

**2015 SIEMENS COMPETITION IN MATH, SCIENCE & TECHNOLOGY  
Regional Finalists – University of Notre Dame**



**NAME:** TUSHAR DWIVEDI

**SCHOOL:** Neuqua Valley High School, Naperville, Ill.

**YEAR:** Senior

**HOMETOWN:** Naperville, Ill.

**PROJECT:** Epigenetic and microRNA-mediated Regulation of BDNF and Apoptotic Regulatory Genes in Lithium-induced Neuroprotection

**FIELD:** Biology

**MENTOR:** Mrs. Jacqueline Burns, Neuqua Valley High School, Science Teacher; Dr. Hui Zhang, University of Illinois at Chicago, Senior Research Associate

*“What strikes me most about STEM fields is the ability of an individual/group to impact millions. Research into mathematics, science, or technology has an endless ability to revolutionize how we think about the world.”*

Tushar’s inspiration is continuously renewed when his work is presented. For his project, he discovered two potentially novel mechanisms for Lithium’s neuroprotective action that could revolutionize Bipolar Disorder’s treatment and diagnosis. Tushar has developed personal connections with patients over the years which encouraged him to believe he could make a difference.

The late Dr. Paul Sally Jr, a professor of Mathematics at the University of Chicago, is the one that first piqued Tushar’s interest in math and research through the Young Scholars Program. Dr. Sally still serves as a motivating figure for Tushar.

Aspiring for a career in the STEM fields, Tushar plans to major in Biology and Mathematics. He hopes to pursue his education at one of the nation’s prestigious academic institutions.

Tushar is the founder and president of his school’s Science Honor Society and was named a US National Chemistry Olympiad finalist. He competes on his school’s math team, serves on the executive board of his school’s student council, is a speech team leader, a clarinetist at a Youth Symphony, president of the Alive Teen Center, and strongly committed to community service. Tushar speaks three languages: English, Hindi, and German. An avid reader, Tushar would love to go back in time to speak to his favorite author, Herman Melville, because Moby Dick is his favorite book and has significantly shaped his way of thought.



**NAME: VIKAS MATURI**  
**SCHOOL: Carmel Senior High School, Carmel, Ind.**  
**YEAR: Senior**  
**HOMETOWN: Carmel, Ind.**  
**PROJECT Engineered Intraocular Injection Guide (IIG): Pain Reduction in Ophthalmic Disease Treatment**  
**FIELD: Engineering**  
**MENTOR: Dr. Kimberly Vogt, Professor of Biology, Marian University**

*“I developed a device that significantly reduces pain during the treatment of major eye diseases.”*

While Vikas Maturi worked a summer job at an eye disease treatment center near his home, he became motivated to develop a product that could reduce or eliminate pain from pre-injection procedures for ophthalmic patients.

Vikas Maturi aspires to be a social designer or design engineer and anticipates majoring in product design and/or biomechanical engineering in college. Vikas is especially inspired by the growing incorporation of engineering in the social design world. Vikas loves his Engineering Design and Development class. The course is a seniors-only team-based capstone project where students design and prototype a product that solves a distinct community need. Currently, Vikas and his partner are modeling and prototyping a product that captures, redirects and filters flood water in developing countries. Vikas especially likes that this project-based subject provides him with an opportunity to utilize his own strengths in product design while teaching others and creating a product that can truly benefit society.

Outside of the classroom, Vikas enjoys playing soccer and piano, and also serves president for TechHOUNDS Robotics, for which he lead a 140-person team and implemented STEM outreach initiatives. If he could talk to any person from history, it would be Leonardo Da Vinci because of his appetite to know every aspect of the world – from technology to art.



