

# Minnesota Academy of Science Newsletter



## MINNESOTA ACADEMY OF SCIENCE

### In this Issue

Message from the President	3
Support from Sponsors	4
Recap: Science Bowl	8
Recap: High School STEM Communicator Awards	9
Reviewing Student Papers	10
Recap: Annual Meeting	11
Learning from Peers	13
Recap: JSHS	15
Recap: Science Fair	17
Student Article: My First (and Last) Science Fair	19
Recap: ISEF	22
Student Article: It All Started with a Simple 6th Grade Science Experiment	25

## How Sponsors Help Us Fulfill Our Mission

By Celia Waldock, Executive Director

The Minnesota Academy of Science is a small non-profit organization that reaches thousands of students every year with educational programs that motivate them to learn and participate in science.

Some students spend all year working on research projects for the State Science & Engineering Fair and present projects ranging from *Scalable Algorithms with Novel Data Structures for Contiguity-Constrained Disaster Response and Evacuation Planning (Phase II)* (Apurv Shekhar) to *Prejudice in Adolescents* (Sabirina Daud) to *The Use of an Oscillating Water Column to Harness Wave Energy* (Katherine Harding) to *GnOME 1.0: A Streamlined App for Surveyors* (Stephen Joyce).

Other students spend hundreds of hours working on research projects and preparing presentations for the North Central Regional Junior Science & Humanities Symposium on topics ranging from *Effects of Early Mdewakanton Dakota Settlement Patterns on the Ecology of Lake Calhoun* (Grant Two Bulls) to *Comparative Analysis of Different DNA Extraction Buffers* (Karina Skov). Or they can submit their research papers to our High School STEM Communicator Program learning how to communicate the real-world application of their research.

Teams of students spend hundreds of hours working to prepare for competing in the Minnesota Academy of Science High School or Middle School Science Bowls, which are fast-paced, highly competitive question and answer quizzes posing questions in all fields of science and math.



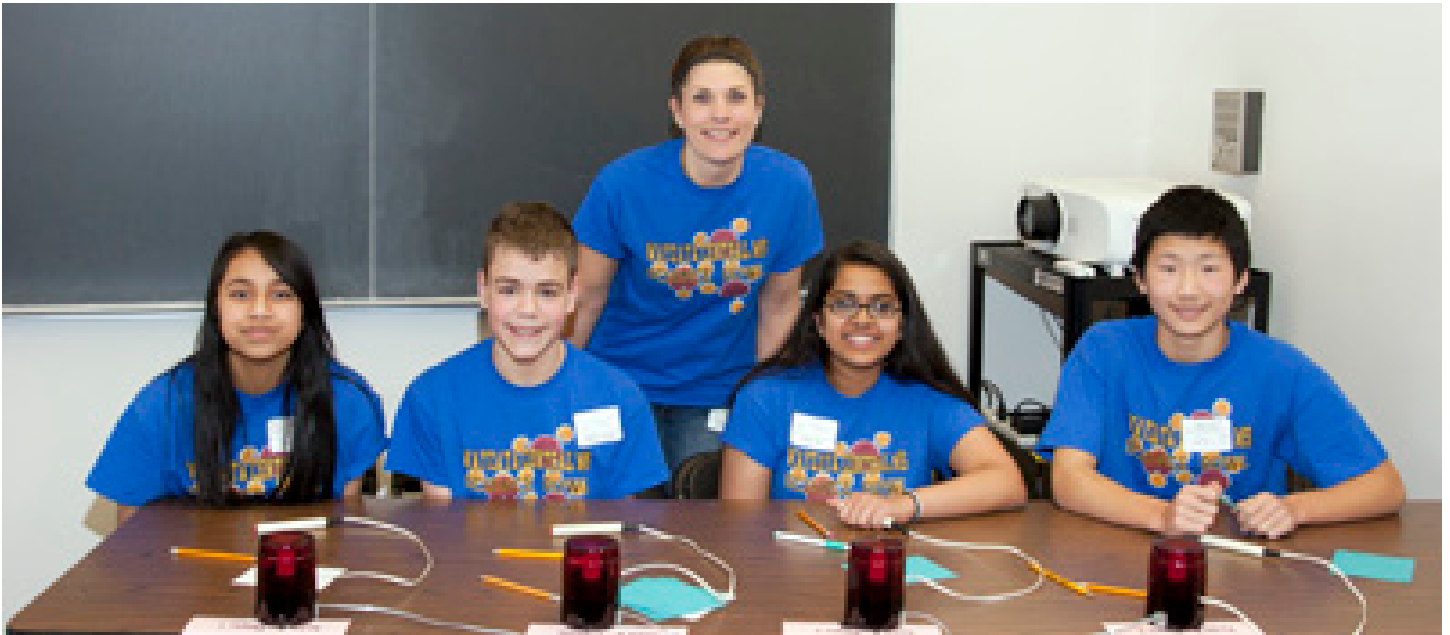
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# How Sponsors Help Us Fulfill Our Mission (Cont.)

The students who participate in our programs have the opportunity to move on to national and international competitions and they represent Minnesota well. Each year, Minnesota students take home thousands of dollars in college scholarships at the National Junior Science & Humanities Symposium, or win prizes such as a trip to visit the CERN Large Hadron Collider particle accelerator in Switzerland at the Intel International Science & Engineering Fair. They distinguish themselves by being invited to participate in the White House Science Fair or the Intel Science Talent Search. They've even had the opportunity to meet the President of the United States!

Our sponsors help us make these wonderful opportunities happen! And we could use your help. If your company is not a sponsor of the Minnesota Academy of Science, please provide us with contact information to invite them to participate. Gifts range from \$1,000 to \$50,000. And there's plenty of recognition opportunities for our great sponsors. Please contact Celia Waldock at [ed@mnmnas.org](mailto:ed@mnmnas.org) with information or questions.

Students do it for the fun, for the camaraderie, for the stimulation, and for the love of science and learning! We do it for the satisfaction of helping students discover science and find their passion.



*Wayzata Central Middle School Team 1 at the 2015 Middle School Science Bowl*

*Photo by Dave Newell*

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## Membership Information

Minnesota will need to fill 188,000 jobs in the fields of science, technology, engineering, and math (STEM) by 2018. The Minnesota Academy of Science works to foster interest in STEM fields by providing opportunities for students and adults to experience the excitement of scientific discovery.

Since 1873, our supporting members have made it possible for MAS to promote scientific exploration, education, and networking through programs for scientists of all ages. Our programs mobilize educators, science professionals, and businesses to provide opportunities for students and adults to showcase their scientific research and gain recognition for their remarkable contributions.

Become a member of the Minnesota Academy of Science and help us recognize, promote, and influence excellence in science at all levels. Join or renew at [www.mnmnas.org/memberships](http://www.mnmnas.org/memberships).

## Board of Directors

The Minnesota Academy of Science Board of Directors is made up of representatives from K-12 education, colleges and universities, and industry professionals. They include science teachers and professors, professional scientists, and other adults who support science and science education. Board members are elected by the Board of Directors to serve a three-year term. Officers are elected by the voting membership.

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## Message from the President

By Mike Williams, President of the Board of Directors

Although most people think of programs like the State Science & Engineering Fair as a pipeline to a career in science, technology, engineering, or mathematics (STEM), the skills students gain by participating in science programs can also help prepare them for non-STEM careers.

By participating in STEM-oriented programs like Science Bowl or the Junior Science & Humanities Symposium (JSHS), students learn skills like problem solving, teamwork, critical thinking, and analytical skills. These skills are in high demand in non-STEM fields such as finance, teaching, law, and policy.

My educational background is in microbiology. I have B.S. and Ph.D. degrees Microbiology. In addition, I have post-doctoral research experience in molecular genetics and biochemistry. This training prepared me for a career in teaching or industry. After teaching at a university for a year, I joined a Research & Development group at 3M Company, where I used my training to use microbes to produce new materials and to develop products for detecting microorganisms in food and beverages.

This background in science was invaluable in preparing me for my current position as a Patent Agent for 3M Innovative Properties Company. In order to

become a registered Patent Agent at the U.S. Patent & Trademark Office, you must have the equivalent of at least a Bachelor's Degree in one of several recognized scientific fields. As a Patent Agent, I use my technical education and technical writing experience to draft patent applications that are translated into other languages and filed in various countries around the world. In this role, I need to analyze the patent literature and non-patent scientific publications to determine (and describe) how our inventions are different from previously-discovered articles, compositions, and methods.

My interest in science blossomed at a very young age. At that time, I had no idea my passion for science could prepare me for a job in a legal profession. I have found that, regardless of what students choose to study in college or what field they pursue when they enter the workforce, the skills they develop by participating in science programs (such as those sponsored by the Minnesota Academy of Science) will prove invaluable.

“...STUDENTS LEARN SKILLS LIKE PROBLEM SOLVING, TEAMWORK, CRITICAL THINKING, AND ANALYTICAL SKILLS.”

