first volume of *JMAS* was published in 1873—a full seven years before *Science*. These early journals contain a wealth of scientific explorations and discoveries by the pioneers of science in Minnesota.

In the first years of its existence, *JMAS* published primarily geological, botanical, zoological, astronomical, and archaeological papers. Although many of these articles are no longer relevant to current scientific discussion, they provide a foundation to understand how far our scientific knowledge and understanding of the natural world has progressed since 1873.

In the archives of *JMAS*, you will find lists of bird and mammal species found in Minnesota in 1880; the list of birds includes a note about the Passenger Pigeon being “Variable with years, but on the whole, abundant.” This provides a glimpse into the rapid decline of the Passenger Pigeon, which was declared extinct just 34 years later in 1914.

Authors published in the early years of *JMAS* include Newton H. Winchell, the first State Geologist, William W. Folwell, the first President of the University of Minnesota, and Thomas B. Walker, the founder of the Minneapolis Public Library system.

This is not to say that the early volumes of *JMAS* always contained perfect science. In 1885, *JMAS* published an article by A.E. Johnson defending ethnocentrism and claiming that Caucasians are the “most noble example” of humans and had evolved from “the lower varieties [of humans].” The Minnesota Academy of Science does not support this position or recognize any validity in the arguments presented in the paper. *JMAS* was not alone in publishing such articles; in 1921, *Science* published the welcome address from the Second International Congress of Eugenics. By preserving and archiving even such arcane ideas as those presented in Johnson’s paper, MAS is maintaining an important historical record that demonstrates how far our society has advanced, both socially and scientifically, in just the last 129 years.

Because of the wealth of early scientific discoveries, knowledge, and history contained in *JMAS*, the Minnesota Academy of Science has begun a project to locate, digitize, and publish all the archives of *JMAS*.

Before the project could begin, we had to locate a copy of every journal and bulletin published by MAS since 1873. Some years were easier to find than others. Articles from 2003-2014 were already published on our website. The early years from 1873-1911 were scanned and made publicly available by Google, which reduced the amount of time required to find those articles. It was the years from 1911-2002 that proved the most difficult to archive because no digital copies existed. MAS had paper copies of most of these journals in the office, but the process of scanning each page, uploading to a computer, compiling, and checking to make sure the full text of each page makes it into the final PDF is time consuming.

Preserving, Digitizing, and Archiving 141 Years of Scientific Research (Cont.)

Our Board Secretary, Karen Newell, introduced us to Bruce Mulder, the Coordinator of the ATTAIN Tech Lab at ISD 287. ATTAIN Tech Lab is a program where students with disabilities receive vocational training in computer applications. Students learn skills by working on job requests from ISD 287 and external community organizations.

Bruce and his students were happy to take on the project of digitizing the paper copies of JMAS for the archive. By working on the project, students are learning how to create perfectly scanned pages without damaging the original copy, combine the individual images into the full journal, split PDFs into multiple files, and run text-recognition software in PDFs.

Digitizing journals is a slow process, and although Bruce and his students are making headway, it will take a while before all of the JMAS archives are digitized and uploaded to the web. For now, journals from 1873-1911 and from 2003-2014 are available at www.mnmas.org. More articles will be uploaded in the months to come.

First Year Advisor's Perspective on the Winchell Undergraduate Research Symposium

By Joanna Klein, University of Northwestern - St. Paul

Winning an Excellence in Science Award at the Winchell Undergraduate Research Symposium - what a way to celebrate your 21st birthday! That is exactly the experience of one of my six research students who attended the 2014 symposium at St. Mary's University in Winona. I had heard of the Winchell symposium for years, but the timing had never been right. In 2014, I had a stellar group of students, their research was firing on all cylinders and I had even been awarded a small travel grant that could be used for student attendance. So at 7 a.m. on April 26th, we piled into the university van, made a stop for coffee and bagels and enjoyed a beautiful drive to southeastern Minnesota.