**NAME:** SARVASVA “SAVVY” RAGHUVANSHI  
**SCHOOL:** Neuqua Valley High School, Naperville, Ill.  
**YEAR:** Senior  
**HOMETOWN:** Naperville, Ill.  
**PROJECT:** New Results on Ramsey Multiplicity and Graph Commonality  
**FIELD:** Mathematics  
**MENTOR:** James Hirst, PhD candidate in Applied Mathematics, Massachusetts Institute of Technology

*“I believe my life will have true meaning if I spread the gift of mathematical curiosity to others.”*

Sarvasva Raghuvanshi discovered that the structure known as a pentagon with a chord occurs frequently in all large networks, including social networks, graphs of the internet and diagrams outlining ecological habitats. His research has potential applications in corporate monetization for networking companies, as well as efficient urban design to minimize environmental damage. Sarvasva parlayed his passion for combinatorial methods to discover a newfound interest in graph theory and Ramsey multiplicity, which ultimately led him to pursue this topic of research.

Sarvasva loves mathematics, both individually and in a group. Independently, he enjoys pondering challenging problems for hours, sometimes even days, and thinking through potential solutions in his spare time. When doing mathematics alone, Sarvasva often seeks elegance and beauty, rather than just discovering a solution and moving on. As part of a group, Sarvasva likes to bounce ideas off of his peers, as well as build upon their suggestions to approach a solution.

Outside of his studies, Sarvasva participates in Math Olympiad, serves as Executive Board President for his school’s Student Council and volunteers at a center that provides supportive recreational space for teenagers. Sarvasva is also a two-time mentor in his high school’s Leadership Training Program, runs cross country and used to competitively swim.



**NAME: LEAH UMANSKIY**

**SCHOOL: University of Chicago Laboratory High School, Chicago, Ill.**

**YEAR: Senior**

**HOMETOWN: Chicago, Ill.**

**PROJECT: Beta Tail and EEQ13: A Novel 3D Cell Culture Material**

**FIELD: Materials Science**

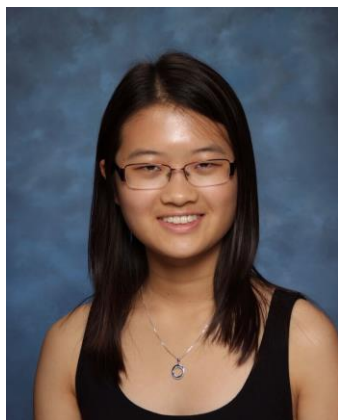
**MENTOR: Joel Collier, PhD, University of Chicago**

*“With my project, the world can decrease the need for animal research because cell culture systems will properly imitate the cell environment in the body and stimulate accurate behavioral responses.”*

Leah Umanskiy characterized a novel 3D cell culture technology that, with further development, will imitate any cell environment in the body and can be used to study cancer cell behavior more accurately. To pursue this research, Leah fell in love with the structure and mechanisms of proteins and peptides after covering the subject in her AP Biology class. She shared her interests with her father, and he encouraged Leah to reach out to the Collier Lab, whose work focuses on self-assembling peptides as a nanofiber material.

Leah’s freshman biology class piqued her interest in science in addition to the positive influence of her parents and other family members. Leah anticipates majoring in history and philosophy of science and medicine and/or biology. Leah aspires to make a career in medicine, while also being involved in healthcare policy and community outreach work.

Outside of the classroom, Leah is a captain of the Varsity Science Team and a member of the Tennis Team. She is also a Pre-K/K teacher at her religious school and has participated in the Diller Teen Fellowship program.



**NAME: RACHEL ZHANG**

**SCHOOL: Parkway South High School, Manchester, Mo.**

**YEAR: Senior**

**HOMETOWN: Ballwin, Mo.**

**PROJECT: Statistics of Intersections of Curves on Surfaces**

**FIELD: Mathematics**

**MENTOR: Moira Chas, Mathematics Professor, Stony Brook University**

*"I really like how STEM is a logical approach to studying the world."*

With Rachel Zhang's project, the world can better understand structures in nature through how curves intersect on surfaces. Her research relates to periodic geodesics, continuous fractions, and the statistics of primes. Rachel always liked Euclidean geometry and pursued a project in topology because it is somewhat related to geometry.