# 3M Supports Science Fair from Day One

By Celia Waldock, Executive Director



You'll find them in backyards and basements, in sheds and garages, in fields and farmyards, in lakes and swamps, in classrooms and college labs, anywhere you can think of students are conducting scientific research. Students are spurred by their interest, inspired by their teachers, and motivated by their opportunities. Opportunities such as the Minnesota Academy of Science State Science & Engineering Fair, a program in which tens of thousands of Minnesota students have had life-changing experiences conducting research for 78 years!

We are proud to have provided this program to Minnesota students and proud to say that 3M Company and 3M Foundation have been right there with us the entire time. 3M has provided financial support as a major sponsor of the Minnesota Academy of Science since the inception of the State Science & Engineering Fair in 1938. Right from the start, 3M recognized the need to support community efforts and to provide programs that motivate students to pursue science, teaching them the skills to be our future leaders and innovators.

Participating in research and presenting at the State Science & Engineering Fair allows students to:

- connect with science in a personal way;
- meet and interact with other students who love science;
- conduct research that has real-world impact;
- earn recognition and reward for their efforts;
- gain opportunities for college and internships;
- meet, interact and learn from Ph.D. experts in their fields of interest; and
- develop, learn, and master skill sets that prepare them for college and careers in science, technology, engineering and math (STEM).



2015 3M Innovation Award winners with representatives from 3M

Photo by Richard Kiely

The spirit of innovation and collaboration that forms the foundation of 3M is also the basis for the 3M Innovation Awards judged every year at the State Science & Engineering Fair by 3M volunteers and presented to students such as eleventh grader Jason Sylvestre for *Engineering Voltx, A Multifunction Teleoperated Rescue Robot* and seventh grader Sarah Betts for *An Exercise Therapy Program and Hand Device Invented to Benefit Osteoarthritic Patients* and eighth grader Andy Eggebraaten for *Building a Better Robotic Hand: Stronger, Wireless, Tactile Feedback, Controllable With an Iphone App* and twelfth grader Alanna Bram for *Optimizing Human Machine Interfaces for Improving Object Detection Assistive Devices*. 3M Innovation Awards include \$1,000 each to the most innovative high school and middle school project; \$750 to second place in high school and middle school and \$500 each to third place in high school and middle school.

Thanks to 3M for their incredible generosity and inspiration to our students!

# Seagate is Instrumental in Helping State Science & Engineering Fair Promote Excellence in Science

By Lise Weegman, State Science & Engineering Fair Director

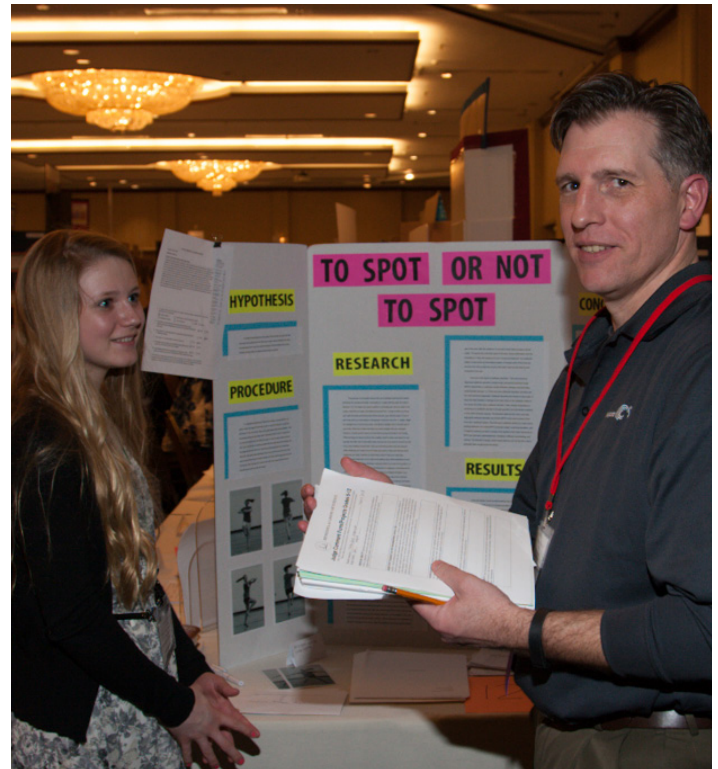
Seagate Technology has been a principal sponsor of the Minnesota Academy of Science State Science & Engineering Fair for over 16 years. With funding from sponsors like Seagate, the Minnesota Academy of Science is able to invite over 500 students to advance from the eight ISEF affiliated Regional Science Fairs throughout Minnesota to the state level of competition.

In order to invite such a large number of projects and students to the state competition, it is vital that there are enough judges to evaluate and score the projects and papers for both the middle school and high school students. Many general volunteers are also required to help monitor various workshops, activities and meals that we provide during the course of the three-day competition. Seagate Technology provides almost 25% of the needed 220 project judges. Seagate employees and their families also serve as general volunteers to help cover critical areas while a few long-term Seagate volunteer veterans act as team leads to help oversee such areas. Seagate provides technical help when needed and Seagate employees have been emceeing the Grand Awards ceremony for ten years.

By encouraging creativity, reinforcing practical application of student's skills and rewarding academic excellence through the use of scientific method or engineering design, the State Science & Engineering Fair aims to cultivate students' scientific research abilities and help them develop the skills necessary to succeed in the fields of science and technology. Seagate Technology helps recognize student excellence by sponsoring a variety of awards at the Grand Awards Ceremony on the last day of the State Science & Engineering Fair.



SEAGATE



*Seagate judges interview students about their projects at the 2014 State Science & Engineering Fair*

*Photos by Dave Newell*

# Seagate is Instrumental in Helping State Science & Engineering Fair Promote Excellence in Science (Cont).

The Seagate Excellence in Science Mentoring Award recognizes outstanding science teachers from around the state who mentor students science fair projects and who find creative ways to nurture students' interest in scientific research and discovery. The award acknowledges teachers who go above and beyond to promote science education in their schools and who encourage students to engage in hands-on projects and experiences outside the classroom. Seagate Technology gives two awards – one for a teacher with less than 10 years of experience and another for a teacher with 11 or more years of experience. Award recipients receive a \$1,000 cash award, plaque and a Seagate portable hard drive. The teachers' schools science labs also receive a \$1,000 cash award and a plaque for their showcase.



*2015 Seagate Excellence in Science Mentoring Award Winners Jodi Prchal and Nick Schmitz*

*Photo by Saleem Ghani*

The Seagate Rising Star Award recognizes two emerging student scientists whose projects not only exemplify excellence in their category but also demonstrate high degrees of difficulty, thoroughness, complexity, creativity, innovation, and effective communication. One high school student receives a \$2,000 award, trophy, and a Seagate portable hard drive; and one middle school student receives a \$1,500 award, trophy, and a Seagate portable hard drive.

The Seagate Emerging Scientist Award recognizes excellent scientific research conducted by students competing for the first time. The top 10% of first-year students receive trophies. Team projects are eligible if all members are first-year participants.

Thank you, Seagate, for your continued financial and volunteer support. We couldn't do it without you!



*2015 Seagate Emerging Scientist Award Winners with Heidi Olson and Ed Neu from Seagate*

*Photo by Saleem Ghani*

# Ecolab has a Long History of Believing in Students

By Celia Waldock, Executive Director

In 1923, Merritt J. Osborn developed a new product that cleaned carpets on the spot and eliminated the need for hotels to shut down to be cleaned. That product, Absorbit™, was the first of many that the newly founded Economics Laboratory would develop over the years. The name Economics Laboratory reflected the company's mission to save customer time, labor, and money with "economic" solutions developed through "laboratory" research. Today, we know the company as Ecolab.



Ecolab's long history of laboratory research goes hand-in-hand with its long history of believing in the power of students and student research. To promote scientific learning and research at a young age, Ecolab Foundation supports the Minnesota Academy of Science State Science & Engineering Fair. To encourage student research, the Ecolab Foundation presents the Ecolab Food Safety Award to one middle school and one high school student whose research seeks to improve food safety through research. The Ecolab Foundation also presents the Ecolab Green Award to one middle school and one high school student. Both awards include a \$700 prize to reward students for their research efforts and to help fund their future studies.



2015 Ecolab award winners

Photo by Richard Kiely

After many years of sponsoring High School Science Bowl, in 2008 the Ecolab Foundation began providing additional funding to start the Minnesota Academy of Science Middle School Science Bowl, encouraging the enthusiasm of sixth, seventh and eighth graders as they log countless hours studying to compete in the fast-paced question and answer tournament.