UNWSP students at the 2014 symposium Photo courtesy of Joanna Klein

We were all thoroughly impressed by the symposium. The number of student presenters and the variety of research topics was fantastic. Furthermore, the quality of the work was high, and my students came away having learned about some fascinating research. Of my students, two presented a poster and two gave an oral presentation. They felt so accomplished presenting their research at a non-campus venue. On the way home – they commented, “this was actually fun”– high praise from college students who could find a number of other ways to spend a Saturday in April.

I came back to the University of Northwestern raving about the day. My enthusiasm was noted, and here we are, hosting the 2015 Winchell Symposium! We are thrilled to welcome an exceptional group of students from Minnesota and beyond to our campus on April 25, 2015. Planning is in full swing, and the organizing committee is enjoying our collaboration with staff and other members of the Minnesota Academy of Science. Thanks for your support of the symposium through encouraging your students to present, attending yourself, and volunteering to serve as a judge. Hint, hint... I look forward to meeting you and your students in April!

Research on!

Winchell presenter wins fourth place in the Minnesota Economic Association Undergraduate Paper Contest

The Minnesota Economic Association recently announced the winners of its 2014 Undergraduate Paper Contest. Among the students honored by MEA was Ozlem Barin, a student at Minnesota State University, Mankato whose research is mentored by Dr. Ihsuan Li, a member of the Minnesota Academy of Science Board of Directors. Ozlem presented her research at the 2014 Winchell Undergraduate Research Symposium prior to being selected as a winner of the paper contest. The Minnesota Academy of Science wishes to congratulate Ozlem on her achievement.

In her own words...

"I am a senior student majoring in Economics at Minnesota State University, Mankato. I transferred to MSU, Mankato from a community college in Iowa two years ago. About one and a half years ago, I signed up for independent study courses under Dr. Ihsuan Li to learn how to carry out scientific research in Economics. I chose to examine topics related to the utilization of antiretroviral therapies and their health outcomes because I planned on pursuing graduate studies in the public health area, and also because I had worked as a nurse in my country, Turkey, years ago. In the spring of 2014, I had the opportunity to present my research at the Winchell Undergraduate Research Symposium held at St. Mary's University in Winona, Minnesota. I presented my preliminary research results in a session for economics and social science disciplines. The experience at the Winchell Undergraduate Research Symposium taught me the importance of communicating well and clearly to the audience. Two months after the Symposium, I submitted my final paper to the Minnesota Economic Association Undergraduate Student Term Paper competition. I was elated to be recognized for my work, for which I won the fourth place. As a foreign student in a large and public university, I am fortunate to have close mentoring and guidance from my professors Dr. Ihsuan Li and Dr. Robert Simonson; their advising led me to fully take advantage of research presentation and competition opportunities such as the Winchell Undergraduate Research Symposium and the Minnesota Economic Association competition."

– Ozlem Barin, Minnesota State University, Mankato

About the MEA Undergraduate Paper Contest

The Minnesota Economic Association (MEA) is a professional connection between business and economic professionals and college economics professors. MEA's primary purposes are the advancement of economic knowledge and the economics profession. The MEA holds a conference every fall on current economic issues and sponsors a paper contest for college students. More information about the MEA Undergraduate Paper Contest can be found at <http://www.minneapolisfed.org/mea/contest/>.

Four student authors published in the Minnesota Academy of Science Journal of Student Research

By Eliza Grames, Communications Specialist



Four Minnesota students can now add “published in an academic journal” to their list of accomplishments. The four students had their original scientific research published in the inaugural Minnesota Academy of Science Journal of Student Research (MASJSR). Studies published include glutamine dependency in cancer cells, a simulation of aerosol vapor pressure for climate modeling, identification and synthesis of artistic copper patinas, and the treatment of hypoglycemia with dextrose.