Solving number puzzles in the third grade for an hour each week is one of the earliest memories Rachel has of utilizing STEM education. She started attending MathCounts in seventh grade, and began to enjoy the competitive aspects of the program. Rachel anticipates majoring in either mathematics or computer science in college.

Rachel earned a gold medal at the European Girls' Mathematics Olympiad and took first place at the Math Price for Girls at MIT in 2015. She participates in robotics and tennis, and plays both the violin and piano. If she could speak with anyone in history, Rachel would talk to Victor Hugo about his writing.

## **TEAM COMPETITORS**

**COLE MAXWELL, Breck School, Golden Valley, Minn.**

**ISABELLA JENNINGS, Breck School, Golden Valley, Minn.**

**PROJECT: Biomolecular modeling, simulation, and design of a bivalent CB2-CCR5 ligand for the potential treatment of HIV/AIDS in the brain**

**FIELD: Computer Science**

**MENTOR: Ms. Lois Fruen, Science Department Head, Breck School; Yuk Y. Sham, PhD, Assistant Director of the Center for Drug Design, University of Minnesota**

Using the power of computers, Cole and Isabella found a potential drug candidate for the treatment of HIV/AIDS in the brain. Through the use of super computers, the cost of drug development decreases significantly and allows more patients access to drugs. With this project the world can be one step closer to finding an effective treatment for HIV/AIDS.



**COLE MAXWELL**

**YEAR:** Sophomore

**HOMETOWN:** Eden Prairie, Minn.

*“I aspire for a career in science that involves helping people all over the world.”*

Cole’s love for science started at a young age. He remembers experiencing the magic of science in second grade when he first saw two two-liter bottles connected and filled with water. This caused the water inside to swirl like a tornado and embedded in him a love of science. Cole plans to pursue a science major, possibly focusing on biochemistry, although he is still undecided as to where he will apply to college.

This project was inspired by the prevalence of medical marijuana on the news and wanting to pursue research to find another medical use of cannabinoids. The most challenging part of the research process was solving problems and overcoming failures. Cole feels that these obstacles forced him and his partner to think outside the box – which turned out to be the best part of the research process.

Cole is part of a Robotics Team that teaches primary school students how to program small humanoid robots. He currently is serving as Sophomore Class President and received the Science Departmental Distinction Award. If Cole could speak to one person in history it would be Archimedes, because he saw life as something that can be improved greatly by science and math.



**ISABELLA JENNINGS**

**YEAR:** Junior

**HOMETOWN:** Edina, Minn.

*“We need to show students that science isn't just facts, it's about using those facts to build something amazing and new.”*



Having always been fascinated by Chemistry, this research project gave Isabella the opportunity to see molecular structures in a way that was completely new. STEM for Isabella is not just about understanding how things work but how to use the understandings for humanities advantage.

Isabella anticipates majoring in either Biomedical Science or Chemical Engineering. She plans to apply to Stanford University, Harvard University, Cambridge University and Massachusetts Institute of Technology. Recently, Isabella received the Department Distinction Award in Science.

Outside of her STEM related school activities, Isabella plays the flute, piano and guitar. She also plays soccer and golf, and looks to Mia Hamm as a role model. If Isabella could speak with one person in history, it would be Nikola Tesla, because she believes he was ahead of his time and does not receive the credit he deserves.

## TEAM COMPETITORS

**EVELYN MCCHESENEY, Breck School, Golden Valley, Minn.**

**MADELINE MCCUE, Breck School, Golden Valley, Minn.**

**PROJECT: Engineering a broad-spectrum antibacterial probiotic via inclusion of antimicrobial peptide-encoding DNA, year two**

**FIELD: Engineering**

**MENTOR: Ms. Lois Fruen, Science Research Instructor, Breck School; Dr. Yiannis Kaznessis, Department of Chemical Engineering and Materials Science, University of Minnesota**

The team of Evelyn and Madeline engineered a genetic system that can be used to turn commonplace bacteria into antibiotics. With this project the world can combat the growing amount of antibiotic-resistant pathogenic bacteria that are causing major problems in global health care.