Ecolab's generosity has paid off in myriad ways for innumerable students. Students such as seventh grader Aiden Flick who reports, "Science Bowl gave me a lot more than just knowledge of science. Sure, I learned about lysosomes, paper chromatography, the Jurassic Period, light bulb filaments, the life cycle of the Great Horned Owl, and a whole host of other things, but Science Bowl meant more than that. Science Bowl taught me to, as our coach put it, "BUZZ IN!" It gave me the courage to speak and be heard. It also gave me friends: I met many new people just in our school. I thought I was pretty useless on our team when we started out. I hardly ever buzzed in, and I lacked self-confidence. Once we began practicing, I was encouraged to buzz in more. But my real confidence booster came after we won Regionals. We began work on our car, and I found that I was helpful with the design document. Where other people can calculate and memorize information, I can write. So I used the skills I had and created a dynamite design document!"

Thank you, Ecolab, for helping the Minnesota Academy of Science fuel the STEM pipeline, creating a strong future workforce and scientific leadership!

# Recap: Middle School and High School Science Bowl

By Barbara Donoho, Science Bowl Program Manager

The 2015 Minnesota State Regional Science Bowls for High School Students and for Middle School students finished with two winning teams qualifying to represent Minnesota and compete at the National Science Bowl in an all-expense paid trip to Washington, D.C., hosted by the U.S. Department of Energy. The DOE outlines all materials and details the roles for regional participants, volunteers, and the coordinator. Tournaments are conducted in a fast-paced question and answer format, with five-person teams going head-to-head to buzz in and answer questions.



*Eden Prairie Central Middle School Team 1 with their first place medals and trophy* *Photo by Eliza Games*

The 21st Minnesota State Regional Science Bowl for High School students (grades 9-12) was held on January 24, 2015 at Macalester College. New this year was that the competition was held on a Saturday. Thirty-two five-person teams from 23 schools competed in the day long tournament, solving technical problems and answering questions in all branches of science and math.

Award Presented	Recipient
First Place	The Blake School Team 1
Second Place	Chanhassen High School Team 1
Third Place	Wayzata High School Team 1
Civility Award	Minnetonka High School Team 1

The 8th Minnesota State Regional Science Bowl for Middle School students (grades 6-8) was held on Saturday, February 14, 2015 at the University of St. Thomas. Twenty-four five-person teams from 17 schools played multiple games in a round robin tournament with the chance to advance to a double-elimination championship.

Award Presented	Recipient
First Place	Eden Prairie Central Middle School Team 1
Second Place	Minnetonka West Middle School Team 1
Third Place	Wayzata Central Middle School Team 1
Civility Award	Guardian Angels Elementary School

More than 100 individuals volunteered to make these events very successful and run smoothly. A new on-line volunteer registration process streamlined registering, task assignments and communicating to a more efficient procedure. The volunteers were very enthusiastic and committed to wanting youth to have a fun learning experience with math and science. Volunteers took on a variety of roles including being a moderator, scorekeeper, timekeeper, scientific judge, proofreader or a general volunteer. Many volunteers make Science Bowl an annual commitment with 74% of them having volunteered previously. Thank you Science Bowl Volunteers!



*Science Bowl volunteers* *Photo by Eliza Games*



# Recap: High School STEM Communicator Awards

By Karen Newell, Program Manager

2015 was a record year for participation in the High School STEM Communicator Awards program. Almost 50 students sent in letters of intent to apply for the program, though only 38 of those students submitted their final papers. The students who applied represented 17 schools, a large increase from the seven schools participating in 2014. More freshmen and sophomores submitted papers.

Part of the participation growth this year was due to our increased efforts to make the competition open to a wider range of participants and to make it easier for students to understand the guidelines for their papers. We modified the application criteria by requiring less advanced classes, which opened up the program to underclassmen. We also carefully edited the Editorial Policies to make them more student-friendly.

Perhaps the biggest change we made this year was extending the deadline for submitting papers until after the State Science & Engineering Fair and North Central Regional JSHS. This meant that students could focus on one competition at a time, and not have to worry about making final changes to their project boards, practicing their presentations, and editing their papers all at the same time.

We had 38 volunteer readers evaluate the writing and scientific content, and provide written feedback to the students. Current scientists working in the field, citizen scientists, high school STEM educators, and technical writers volunteered to evaluate the papers. The judges' scores were combined with information from five readability tests (e.g. the Automated Readability Index) to determine the top 10 student papers and the honorable mentions.

For 2016, we will continue to work on encouraging student participation, increasing the amount of time students have to work on their papers, and clarifying the editing process. We hope the program continues to grow as it has over the past three years and more students have the opportunity to receive detailed feedback on their scientific writing and an opportunity to publish their work.

Thank you to St. Jude Medical for their generous support of this program!



*Evelyn McChesney and Maddy McCue work on their project*

*Photo courtesy of Evelyn McChesney*

# Reviewing Student Research Papers

By Stephanie Yancey, Board Vice President

Judging two of the papers that were submitted to the High School STEM Communicator Awards program reminded me of how important good writing skills are in science, mathematics and engineering. In the age of tweets and texts, it is heartening to know that some of our high school students still care enough to take the time to write a scholarly paper.

I volunteered to be one of the “working scientist” judges because I have seen first-hand what can happen to papers or grant proposals when the writing is not clear and precise. Every discipline has its jargon, and we can get bogged down in our acronyms and technical lingo to the point where it doesn’t even sound like English. There was no formal science writing class when I was in college, so I had to learn in graduate school. This would be much too late in one’s career now. Style manuals and instructions to authors from journals give rules to follow, but they can generate a stilted writing style that doesn’t sound natural and is difficult to master.

**“ I OFTEN TELL STUDENTS THAT ONE COMMON TRAIT OF ALL SCIENTISTS, REGARDLESS OF DISCIPLINE, IS A WELL-HONED SENSE OF CURIOSITY.**

To submit papers to High School STEM Communicator awards, students may work in teams of no more than two individuals. They were asked to submit biographical essays as well as an abstract and a completed manuscript. The essay allows judges to read each student’s “native” writing, to help determine how much (or how little!) effort they put into the paper itself, or how much editing may have been done by someone other than the author(s). I was

fortunate to read two papers from two teams who wrote essays that gave me a sense of who they were as people and why they were interested in the work they presented. They didn’t sound faked, or as if they’d been told to write a certain way.

I genuinely enjoyed reading both papers. It was obvious that they were written by students who had a good grasp of the basic science involved and weren’t simply repeating information they got from a post-doc or grad student. This is one criterion that we judge on and it often sets the winners above the rest. I don’t want to give away whose papers I read, but one did take me back to my graduate school days. It brought back fond memories of watching students reach that “aha!” moment, when the answer finally dawns on them. With the second paper, there were a few mistakes that were easily corrected, but I also learned some interesting tidbits along the way, and that is always a good thing. I often tell students that one common trait of all scientists, regardless of discipline, is a well-honed sense of curiosity. And happiness in solving puzzles.

I hope that my comments to these young scientists did not nip their senses in the bud, so to speak. We all need help to look at our work with fresh eyes, to see the little inconsistencies that might confuse readers or simply point out a graph legend that is backwards. We all make mistakes. The winning papers will be published in the Minnesota Academy of Science Journal of Student Research. My goal was to make sure that the articles chosen were of the highest quality. It makes me very happy to learn that one of the papers I read was one of the 10 winners while the other earned an honorable mention.

I certainly plan on participating in this worthy endeavor in the future, and applaud the effort of the Minnesota Academy of Science to promote science/engineering/math writing skills at an early age. Regardless of whether these students go on to careers in STEM fields, the skills they acquire now will be useful no matter their future paths.

# Recap: Annual Meeting & Winchell Undergraduate Research Symposium

By Eliza Grames, Annual Meeting Coordinator

The 2015 Annual Meeting & Winchell Undergraduate Research Symposium was held at the University of Northwestern – St. Paul on April 25, 2015.

A total of 172 people participated in the Annual Meeting in 2015, including 105 student presenters. Student presenters represented 20 different colleges and universities, five of which were brand new to the symposium this year. We were pleased to welcome students from Anoka Ramsey Community College, Augustana College (South Dakota), Bemidji State University, the College of St. Scholastica, and Concordia University – St. Paul to the symposium.

Students presented projects in ten out of eleven eligible disciplines. Research projects ranged from calf-cow interactions in wild female African Elephants, to optimizing reaction rates between sodium borohydride and ethylene glycol for use in portable fuel cells, to protein changes associated with rapid winter recovery in conifers, to a study of problem-solving differences between students in the natural vs. social sciences.

New awards were given out in 2015. The new awards were named for past presidents of the Minnesota Academy of Science who were leaders in their fields and were awarded to the top 10% of students in each discipline. The American Chemical Society also gave awards to top chemistry and biochemistry students. Judges selected 31 students to receive the awards.

We were honored to have Dr. David Odde, Professor of Biomedical Engineering at the University of Minnesota, as the keynote speaker. Dr. Odde's current research seeks to discover how cells migrate and divide; currently, this research is focused on these processes as they relate to brain cancer progression. The goal of his laboratory is to develop "flight simulators" for cancer cell migration and division which can be used to identify novel therapeutic strategies. The title of his talk was "Building Cell Simulators" and received positive reviews from the students, advisors, volunteers, and judges who attended.

