

2016 SIEMENS COMPETITION IN MATH, SCIENCE & TECHNOLOGY
Regional Finalists – University of Notre Dames



NAME: DHWEEJA DASARATHY
SCHOOL: Hawken School, Gates Mills, OH
YEAR: Senior
HOMETOWN: Highland Heights, OH
PROJECT: Novel column designs for improved bioseparation of complex molecules using counter current chromatography
FIELD: Chemistry
MENTOR: Dr. Yoichiro Ito, Laboratory of Bioseparation Technology, National Institutes of Health

"It is the open-ended inquiry that does not have tests or grades, which makes me passionate about research."

Dhweeja Dasarathy developed a new approach for separating complex chemical mixtures into pure compounds. Her research has numerous applications for science and medicine, where the separation and purification of mixtures is critical.

For as long as Dhweeja can remember, she has been passionate about scientific research. As a young child, she used to set up experiments in her basement to test the composition of the different foods that her parents told her were healthy. She bought her own pipette, balance and MicroWell plates from eBay to investigate changes in the fat and protein content of food groups, and learn more about nutrient content of foods. Dhweeja's initial experiments led to more ambitious projects working with pure molecules and chemicals. But she was frustrated by the lack of efficient methods for purifying mixed compounds, and was drawn to the field of bioseparation – the focus of her current project.

Outside of the classroom, Dhweeja excels in classical Indian dance and is the youngest graduate of her dance academy. She is also the captain of her school's Lincoln-Douglas debate team, and has launched an international public health awareness project about the Zika virus in a rural community of Nicaragua.

One of Dhweeja's proudest accomplishments is founding a STEM initiative in rural India, where she has developed a distance education program for students in math and science. Dhweeja is also a National History Day Silver Medalist, competing against middle and high school students. She was an international finalist in the 2015 Future Problem Solving Competition and participated in the prestigious Research Science Institute at MIT.

A proud native of Cleveland, Dhweeja always roots for the Cavaliers basketball team. Her hero is Malala Yousafzai, an activist for the education of girls, and her favorite book is *The Great Gatsby*.



NAME: ABHINAV RAMKUMAR
SCHOOL: Carmel High School, Carmel, IN
YEAR: Senior
HOMETOWN: Carmel, IN
PROJECT: "Molecular Dynamics of Adenosine Triphosphate Interacting with Phosphatidylcholine Lipid Bilayers"
FIELD: Physics
MENTOR: Dr. Horia I. Petrache, Indiana University-Purdue University Indianapolis, Indianapolis, IN

"The field of energy science fascinates me due to its connection between fundamental scientific research and innovative social engineering to pioneer a sustainable future."

Scientists have identified Adenosine Triphosphate (ATP) as a molecule that provides energy for cellular reactions. The important finding in Abhinav Ramkumar's research is that ATP is directly involved in the electrostatic charging of membranes and this mechanism can affect the transmission of the action potential in neurons. The findings of this project could help us understand the causes of major neuronal diseases such as Alzheimer's and Parkinson's, better explain ATP's role in cell signaling, and suggest future possibilities in the field of biotechnology.

Abhinav has been both an Intel International Science and Engineering Fair (ISEF) Finalist and a TEAMS Engineering Competition National Finalist. He hopes to become an energy scientist when he grows up, and is passionate about research, music, and tutoring special needs students. He hopes to make significant contributions for developing clean and sustainable methods of energy production.

Abhinav speaks Spanish and Tamil, is a fan of the Indianapolis Colts, and plays ping-pong.



NAME: PRANAV SIVAKUMAR
SCHOOL: Illinois Mathematics and Science Academy, Aurora, IL
YEAR: Senior
HOMETOWN: Tower Lakes, IL
PROJECT: Searches for Almost Dark Galaxies in Blank Sky Fields with the Sloan Digital Sky Survey
FIELD: Physics
MENTOR: Dr. Donald York, Horace B. Horton Professor Emeritus, Department of Astronomy and Astrophysics, University of Chicago

"Pursuing research, whether in STEM or any other field, is like solving a jigsaw puzzle: there is a great amount of satisfaction when the pieces start fitting together. However, the satisfaction is far greater when you see that your mentorship has opened the door for others to have the same Zen experience."