**EVELYN MCCHESENEY**

**YEAR:** Senior

**HOMETOWN:** Andover, Minn.

*“My favorite thing about STEM is that there is always more to discover. No matter how much we think we know about a topic, we will never know everything, which makes STEM so exciting for me as a career.”*

As a child Evelyn’s interest in science and math was first piqued when she started exploring science museums. She now enjoys taking other students to science museums so they can experience her love for the world of science. Evelyn is a leader on her Robotics Team and Lego League Team.

Evelyn has earned a second-degree black belt in karate, been awarded the Science Department Book Award, and is the Robotics Team captain. She plans to major in Biomedical Engineering and has applied to Johns Hopkins University, Stanford University, Yale University, Case Western University, Northeastern University and the University of Minnesota.

Evelyn looks to her mother as her role model and has always been inspired by her mother's love for work no matter how stressful it may be. If Evelyn could meet one person in history it would be Rosalind Franklin, a female in the world of STEM who faced many obstacles because of her gender yet still contributed to major discoveries of the molecular structures of DNA and RNA.



**MADELINE MCCUE**

**YEAR:** Senior

**HOMETOWN:** Minneapolis, Minn.

*"I'm fascinated by genetic engineering! I love the idea of augmenting the natural process of evolution to better suit our rapidly progressing society."*

Coming from a pair of doctor parents, Madeline has been hearing about medical updates around the dinner table for many years. Her father taught her about the basic principles of algebra when she was three and she has been hooked ever since.

Madeline speaks English, Spanish, Italian and Vulcan. She has performed in a circus, enjoys playing the piano and dancing. Madeline thinks of Commander Spock from *Star Trek* as her role model and she would love to meet Alexander the Great.

Aspiring for a career with the United Nations or the U.S. State Department, Madeline plans to major in International Relations and has applied to Harvard University, Stanford University, Yale University, the University of Southern California, Brown University, and the University of California at Los Angeles. Madeline has been previously named a National Merit Scholar Semifinalist and received the First Grand Prize at the Minnesota Academy of Science State Science Fair.



## TEAM COMPETITORS

**KEVIN QIAN**, Wayzata High School, Plymouth, Minn.

**DAVID HERMAN**, Davis Renov Stahler Yeshiva High School for Boys, Woodmere, N.Y.

**PROJECT:** Analyzing the Effects of Gold Nanoparticles Coated on Various Nafion Membranes for Improved Performance through the Catalysis of Carbon Monoxide Oxidation

**FIELD:** Materials Science

**MENTOR:** Miriam Rafailovich, Director of Garcia MRSEC at Stony Brook University; Hongfei Li, Graduate Student at Stony Brook University; Gerry Kirshenbaum, Doctor, Principal at Renov Stahler Yeshiva High School for Boys

Kevin and David's project focuses on eliminating the use of fossil fuels. The team investigated the effects of implementing Gold Nanoparticles in Hydrogen Fuel Cells in hopes that it could help increase the efficiency and viability of environmentally-friendly technology. With the discoveries made by Kevin and David, the world is one step closer to achieving sustainable green energy.



**KEVIN QIAN**

**YEAR:** Senior

**HOMETOWN:** Maple Grove, Minn.

*"In STEM I like the drive/purpose, the whole idea that we're trying to learn more about the world in order to improve it."*

Kevin's first introduction to STEM came in the form of ice cream. When he was in the fifth grade, high school students came to his class and demonstrated how to make ice cream with liquid nitrogen. Since then Kevin has enjoyed many STEM classes, currently taking Organic Chemistry and Multivariable Calculus at the University of Minnesota.

Having received multiple awards, Kevin is most proud of being a National Merit Semifinalist and being a Science Olympiad Event Leader for Chemistry Lab and Protein Modeling. Kevin hopes to major in either Chemistry or Chemical Engineering. He has applied to California Technology University, the University of Chicago, and the University of Minnesota. After college, Kevin hopes to be a chemist and would enjoy working in a lab.