“A great deal of research has been done to find less invasive cancer treatments, which has included extensive work on the role of glucose in cancer-cell metabolism, but less research has been done on the role of glutamine in abnormal cancer-cell metabolism,” wrote Greer Bingham about her research on glutamine-dependency in cancer cells. “Glutamine was

important to this work because it is essential for cancer-cell proliferation, growth, and survival.” Bingham’s study found that overexpression of cyclin D1 decreased cell viability in glutamine-dependent SkHep liver-cancer cells that are starved of glutamine, but this was not the case in glutamine-dependent healthy AML12 mouse cells. The results of Bingham’s study could lead to non-invasive cancer treatments that target glutamine-dependent cancer cells. Bingham is currently a sophomore at Bowdoin College, where she is a mathematics and economics double major and a Bowdoin Faculty Scholar.

Claire Simpson conducted her research on writing and applying a Monte Carlo simulation code to examine aerosol vapor pressure, which is cited as the second most important factor in radiative forcing that impacts climate change. The purpose of her study was to examine whether the Kelvin Equation and Classical Nucleation Theory (CNT) can describe the vapor pressure of the nano-droplets involved in aerosol nucleation. Her simulations indicated that CNT was marginally more accurate than the Kelvin Equation at predicting the equilibrium vapor pressure of the nano-droplets, though both were effective. Her research even proved viable for clusters of 100 to 300 particles. “This is important since

experimental measurements are very challenging for small clusters sizes,” wrote Simpson, who is currently attending the Massachusetts Institute of Technology. Because aerosol nucleation is not well understood and causes the most uncertainty in climate change models, the results of her study could be used to increase the predictive ability of climate models.

For centuries, artists have been utilizing natural patinas to add finishes to their work. These patinas form as the result of reduction/oxidation reactions between copper and various atmospheric compounds. In more recent years, artists have turned to chemically produced patinas that mimic natural patinas. “Very little is known about the chemistry involved in artistic patination, and the topic has only been touched upon in the scientific literature,” wrote Claire Drysdale. To understand what chemicals were involved in commonly used artistic patinas, Drysdale utilized Raman microscopy to identify the chemical compounds. The results of her study will be used to develop scientifically based copper patina recipes which will be compiled into a reference guide for artists. Drysdale is currently attending the University of North Carolina - Chapel Hill on a full-ride scholarship from the Morehead-Cain Foundation.

Four student authors published in the Minnesota Academy of Science Journal of Student Research (Cont.)

Hypoglycemia, which can cause seizures and lead to brain damage, impacts between 5-15% of infants. Currently, the treatment for hypoglycemia involves a dose of 10% dextrose, however physicians say this treatment is not as effective as they would like it to be. To address this pressing problem, Kira Hinz researched whether infants can safely receive a dose of 50% dextrose without significantly increasing their PAR (Poly[ADP-ribose]). Surprisingly, Hinz found that even the currently prescribed 10% doses led to overexpression of PAR.

“These results suggest that physicians should reconsider the safety of administering 10% dextrose to hypoglycemic infants and should not treat hypoglycemic infants with 50% doses of dextrose,” wrote Hinz. “If PAR results are verified, methods other than treating infant hypoglycemia with 10% dextrose must be found.” Hinz is currently attending Loyola University Chicago.

MASJSR is an open-access, online, interdisciplinary, peer-reviewed journal for pre-collegiate student research. By publishing MASJSR, the Minnesota Academy of Science

seeks to promote excellence in science and scientific research at all levels and provide a forum to recognize pre-collegiate students who conduct exceptional research projects. Any pre-collegiate students who have conducted original scientific research and written a paper that meets the standards of MASJSR may submit an article for consideration.

To read the students’ papers or learn more about the Minnesota Academy of Science Journal of Student Research, please visit www.mnmas.org.

Reflections on Winning the National Junior Science & Humanities Symposium

By Carolyn Jons, Eden Prairie High School

Last spring I discovered that JSHS, a program of the Minnesota Academy of Science, is an amazing program. JSHS stands for Junior Science and Humanities Symposium. It is sponsored by the United States military with the purpose of inspiring high school students to become the next generation of research scientists. The program further aims to expose high school students to the breadth of science research conducted in the public sector, ranging from sustainable energy to advancements in medical care.