The planning committee was chaired by Dr. Joanna Klein, Professor of Biology at the University of Northwestern. Dr. Klein volunteered to host the symposium after attending for the first time last year at St. Mary's University of Minnesota. Dr. Klein was joined on the committee by seven faculty members at four different colleges and universities. Thank you to all the members of the planning committee who put in hundreds of hours of work to make the symposium so successful.

Thank you to our generous sponsors who support the symposium and make it affordable for students to participate.

American Chemical Society – Minnesota Local Section

Anonymous donation in memory of former Executive Director M.I. (Buzz) Harrigan

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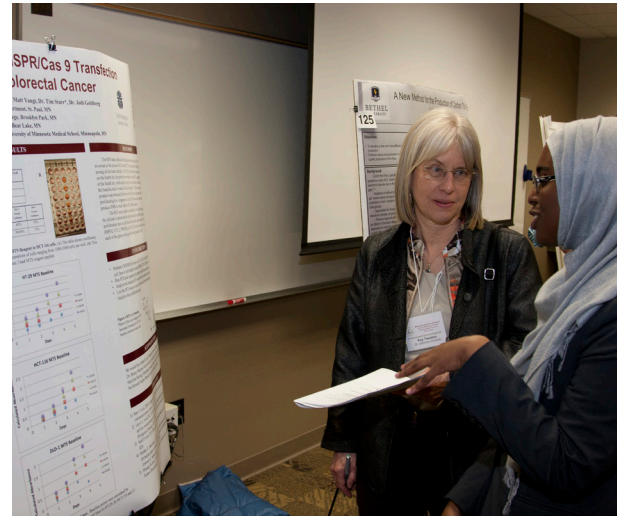
University of Northwestern – St. Paul

# In Pictures: Annual Meeting & Winchell Undergraduate Research Symposium

Photos by Dave Newell



*Gilbert Penaherrera from Bemidji State University presents his research on problem solving in social vs. natural sciences*



*Fathima Mohamed explains her research for Kay Tweeten, professor at St. Kate's*



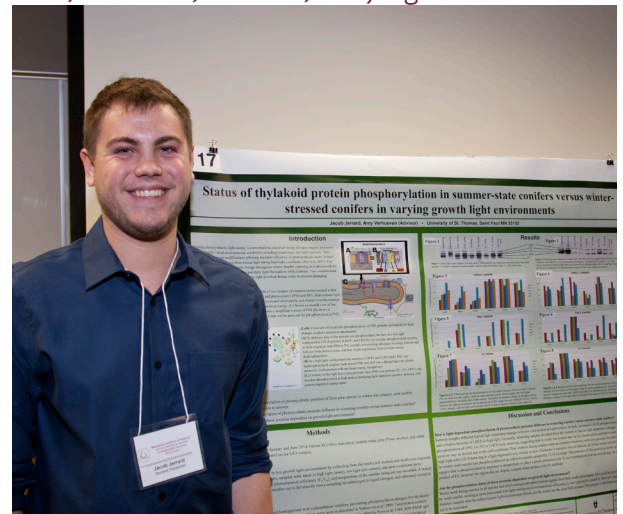
*Judge Gibson Batch (left) from 3M talks with keynote speaker Dr. David Odde (right)*



*The morning and afternoon poster sessions were packed with student presenters, observers, advisors, and judges*



*Isaac Wakiro is the first student from the College of St. Scholastica to present at the symposium*

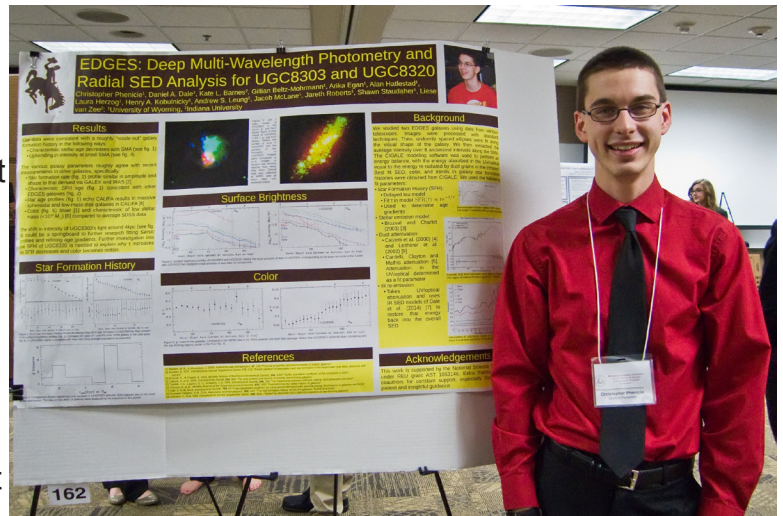


*Jacob Jerrard from the University of St. Thomas*

# Learning from Peers at the Winchell Undergraduate Research Symposium

By Chris Phenicie, University of Minnesota '16

A little over a year ago, I nervously walked around the poster session at the Winchell Undergraduate Research Symposium in Winona. I was a confused physics major looking at posters that definitely were not about physics. All the titles were “drosophila”-this and “ethyl”-that. From what I can tell, this is a common trend in undergraduate symposia: the field is dominated by biology, chemistry, and ecology. I had little to no background on any of the research. This was tough news for me to grapple with. How is it that I, a physicist, practicing the “most pure” science of anyone at the symposium, could be so lost? My science explains their science!



Chris with his poster at the 2015 symposium

Photo by Mike Phenicie

I timidly attempted to interact with people that seemed the least busy, that way other people wouldn't hear me ask “stupid” questions about their research methods. Much to my surprise, I started to learn a lot. Perhaps more than I've ever learned in an hour. Even more surprisingly, I was really enjoying what I was learning. There is something incredibly refreshing about talking to people who are passionate about science, and Winchell attracts the most passionate undergraduate scientists in Minnesota (and many from out of state!). Once I got past the big words, I realized our data taking strategies are essentially the same. Other scientists still use the scientific method. That is something quite beautiful.

There's something else special about Winchell that is only possible because it's an undergraduate symposium: when most presenters at the Winchell talk about their research, I actually understand them. They are able to explain to me new concepts without assuming any background knowledge. I really understood how special this is after I attended the American Astronomical Society (AAS) meeting in January. If there's one thing I learned from the AAS meeting, it's that astronomers love acronyms. My goodness. I'd hear things like “You can see from the SED that the AGN contains O and B type stars.” All I really was thinking that whole time was “IDK”, and tried not to “LOL”.

Of course, I'm painting this picture too black-and-white. It's certainly not true that every presenter at the AAS was cryptic, just as it is not true that all presenters at Winchell are understandable or engaging. Indeed, many people at Winchell are not prepared to present, and it's not easy to learn from them. One example was yours truly. At my first Winchell in Winona, I was caught up on the first question a judge asked me. He glanced at my poster and asked me to “start from the beginning.” (In retrospect, I should have expected people to ask me to explain my poster.) In the first 30 seconds as I struggled to explain what I did, I realized explaining research is hard. Not only do I have to understand what I did, I have to get someone else to understand what I did. I was not ready for this. But, thanks to the excellent design of the Winchell, I had three judges come by and provide detailed feedback about what I could do better. I was having tenured faculty, the exact people I need to impress over the next 10 years, telling me exactly how I could better impress them. It was ridiculously productive.

# Learning from Peers at the Winchell Undergraduate Research Symposium (Cont.)

Presenting at Winchell taught me how to engage people in what I'm saying and explain my work in terms they understand. This is a skill I think most physics students lack precisely because we don't have a strong showing at symposia. However, our entire future depends on presenting our work. No one is going to pay a researcher that has no results to speak of. This fact alone convinced me to attend Winchell again: it's incredibly cheap job experience. I was probably already going to return because of my engaging peers and, most importantly, the good food, but job experience sounds more responsible.

**“ PRESENTING AT WINCHELL TAUGHT ME HOW TO ENGAGE PEOPLE IN WHAT I'M SAYING AND EXPLAIN MY WORK IN TERMS THEY UNDERSTAND.**



*Chris did an oral presentation on his material science research project*

*Photo by Mike Phenicie*

I'm actually quite thankful there were hardly any other physics posters at Winchell in Winona. It forced me to broaden my horizons, and really got me thinking about other fields of study. Even squishy and smelly fields of study. This fall I was looking to start a new research project. I remembered one poster I particularly liked from Winchell was solar cell research. So, I looked around for research in solar cells at my home university. There was no research on solar cells in the physics department. But, brazen with my interest from the Winchell, I looked at working with a professor in the Materials Science department (one of those "smelly" fields filled with Chemistry). I was lucky enough to start a project about growing crystalline solar cells in September, and it was love at first growth.