Kevin looks to Elon Musk, CEO and product architect of Tesla Motors, as a role model. In Kevin's own words, "Elon Musk is basically Iron Man." Kevin also has an interest in meeting Linus Pauling because he would love to talk to him about the many contributions that he has made to advance scientific knowledge in the field of chemistry and biochemistry.



**DAVID HERMAN**

**YEAR:** Senior

**HOMETOWN:** Lawrence, N.Y.

*“My siblings and I would do math problems with [my Moroccan grandfather], and every time we answered correctly, he would give us a peanut.”*

David’s inspiration for this project came from two places: seventh grade chemistry and his love for the environment. In chemistry class, he loved learning about how the universe is made up of tiny atoms and how they combine to form different objects. His everyday concern about the environment made him want to search for a way to help the planet. When he discovered that hydrogen fuel cells can be used as a replacement to the burning of fossil fuels, he knew he found his research area.

His junior year, David founded two separate initiatives: ‘Everyone Gets a Shot,’ an organization whose goal is to provide opportunities for special-needs children to play in high school sports games. The second initiative is called ‘The Healthy Choice,’ striving to make the school a healthier place, both with food and lifestyle.

David is the Captain of Science Olympiad, a member of the National Honor Society and has his own column titled “*Can You Figure It Out*” in the Five Towns Jewish Times. He aspires to become a Chemical Engineer, and plans to apply to the Massachusetts Institute of Technology, New York University and the University of Pennsylvania.

## **TEAM COMPETITORS**

**PRANAV SIVAKUMAR, Illinois Mathematics and Science Academy, Aurora, Ill.**

**PAUL NEBRES, Illinois Mathematics and Science Academy, Aurora, Ill.**

**PROJECT: An Automated Search for Gravitationally Lensed Quasars in the Sloan Digital Sky Survey**

**FIELD: Physics**

**MENTOR: Sivakumar Muthuswamy, Fellow of the Technical Staff, Motorola Solutions, Inc.**

Pranav and Paul’s project aims to further our understanding of the universe. The team’s researched the gravitational lensing effect of objects located between Earth and distant quasars. It is a small but measurable step in deciphering two major physics mysteries that will ultimately determine the future of the universe: dark energy and dark matter.



**PRANAV SIVAKUMAR**

**YEAR:** Junior

**HOMETOWN:** Tower Lakes, Ill.

*“The key to encouraging students to pursue STEM is to make learning enjoyable. All kids love mysteries, and science is the ultimate whodunit. If teachers and parents convey this sense of joy and mystery, there is no better way to promote math and science.”*

Pranav has early memories as a six-year-old watching the video lectures of Massachusetts Institute of Technology professor Walter Lewin. Admittedly, he understood very little of the content, but what resonated was the sheer joy of learning physics. Pranav’s role model is Astrophysicist Subrahmanyan Chandrasekhar. He is inspired to pursue a career in the same field.

One of the high points in Pranav’s life so far was meeting and being recognized by President Obama during Astronomy Night at the White House. Pranav also had the opportunity to meet with Google founder Sergey Brin. Also of note, Illinois Governor Pat Quinn declared June 7, 2014 “Pranav Sivakumar Day” in recognition of his performance in the National Spelling Bee over a three-year period.

Pranav speaks four languages: English, Tamil, German and Latin. He plays cricket as well as the piano and viola. Since attending the Illinois Mathematics and Science Academy, Pranav has introduced many of his peers to student research.



**PAUL NEBRES**

**YEAR:** Senior

**HOMETOWN:** Naperville, Ill.

*“A lot of kids have some fascination with science and math. Children are naturally curious, and this inherent curiosity should be explored at a younger age.”*

As an advocate for STEM education, Paul believes that STEM naturally revolves around creative thinking and discovery. Paul enjoys that STEM education allows for the application of concepts as opposed to sheer memorization. As part of the Illinois Mathematics and Science Academy Kid’s Institute, Paul was a group leader for summer programs, encouraging science and math learning for primary school students.