As the North Central Regional JSHS winner, I had the wonderful opportunity to advance to the national competition in Washington, D.C. There I competed with 230 students from around the United States. We were divided into subcategories and, like the North Central Regional event, were judged within our own category. My project, focusing on a new method of desalinating seawater using carbon nanoparticles and focused sunlight, fell into the Chemistry category. At the competition, I presented my research once to a panel of judges. I was then asked a series of questions that required me to not only describe my project, but to demonstrate my knowledge of the fields of science underlying my research. Much to my delight, at the awards ceremony I received the first place award in Chemistry along with a \$12,000 college scholarship.



Carolyn Jons after winning National JSHS
Photo by Lise Weegman

Reflections on Winning the National Junior Science & Humanities Symposium

By Carolyn Jons, Eden Prairie High School

Although winning a first place award was certainly a highlight of the week, my National JSHS experience was much more than just competing. JSHS had numerous fascinating speakers. My favorite speaker was NASA astronaut, Commander Christopher J. Cassidy. In addition, JSHS provided me with the opportunity to network with DoD Scientists and Engineers. Networking with these individuals broadened my understanding of the breadth of military research. Much to my surprise, many of these research scientists worked on cutting edge research in areas that I would never have directly associated with the military.

JSHS was also a whole lot of fun. I had the opportunity to experience the USA Science and Engineering Festival where over 350 thousand people came to celebrate science. There were a plethora of displays ranging from musical quad-copters to FDA food safety. In addition, professional athletes, musicians, magicians, and many people's favorite scientist, Bill Nye the Science Guy, were present. I also had the opportunity to do some sightseeing in our nation's capitol. The Minnesota contingent had a great time getting to know one another while walking the National Mall, visiting monuments, and touring museums. In fact, we had so much fun together that some of us reunited over the summer!

As I reflect on my JSHS experience, I am so thankful to the Minnesota Academy of Science and its sponsors for providing me with this opportunity. Participating in JSHS has certainly strengthened my love of science and encouraged me to continue to pursue scientific research in my next years of high school, college, and beyond. I would also like to thank all my science mentors and science fair directors for their continued support. Finally, special thanks go out to Lise Weegman for being a totally awesome chaperone!



The Minnesota delegation to the 2014 National JSHS: Kevin Zheng, Matthew Lerdahl, Carolyn Jons, Alanna Bram, and Tim Renier

Photo by Lise Weegman

What Do Teachers Need to Know About the 2015 State Science & Engineering Fair and North Central Regional JSHS?

By Lise Weegman, Program Director

The State Science & Engineering Fair and North Central Regional Junior Science & Humanities Symposium (JSHS) are both wonderful pipelines for students to get involved for the first time in scientific research or to continue to fuel their passion for science and engineering. Students are able to share their research with experts in their field in a competitive environment and be rewarded with awards in the form of college scholarships, trophies, medals, and trips to the International Science & Engineering Fair. More than just a competition, the science fair and symposium introduce students to new ideas, inspire them to research topics of personal interest, and encourage them to network with professional scientists and their peers.



Darartu Gamada explains her research to Sen. Melissa Wiklund Newell Photo by Dave Newell

Having all of the students in your class work on scientific research covers most of the science standards, from inquiry to conclusion and evaluation. Completing scientific research provides the student opportunities to think critically, and fuel their passion or interest through inquiry-based learning.

As a reminder of the rules, students need to complete their Scientific Review Committee (SRC) forms before competing at Science Fair. Teachers should pay careful attention to which forms need to be completed first and which projects require prior approval. Teachers should also be aware that team members must be in the same division (grades 6-8 or grades 9-12) and all team members must participate in the competition. Projects should follow ISEF rules and papers should follow National JSHS paper guidelines.

To get involved with Science Fair or JSHS, teachers should contact the closest Regional Science Fair to your school. Visit www.mnmas.org for more information or email the Director, Lise Weegman, at lise@mnmas.org.