By March, I had enough data to submit my abstract to for my second Winchell. I was a lot more prepared to present my results this time around. When I attended the Winchell this year, I was still a confused physicist walking around the room, but I was no longer timid. With the knowledge I gained from my first time around, I was able to make the most of this poster session. I wanted to know what else Materials Science has to hold for me, and I was in the perfect place to find out. I found three or four projects that focused on what I was interested in, and I was able to learn exactly what sort of machines the projects needed, what was good/bad about the project. In about 10 minutes, I was able to gain the wisdom of a semester of hard work.

At the end of the day, I was feeling even more refreshed and ready for research than my first time at the Winchell. It was without a doubt the most productive day of the year (except, perhaps, the day before a paper is due). A lot had changed about me since my first Winchell. I've grown a little more interdisciplinary and a lot less conceited. I can't wait to wander around in confusion again next April, becoming hopelessly engaged in the work of my peers.

# Recap: Junior Science & Humanities Symposium

By Lise Weegman, Program Director

The North Central Regional Junior Science & Humanities Symposium (JSHS) is a competition hosted by the Minnesota Academy of Science and is no exception to the organization's mission to recognize, promote and influence excellence in science.

The North Central Regional JSHS is a scientific research paper competition for high school students in Minnesota, South Dakota, and North Dakota. The primary aims of JSHS are to promote original research and experimentation in the sciences, engineering, and mathematics at the high school level, and to publicly recognize students for outstanding achievement. By involving talented students and their teachers in affiliated symposia, and by recognizing students' research endeavors through scholarships and other awards, JSHS aims to encourage continued interest and participation in the sciences and ultimately to widen the pool of trained scientific and engineering talent prepared to conduct research and development vital to our nation. The Minnesota Academy of Science has hosted the North Central Regional JSHS since 1968. The first National JSHS competition was held in 1962.

The 2015 North Central Regional JSHS competition was held March 22-23 at the Doubletree Hotel in Bloomington, Minnesota. Seventy papers advanced from the eight Regional Science Fairs throughout the state to compete at the North Central Regional JSHS. Top students received awards and the top five students advanced to the National JSHS competition.

The first round of competition began on Sunday, March 22. Students presented their scientific research papers according to their category in seven different category rooms where judges sat, listened, evaluated and scored each student paper in the room based on the student's research PowerPoint presentation.

While students were anxiously awaiting callbacks, students and adults alike were able to sit back, relax, talk over the day of judging, and listen to some smooth jazz before and during dinner brought to us by the Reid Kennedy Trio. After dinner, students and adults listened to the keynote speaker, Dr. Eugene Kwon from the Mayo Clinic. His research in the Kwon Lab focuses on methods to evoke a potent immune response to treat relatively advanced forms of malignancy. Specific areas of research pertain to the preclinical and clinical use of novel vaccines and antibodies to activate antitumoral T cells; the use of hormone manipulations to boost or rebuild host immunity; the treatment of patients with immunotherapy in order to induce clinical tumor regression. A special emphasis is placed on developing highly state-of-the-art immunotherapies to be tested in clinical phase I or II trials to treat patients with prostate, kidney or bladder cancer.



*Students and professional scientists mingle during Breakfast with the Scientists*

*Photo by Eliza Grames*

# Recap: Junior Science & Humanities Symposium

After dinner, top papers were called back for a second presentation with the judges. In the callback round, students compete to advance to the National JSHS as well as to the American Junior Academy of Science (AJAS) conference. The participants who were not called back were able to listen to the presentations, or head to the student hang-out lounge where students were interacting, meeting other students, and playing board games with others from around the state.

On Monday morning, the students were engaged in conversations during round table discussions with eleven scientists from different organizations and academia. The North Central Regional JSHS concluded with the awards ceremony where students were recognized for their scientific excellence with scholarships, medals, and certificates. Five papers were selected for an all-expense paid trip to compete at the National JSHS in Hunt Valley, Maryland from April 29-May 2.

Additionally, one paper received an all-expense paid trip to the American Association for the Advancement of Science (AAAS) Annual Meeting in Washington, D.C. from February 10-14, 2016, where students will be able to present their scientific research in a non-compete traditional presentation style, or round table discussion format with scientists from AAAS. AAAS is an international non-profit organization dedicated to advancing science for the benefit of all people. The American Junior Academy of Science (AJAS) mission is to introduce, encourage and accelerate pre-college students into the world of science, engineering and technology by enabling and integrating their participation into the social, cultural and scientific activities at the AAAS Annual Meeting.

The 2016 North Central Regional JSHS will be held April 2-3 at the Doubletree hotel in Bloomington, Minnesota.



*First, second, third, fourth, and fifth place winners (from left to right)*

*Photo by Eliza Grames*



*Outstanding Achievement Award Winners*

*Photo by Eliza Grames*



*A student accepts her participation certificate*

*Photo by Steve Jons*



# Recap: State Science & Engineering Fair

By Lise Weegman, Program Director

I had a wonderful conversation while at International Science & Engineering fair (ISEF) with one of the high school students who advanced from State Science & Engineering Fair to compete in ISEF. Though this student did not win awards at ISEF, he commented to me that he really enjoyed his experience at the international level. It was his first experience at the regional and state level too, and he only wished that he would have been involved in science fair much earlier than a senior in high school. This student put everything into perspective of why students should participate in science fair, and is currently helping his younger brother's 5th and 6th grade science teacher with becoming involved in science fair for the 2015-2016 school year.

So, why you ask would a student want to compete in science fair? Why would a teacher use up hours of his/her time in helping students learn the scientific method, or engineering design, write a hypothesis, collect data, learn to analyze that data, interpret results, and think about future research?

Some of you may know the answers while others may not. As the state science fair director, and a parent of three children who all competed in science fair from grades 7 through 12, I am able to tell you from my perspective: To be able to formulate an educated decision, based on exploration, literature, data and experience, as to whether or not they want to become scientists and engineers in the future. Both at the state and national level, we need qualified individuals to move into science, technology, engineering and math positions and our governments are focusing more on STEM education to fill those needs. The students would also like to advance to the next level of competition, be able to share their research with experts in the field, win awards, and win scholarships to any college of their choice. The students look forward to spending time with other students who share similar excitement and passion for science, technology engineering and math. By advancing to the State Science & Engineering Fair, students are able to do just that. The mission of the Minnesota Academy of Science is to recognize, promote and influence excellence in science.

Because of financial contributions we receive from companies and organizations, we were able to host over 500 students, 424 projects and 52 middle school students competing with their scientific research papers at the Minnesota Academy of Science State Science & Engineering Fair at the Doubletree Hotel in Bloomington, Minnesota, from March 20-22, 2015.



*U of M College of Pharmacy Award  
Winners with judge Heidi Bjerketvedt Richard Kielty*



*Diasorin Merit Award winners with  
judge and emcee Bruce Luedducke*

*Photo by Richard Kielty*

## Recap: State Science & Engineering Fair (Cont.)

With a packed house of over 650 science fair participants and enthusiasts, the Minnesota Academy of Science Board President Dr. Michael Williams started our competition weekend with a kick-off welcome ceremony. The following day was a fun-filled (stressful for some students) day of judging. For the parents and siblings waiting, there were interactive activities led by the 3M Visiting Wizards and workshops on Science Fair Project Coaching facilitated by Joe Nicol.

After a buffet dinner, students attended a keynote speech by Dr. David Smith from the Mayo Clinic. Currently, he is a Professor in the Department of Laboratory Medicine and Pathology and he is also the Chairman of the Technology Assessment Group for the Center for Individualized Medicine of the Mayo Clinic. In his own laboratory, he and his team use the new and powerful tool of next generation sequencing to better understand cancer development and to use this information to devise better ways to detect and treat people with cancer. Dr. Smith's interesting presentation was about how the second molecular revolution is going to transform how we look at ourselves and move rapidly into a science fiction future. After the keynote, students were recognized for their accomplishments at the Special Awards Ceremony and then were able to unwind at evening activities. There was a Dance/DJ provided by Howard Walstein and Total Entertainment/Kidsdance Production, board games, and fun with Minecraft activities led by Mad Scientist of Minnesota alum, Colin Kilbane.

The State Science & Engineering Fair concluded on Sunday with a buffet breakfast and the Grand Awards Ceremony. Ed Neu and Heidi Olson from Seagate Technology emceed the Grand Awards Ceremony, where they announced the top science fair students in the state of Minnesota, the Seagate Rising Star Award winners, the Seagate Excellence in Science Mentoring Award winners, and the Seagate Emerging Scientist Award winners. Four outstanding projects were selected to advance to International Science Fair competition, held in Pittsburgh, PA May 10-15.

The 2016 State Science & Engineering Fair will be held April 3-5, 2016 at the Doubletree Hotel in Bloomington, Minnesota.