Paul leads the Student Council Campus Activities Board, is a member of the Math Team, tutors at the Writing Center, and plays Ultimate Frisbee as well as the trumpet. Paul speaks English, French and Tagalog. If he could meet one person in history, it would be Leonardo da Vinci because of his venture into so many different fields of study.

As a mathematics aficionado, Paul hopes to major in Applied Mathematics. He is looking into colleges that allow him to continue pursuing research. After college he hopes to enter into the field of mathematics so he can use the application of math to solve real world problems.

## TEAM COMPETITORS

**EMILY SUN, Park Tudor School, Indianapolis, Ind.**

**JESSICA MO, Carmel High School, Carmel, Ind.**

**PROJECT: Using novel VBIM approach to discover carboplatin resistance genes in ovarian cancer cells**

**FIELD: Biology**

**MENTOR: Dr. Tao Lu, Assistant Professor of Pharmacology and Toxicology, Indiana University**

*"...students should be more exposed to new discoveries that allow them to gain interest and curiosity about math and science."*

Emily Sun and Jessica Mo discovered a novel carboplatin resistance gene that can be used as a therapeutic target to overcome carboplatin resistance in ovarian cancer using the validation-based insertional mutagenesis (VBIM) technique. With their project, the world can embrace stronger, happier, ovarian cancer-free women.



**EMILY SUN**

**YEAR:** Freshman

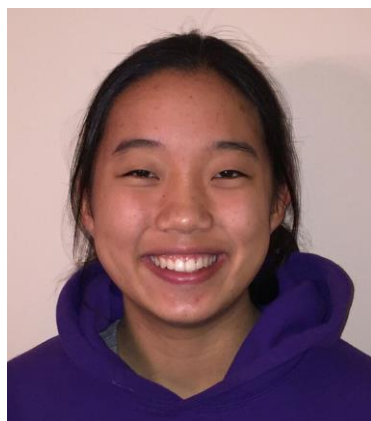
**HOMETOWN:** Carmel, Ind.

Emily Sun likes STEM because it challenges her intellectually and allows her to make unexpected discoveries. She thinks that in order to encourage more students to pursue STEM, they should be more exposed to new discoveries in the field. One of her earliest STEM memories was a fifth grade field trip to a NASA center that simulated air travel.

Emily plans to pursue a career in medicine or science. She anticipates majoring in chemistry and/or biology when she enters college. Emily's very first science project was a baking soda and vinegar volcano. At that time, she hadn't taken into consideration the angle of the spray that formed from the reaction, so the baking soda/vinegar actually didn't come out of the top of the volcano, but rather

leaked out from its bottom. Knowing what she knows today, Emily would have been more careful in planning things out before running the experiment—an important lesson she has taken with her as she continues pursuing more research.

Outside of the lab, Emily serves on her school's Student Council board and as a Student Ambassador. She also plays tennis and cello and participates in Model United Nations, Science Olympiad and volunteers for Special Olympics. If she could speak with anyone from history, Emily would speak with Albert Einstein because he was an incredible thinker, scientist, and mentor. She particularly likes his quote, "Learn from yesterday, live for today, hope for tomorrow. The important thing is not to stop questioning."



**JESSICA MO**

**YEAR:** Sophomore

**HOMETOWN:** Carmel, Ind.

Jessica Mo aspires to be an environmental scientist or a biologist, and plans to major in biology and/or environmental science when she enters college. Jessica's parents first piqued her interest in STEM, and she fondly remembers playing with her mom's molecular model kit as a child.

Jessica completed her first science project in the fourth grade, testing the absorption of materials such as napkins, paper towels and sponges. If she approached it again today, Jessica would pick more similar materials to experiment with—for example, a Brand A sponge vs. a Brand B sponge.

Outside the lab, Jessica enjoys studying language arts, which allows her to satiate her passion for reading and writing. Jessica also runs cross country, participates in the Action for Animals club, volunteers at the Humane Society and participates in Science Olympiad.