Students – Apply for the High School STEM Communicator Awards Program

By Karen Newell, Program Manager

The goal of the High School STEM Communicator Awards program is to identify and encourage high school students who show exceptional potential in performing scientific and mathematical research, in communicating their research through writing, and in understanding the societal context of their research and results. Top students receive a cash prize, medallion, and publication in the *Minnesota Academy of Science Journal of Student Research*.

All students applying for the High School STEM Communicator Awards program must submit an Intent to Apply by **December 15, 2014** and submit all of their application materials by January 15, 2015. For more details visit www.mnmas.org.

Looking Ahead to the 2015 Science Bowls

By Barbara Donoho, Program Manager

The Minnesota Academy of Science sponsors the Minnesota State Regional Science Bowl, a highly competitive science education and academic tournament of high school and middle school students who compete in fast-paced verbal forums to solve technical problems and answer questions in all branches of science and mathematics.

To maximize the number of schools participating in each tournament, teams are registered on a first-come, first-served basis so the date the paperwork is received is very important. If a school wishes to have more than one team participate, they should submit registration materials and payment for up to three teams, as early as possible, but no later than the registration deadline.

The winning team from each of the Minnesota Regional Science Bowl tournaments will go on to compete in an all-expense paid trip to the National Science Bowl (NSB) in Washington D.C., April 30 – May 4, 2015.

High School Science Bowl tournament

SATURDAY, January 24, 2015

Macalester College

Registration Deadline: December 15, 2014

32 teams (grades 9-12)

Middle School Science Bowl tournament

Saturday, February 14, 2015

University of St. Thomas

Registration Deadline: January 15, 2015

24 teams (grades 6-8)

For more information about Science Bowl and registration, please visit our website <http://www.mnmas.org/science-bowl/science-bowl> or contact Barbara Donoho, Science Bowl Manager, bdonoho@mnmas.org.



Eden Prairie Central Middle School (left) waits to start their match against Wayzata West Middle School (right)

Photo by Eliza Grames

Science and Engineering Judges Needed

Judges are needed to evaluate student projects and provide feedback to students on their research and presentation skills at the 2015 State Science & Engineering Fair and North Central Regional Junior Science & Humanities Symposium (JSHS). The competitions take place from March 20-23, 2015 in Bloomington, MN.

Judges' scores are used to determine student winners for more than \$25,000 worth of awards and scholarships. The top four high school projects go on to compete in the prestigious Intel International Science & Engineering Fair (ISEF). Not only do judges have fun helping out and encouraging students to pursue science and engineering, this is an excellent opportunity for networking and developing evaluation skills. Learn more at <http://mnmas.org/science-engineering-fair/judges>

Science Bowl Volunteers Needed

Approximately 150 volunteers are needed to run the Minnesota State Regional Science Bowl of High School Students to be held January 24, 2015 and the Minnesota State Regional Science Bowl for Middle School Students to be held February 14, 2015. The majority of volunteers are either working in academia or in one of the many scientific companies in the area. Chemists, physicians, researchers, engineers, professors, biologists and many others help to continue the Minnesota Academy of Science's long tradition of programs of excellence. Volunteers staff the roles of question proofreader, moderator, scientific judge, scorekeeper, rules judge, and timekeeper. Training is provided on-site the day of each event. Volunteers may work either or both of the competitions. Learn more at <http://mnmas.org/science-bowl/volunteers>

Dates for the Annual Meeting & Winchell Undergraduate Research Symposium

2015

University of Northwestern, St. Paul
Saturday, April 25, 2015
Chair: Dr. Joanna Klein

2016*

University of Minnesota - Twin Cities
Friday, April 29, 2016
Chair: Dr. Alptekin Aksan

2017

Macalester College
Date TBD

**In 2016, the Winchell Undergraduate Research Symposium will be held in conjunction with the University of Minnesota Office of Undergraduate Research Undergraduate Research Symposium.*

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