*Students, parents, and teachers attended the keynote speech by Dr. David Smith*

*Photo by Richard Kielty*

# My First (and Last) Science Fair

By Rahul Parhi, Wayzata High School '15

After wasting most of last summer doing absolutely nothing, I decided to do something that was at least somewhat productive. This was the start of my science fair project. My project is about fault-tolerant arithmetic computing, i.e., taking digital integrated circuits that compute arithmetic functions such as addition, multiplication, etc., and making them more tolerant to faults. There are several sources of faults in integrated circuits, including: soft errors, electromigration, and manufacturing defects. My project focused on soft errors specifically (high energy particles hitting semiconductors causing a signal that is supposed to be a 1 to become a 0 and vice versa). My project proposed a new method of fault-tolerance that I refer as “Partial Triple Modular Redundancy (PTMR),” a variant of the well-known “Triple Modular Redundancy (TMR)” that was proposed by John von Neumann in the 1950s. By using the proposed PTMR, I showed that it’s possible to have a higher fault-tolerance than that of TMR using much less hardware.



2015 Seagate Rising Star Award winners Rahul Parhi and Valerie Bares with Seagate representatives

Photo by Saleem Ghani

I worked on this project from August through October, and submitted my research paper to the Intel Science Talent Search (STS) competition. To my surprise, I ended up being named an Intel STS Semifinalist. I never planned to participate in any science fair, but about a week before the Twin Cities Regional Science Fair (TCRSF), Ms. Timara Underbakke, the fair director, invited me to participate. I put together my poster the day before the fair itself, and that’s how I got involved in the science fair this year.

At TCRSF, I won the Intel Excellence in Computer Science (ECS) Award. After TCRSF, there was the Minnesota State Science & Engineering Fair (MSSEF). I actually almost missed MSSEF because I was on vacation in California. I was able to attend because my father preponed the flight for us to come back earlier than we had planned. Here, I was able to present my poster to engineers from Seagate, Broadcom, and the University of Minnesota. I received the Seagate Rising Star Award and was selected to go to the Intel International Science and Engineering Fair (ISEF). This year, ISEF was in Pittsburgh, Pennsylvania. I had the privilege to present my work to judges from many different institutions. I also met many kids who are much smarter than me. It was a wonderful experience.

Since this was my first (and last, I guess) year of science fairs, I actually had no idea there was a Seagate Rising Star Award. When Mr. Ed Neu was describing the award, and how the winner would receive \$2,000, I was baffled. When my name was called, I was even more baffled. The award involved a tour of the Seagate facilities and for me to meet several engineers and present my work. It was a great experience for me to meet engineers who work in the same area as my project and to see what engineers do in their jobs.

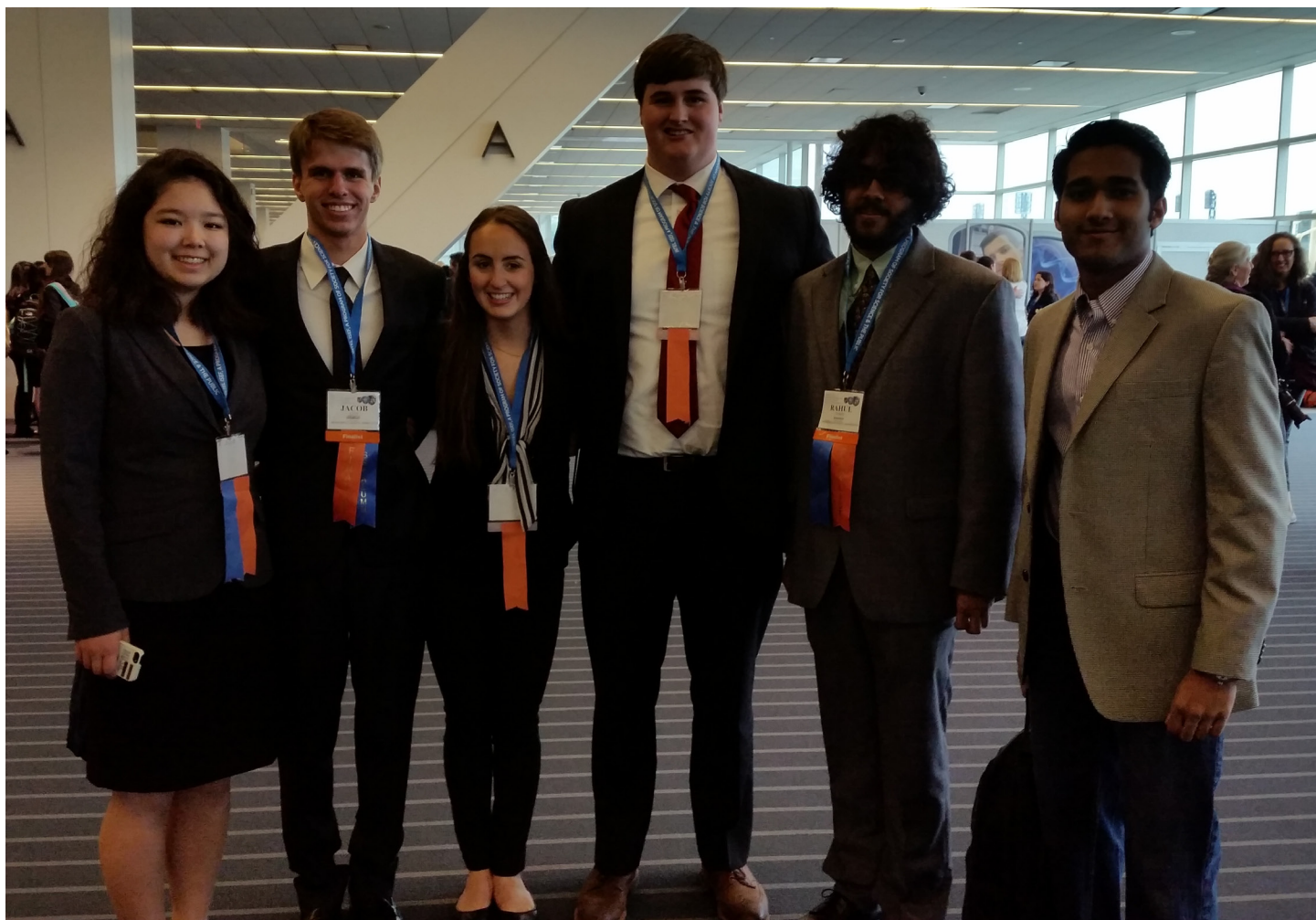
## My First (and Last) Science Fair (Cont.)

I also submitted my paper to the Institute of Electrical and Electronic Engineers (IEEE) International Symposium on Circuits and Systems (ISCAS) 2015 conference. My paper was accepted for a lecture presentation. I was awarded an IEEE Student Travel Grant to present my paper in Lisbon, Portugal. I presented my paper in the last week of May this year. At ISCAS, I also listened to many presentations on topics ranging from memristors to neural networks.

**“ IT WAS A GREAT EXPERIENCE FOR ME TO MEET ENGINEERS WHO WORK IN THE SAME AREA AS MY PROJECT AND TO SEE WHAT ENGINEERS DO IN THEIR JOBS.**

The most important thing I learned through this whole process was how to write a scientific paper. It taught me to not only coherently describe the experiments, results, and conclusions, but also taught me how to place my work in context with prior publications. The latter required me to perform a thorough review of prior work. This is something that I had not learned in school.

Now that I am done with high school, I plan to study Aerospace Engineering and Computer Science. This research project has taken me to places that I never would have thought of when I was first starting. I actually had no idea that these science fairs like TCRSF, MSSEF, or ISEF even existed when I was starting this project. I am grateful to have had all these opportunities this year. In retrospect, I wish I had known about these fairs earlier. Then I may have participated in previous years.



Rahul (second from right) with the other students who advanced to ISEF from State

Photo by Lise Weegman

# State Science & Engineering Fair Award Winners

The list below includes the top student award winners from the 2015 State Science & Engineering Fair. A total of 452 awards were given out in 2015. Please visit [www.mnmas.org](http://www.mnmas.org) for the full listing of award winners on the State Science & Engineering Fair page.

Award	Winner(s)	Project
3M Innovation Award <i>High School 1st Place</i>	Alanna Bram	Optimizing Human Machine Interfaces for Improving Object Detection Assistive Devices
3M Innovation Award <i>Middle School 1st Place</i>	Andy Eggebraaten	Building a Better Robotic Hand: Stronger, Wireless, Tactile Feedback, Controllable With an iPhone App
Beckman Coulter Award <i>High School 1st Place Science</i>	Ian Johnson	The Electrolyte Fight
Beckman Coulter Award <i>Middle School 1st Place Science</i>	Olivia Nelson	The Effects of Caffeine on the Spatial Learning and Memory of Mice
Beckman Coulter Award <i>High School 1st Place Engineering</i>	Alanna Bram	Optimizing Human Machine Interfaces for Improving Object Detection Assistive Devices
Beckman Coulter Award <i>Middle School 1st Place Engineering</i>	Hannah Farmer	Crumb Catching Cereal Bag
Ecolab Food Safety Award <i>High School</i>	Ellen Roufs	Reducing Carcinogenic Toxins in Milk: Examining the Effects of Using Probiotic Bacteria to Bind Aflatoxin M1
Ecolab Food Safety Award <i>Middle School</i>	Danielle Likar	Are You Eating Explosives?
Ecolab Green Award <i>High School</i>	Max Ylitalo	Landfill to Car Fuel: Using Surfactants to Increase Cellulosic Ethanol Production from Waste Paper
Ecolab Green Award <i>Middle School</i>	Abigail Mueller	Crude Impact
Institute of Food Technologists <i>High School 1st Place</i>	Evelyn McChesney & Maddy McCue	Novel Antibiotic Alternatives: Genomic Alteration of Probiotic Bacteria for Production of Antimicrobial Peptides to Target Antibiotic-Resistant Pathogens
Institute of Food Technologists <i>Middle School 1st Place</i>	Elizabeth Corradi	What's in Your Carton?
ISEF Award <i>State Finalist</i>	Jacob Levy & Sofie Kim	Optimized Syntheses of Novel, Medicinally Applicable 1,2,3-triazole Derivatives
ISEF Award <i>State Finalist</i>	Stephen Mylabathula	AirTouch
ISEF Award <i>State Finalist</i>	Rahul Parhi	Fault-Tolerant Arithmetic Computing Using Partial Triple Modular Redundancy (PTMR)
ISEF Award <i>State Finalist</i>	Karsten Salveson & Eve Zelickson	Zebra Mussel ( <i>Dreissena polymorpha</i> ) Preference for Colonization on Macrophytes
Seagate Rising Star Award <i>High School</i>	Rahul Parhi	Fault-Tolerant Arithmetic Computing Using Partial Triple Modular Redundancy (PTMR)
Seagate Rising Star Award <i>Middle School</i>	Valerie Bares	How do the Wood Anatomical Structures of Different Plant Species Affect Their Ability to Filter Water?
The Pentair Foundation Award <i>High School 1st Place</i>	Madison Pallin	Disappearing Act: The Effect of Location and a Large Storm Event on the Overall Water Quality, as well as the Distribution and Abundance of Crayfish, within the Lake Superior/St. Louis River/Spring Creek Watershed
The Pentair Foundation Award <i>Middle School 1st Place</i>	Caden Boike	Got Water... Fresh Water?

# Team Minnesota Travels to Pittsburgh, PA for the 66th Annual Intel ISEF

By Timara Underbakke, Twin Cities Regional Science Fair Director

May 9-15, 2015, 1702 international finalists from 78 countries representing 422 affiliated science fairs gathered in Pittsburgh, PA, to compete in the 66th annual Intel International Science and Engineering Fair (ISEF). Team Minnesota had 34 finalists this year (24 individual projects and 5 projects by teams of two). In addition, several student alternates, teachers, parents, and fair chaperones also participated. To make up Team Minnesota, the Minnesota State Science and Engineering Fair sent 6 finalists (4 projects), the regions sent 24 finalists (22 projects), and 4 finalists (3 projects) were sent from the American Indian Science and Engineering Society (AISES). All 3 projects sent from the AISES nationals were from Minnesota this year!

On Sunday evening, the students socialized at a pin exchange mixer, where they met other science students like themselves from around the world. On Monday, the opening ceremonies featured entertainment from the XPOGO Stunt Team. The crowd enjoyed a live performance of extreme pogo stick tricks including choreographed group pogo sticking as well as flips in midair during jumps that took the stunt people between 6 to 12 feet in the air with each amazing bounce. The Monday keynote speaker, Luis von Ahn, is one of the founders of crowdsourcing, using the efforts of the masses for a productive result. von Ahn is known for his success as co-creator of reCAPTCHA (the tool that frustrates internet users by forcing users to key in the text from distorted images of words to prove that the user is not a machine) which he sold to Google in 2009. His latest success is being co-founder and CEO of DuoLingo – the highly acclaimed free application for learning another language. von Ahn shared how these services are provided without charge by harnessing human efforts of large numbers of users to do productive work that pay for the service rather than by charging each user. reCAPTCHA is being used to help translate the world's books into digital text, particularly those passages that OCR cannot read and DuoLingo pays for itself by assigning students to translate articles back into their native language, which is useful as well as being a learning exercise.

Twin Cities students were honored to create the USA shout out poster for the opening ceremonies which showcases every country represented. Carolyn Jons (Eden Prairie), Maxwell Ylitalo (Stillwater), and Amrita Mohanty (Woodbury) were featured in the Shout Out video clip representing the entire USA and they carried the group effort USA student created poster on stage.

Students were able to participate in an Excellence in Science and Technology Discussion Panel which featured Nobel Laureates Martin Chalfie (2008 Chemistry), H. Robert Horvitz (2002 Medicine), Sir Harold Kroto (1996 Chemistry), and John Mather (2006 Physics), moderated by Joe Palca, NPR Science Correspondent. Interfacing with the Nobel Laureates is often a highlight for many of the students. Minnesota participants also attended seminars including how to present science, the use of statistics in science, how to fund a science fair, how to patent your invention, and updated rules and regulations for the 2016 competition.

All finalists and alternates in attendance won Wolfram Alpha Mathematica software. All finalists won their 2015 finalist medal and certificate. At most, 30% of the projects win additional awards, but team Minnesota brought home 10 awards! Congratulations to our students for their excellence in research and presentation of their research! We look forward to what each student accomplishes for 2016.

# In Pictures: Intel ISEF

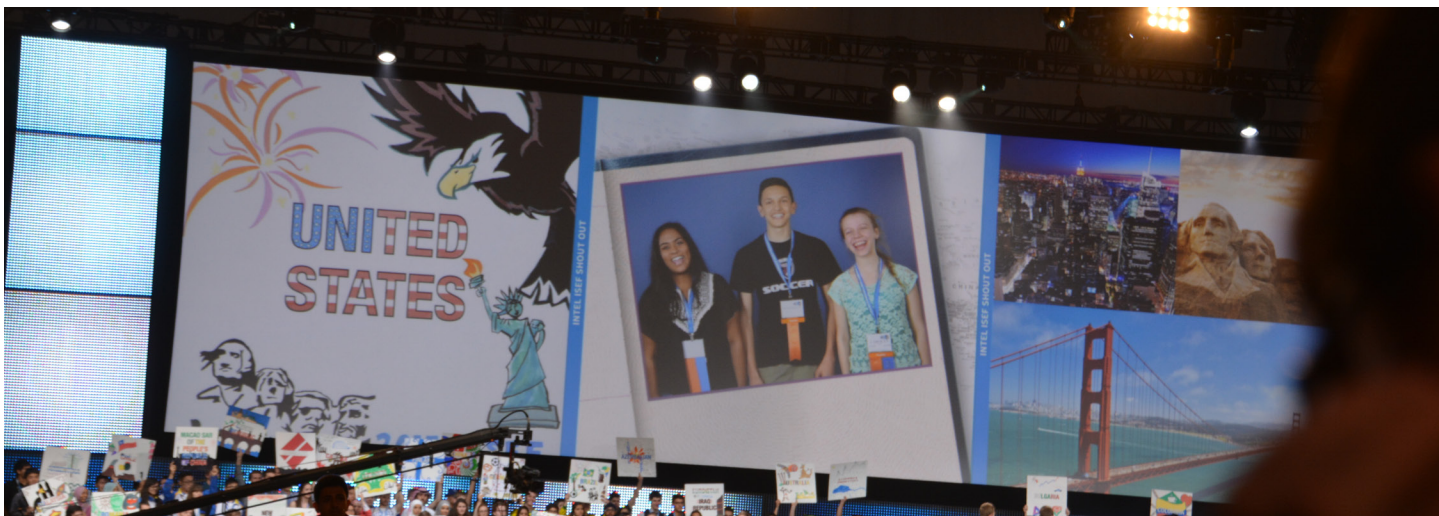
Photos by Timara Underbakke and Lise Weegman



Carolyn Jons, Max Ylitalo, and Jonah Butler at ISEF



Carolyn Jons (second from right) and Tim Renier (third from left) attended an SSP alumni networking social at ISEF



The Twin Cities Regional Science Fair was selected to represent the United States during the showcase



Carolyn Jons accepting her scholarship award from the Florida Institute of Technology



Max Ylitalo poses with his project board at ISEF

# Intel ISEF Award Winners

Thirty-four students from across Minnesota participated in the 2015 Intel International Science & Engineering Fair (ISEF). Eight students from Minnesota received awards at the competition.

Award	Winner(s)	Project
Florida Institute of Technology Full Tuition Presidential Scholarship (valued at approximately \$150,000)	Carolyn Jons	Improved Efficiency of Seawater Steam Generation Using Carbon Nanoparticles
American Dental Association First Place Award of \$2,000	Tim Renier	The Development of an Inexpensive Hand Hygiene Monitoring System with a Raspberry Pi Computer: Applications for Healthcare and Beyond
Second Place Grand Award of \$1,500 in Energy: Chemical Category	Max Ylitalo	Landfill to Car Fuel: Using Surfactants to Increase Cellulosic Ethanol Production from Waste Paper
Second Place Grand Award of \$1,500 in Energy: Chemical Category	Jonah Butler	Employing White-Rot Fungi for Superior Delignification Combined with Fungal Biosynthesis to Produce Biofuels
Third Place Grand Award of \$1,000 in Microbiology Category	Ellen Roufs	Reducing Carcinogenic Toxins in Milk: Examining the Effects of Using Probiotic Bacteria to Bind Aflatoxin M1
Fourth Place Grand Award of \$500 in Energy: Chemical Category	Brian Prchal	Battle of the Diesels: A Comparison of B-10 Diesel vs. B-100 Homemade Biodiesel for Efficiency and Exhaust Analysis
Fourth Place Grand Award of \$500 in Computational Biology Category	Isaiah Croatt	Computer Input and Therapy for the Physically Impaired
Fourth Place Grand Award of \$500 in Biomedical and Health Science Category	Michelle Campeau	Gelatin and Hyaluronic Acid Nanoparticle Based Delivery of miR-34a for Treatment of Pancreatic Cancer
NASA Honorable Mention Award	Carolyn Jons	Improved Efficiency of Seawater Steam Generation Using Carbon Nanoparticles
Third Place Grand Award of \$1,000 in Material Science Category	Carolyn Jons	Improved Efficiency of Seawater Steam Generation Using Carbon Nanoparticles



# It All Started With a Simple 6th Grade Science Experiment

By Ellen Roufs, Cathedral High School '15

Everyone has those experiences they would consider “life-changing.” A single, seemingly insignificant event that may have seemed ordinary at the time can often cause a domino effect. By the end, one looks back and thinks “What if that never would have happened? Without that initial event that set the ball rolling, I would not be in this position today and my future would look very different.” It is like a spark that starts the fire, and that fire can change the course of one’s entire life. My spark was a simple 6th grade science fair project, and my fire was a life-changing science fair career!

It began with the assignment to design, conduct, and present an experiment using the scientific method. At the start, I had the same attitude as my fellow 6th grade classmates: science fair was the notorious beast of a project that was stressful, hard, and unpopular. But thanks to my inspiring teacher and supportive parents, I was proved wrong. My project was about the dangers of distracted driving; by simulating the driving experience with a video game, I found that talking on your cell phone greatly affects your concentration. More importantly, I found that I actually did not mind doing the work and I had a lot of fun at the regional fair. When the required project was assigned the next year, I was excited and ready to do another science fair experiment! I was hooked.

My 7th grade project was about what fruit is most economical. I compared the price per unit weight of the edible portion of several different fruits. (Bananas are the most economical, by the way.) This was the first project that I competed with at the Minnesota State Science & Engineering Fair, and I have many valuable memories from that experience! In fact, it was my positive experience at State that motivated me to do another project as an 8th grader, this time on a volunteer basis.

And so the pattern continued throughout high school. Over the next 5 years, I researched natural antibacterial cleaning products, microbial fuel cells, and probiotic treatments for toxins in dairy milk. My work evolved from basic experiments into in-depth research projects. My motivation also evolved from a desire for a fun time into a genuine passion for scientific research. Looking back at my journey, I cannot believe how much I have learned!

Science fair has helped me learn to ask questions, use critical thinking skills, solve problems, be creative, and develop good communication skills. It transformed the way I learned science: instead of simply absorbing the information in the classroom, I actually learned science by being the scientist! I became a knowledge producer versus a knowledge consumer, something that has given me incredible confidence and motivation. Science fair has also introduced me to STEM (science, technology, engineering, and math) in an exciting and interactive way. Being able to talk about my research experience has given me a unique distinction when applying for colleges and scholarships.



*Ellen her first year at State (8th grade) and final year (12th grade)*

*Photo courtesy of Ellen Roufs*

# It All Started With a Simple 6th Grade Science Experiment (Cont.)

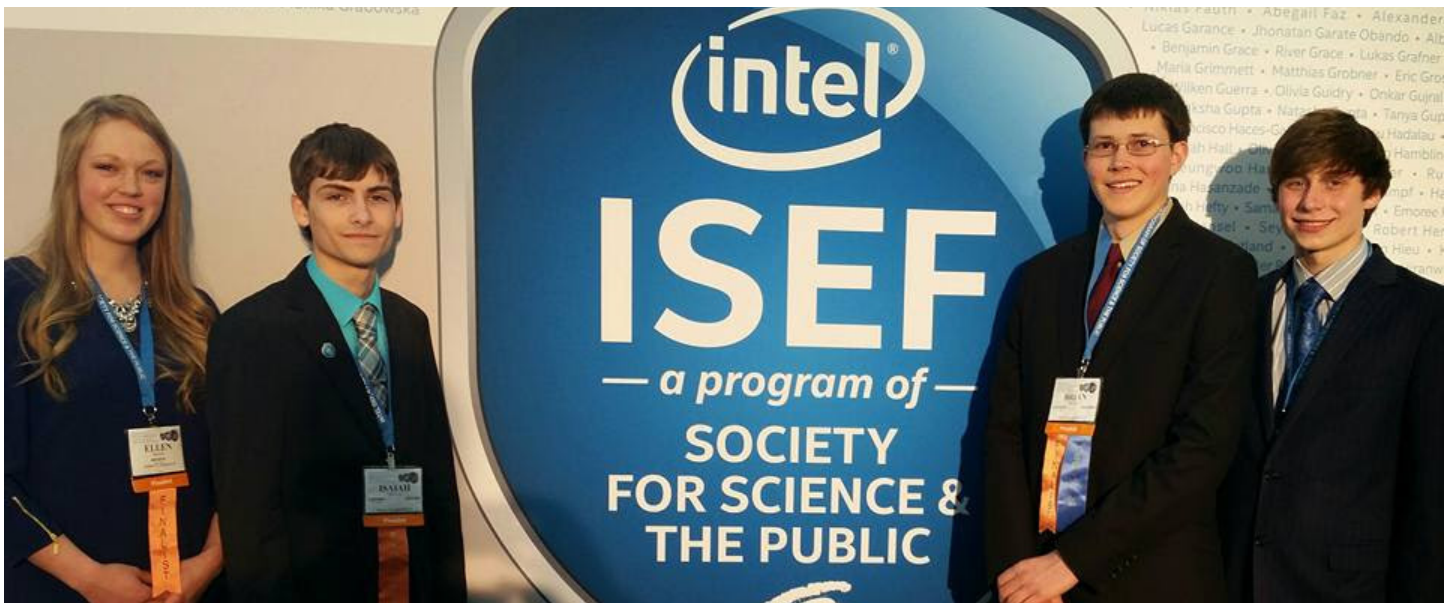
But perhaps the most important thing that science fair has taught me is actually not a skill or a scientific concept at all. Science fair has led me to recognize my passion for scientific research. I plan to continue my scientific work as an undergraduate majoring in biology at the University of South Dakota next year. My long-term career plan is to earn my master's and doctoral degrees so that I can conduct research in my own lab as a research scientist. I am particularly interested in nutrition, autoimmune disorders, and the agricultural practices that affect these aspects of human health. To think that it all started with a simple science experiment in 6th grade...

Another incredible experience I had because of my involvement in science fair is a trip to the International Science and Engineering Fair this past May. I traveled to Pittsburgh, Pennsylvania where I competed alongside 1700 other students from around the world for \$4 million worth in prizes. I made many new friends who have the same interests as I do, had good discussions with experts in my field of study, and came home with a 3rd place prize in my category of microbiology! It was a once in a lifetime experience and a great way to end my science fair career!

**“ SCIENCE FAIR HAS HELPED ME LEARN TO ASK QUESTIONS, USE CRITICAL THINKING SKILLS, SOLVE PROBLEMS, BE CREATIVE, AND DEVELOP GOOD COMMUNICATION SKILLS.**

Based on everything I have learned over the past 7 years of science fair, my advice to other students is to work with something you are interested in. I do not know how many times I heard my teachers tell me this, but it did not hit home until I found a topic I was really excited to learn about. Keep exploring; you might be surprised at what you learn about yourself, your unknown talents, and your true interests! Not to mention, you might make a great scientific discovery or engineer something that will change millions of lives!

So in conclusion, I want to say thank you to everyone who has helped me personally or worked to make science fair such a great program for students! Science fair has changed my life and I am so grateful for the opportunities it has provided me! Entering an exhibit hall full of cardboard display boards will always hold a unique magic for me because it is like looking at a bunch of sparks that will light a brighter future!



Ellen (left) with the other ISEF students from the Southern Region

Photo courtesy of Ellen Roufs

# Thank You to Our Funders and Corporate Sponsors

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