Pranav Sivakumar's research aims to decipher one of the major mysteries of physics: dark matter. This elusive matter gets its name because it can neither absorb nor emit light. Though astronomers cannot

observe dark matter directly, they strongly suspect that it exists. He has been studying Almost Dark Galaxies, masses that are mainly composed of dark matter, in hopes of learning more about this substance and the history of the universe.

Pranav's passion for science started at a young age. When he was six, he would watch video lectures of MIT professor and astrophysicist Walter Lewin, and developed what he calls "a sheer joy for learning physics." He also loved to watch the night sky and spent many hours memorizing stars and constellations.

In 2015, Pranav won Google Science Fair's Virgin Galactic Pioneer Award and was later recognized by President Obama at the White House Astronomy Night for his research. Additionally, Illinois Governor Pat Quinn declared June 7th, 2014 "Pranav Sivakumar Day" in recognition of his performance in the National Spelling Bee over a three-year period.

Pranav is a member of his high school Quizbowl Team, and is active in Zooniverse and other citizen science projects. He is an avid reader and his favorite book is *Hitchhiker's Guide to The Galaxy*.

Pranav hopes to one day pursue a career as an astrophysicist and continue deciphering the mysteries of the universe. He is grateful for the mentorship and guidance of a broad cross-section of scientists, and looks forward to sharing his enthusiasm for STEM with new generations of students – igniting what he hopes is a similar passion for science and mathematics.



NAME: ZOE SOLT
SCHOOL: Hathaway Brown, Shaker Heights, OH
YEAR: Senior
HOMETOWN: Cleveland Heights, OH
PROJECT: "Domain Wall Motion in Concave Ferromagnetic Nanowires"
FIELD: Physics
MENTOR: Dr. Jesse Berezovsky and Robert Badea, Case Western Reserve University

"I want to understand how we exist, what we're made of, how the universe came to be, what's happening beyond the stars, and what the inevitable fate of the universe will be. You know, lighthearted stuff."

As a child, Zoe attended summer science camps at the Natural History Museum and Science Center in Cleveland dissecting fish, building straw bridges and learning about the universe. She was hooked, and in high school found her true scientific love – physics. She became addicted to YouTube physicists – "Vsauce" who questioned what would happen if the moon disappeared and "Veritasium" who explained quarks and the four fundamental forces in a way that left her curious for more. Her research studied how electrons move within different areas of a magnet which could possibly be used in the future to make computers faster and more stable. She is an avid artist, flutist and Cleveland Cavaliers fan and

loves “intense orchestral music.” She is a winner of the Yale Science and Engineering Association Science Fair Award.



NAME: SUSHIL UPADHYAYULA

SCHOOL: Illinois Mathematics and Science Academy,
Aurora, IL

YEAR: Senior

HOMETOWN: Plainfield, IL

PROJECT: “Exploring Differential Gene Expression in CD4+ T-
Cells to Elucidate Pathways and Subsets Involved in
Rheumatoid Arthritis”

FIELD: Biology

MENTOR: Dr. Soumya Raychaudhuri, Harvard University
and Mr. Kamil Slowikowski, Harvard University

“Over the years, I’ve come to love computer science, math, and computational biology, but competition math started it all. What I like most about STEM is the power to have a direct impact in the world.”

Sushil’s research identified subsets of human T cells which have different predisposed risk levels for rheumatoid arthritis. This could potentially be used in improving rheumatoid arthritis detection. Sushil was selected to represent his state at the Research Science Institute (RSI), sponsored by MIT, where he conducted research in computational immunology at Harvard Medical School for the summer. Additionally, Sushil won second place in the nation in the International Math Kangaroo Competition and was selected to represent the United States’ national team at the international competition in Poland.

Sushil plays the violin, is an Eagle Scout, and has been a Boy Scout since fifth grade. He loves computer science because of its real world applications. He hopes to pursue computer science and entrepreneurship as a career.

TEAM COMPETITORS

KETAN AGRAWAL, Columbus Academy, Gahanna, OH

HARI KOTHAPALLI, Roxbury Latin School, West Roxbury, MA

PROJECT: "Enhancing the Efficiency of Bulk Heterojunction Solar Cells via the Addition of Amorphous and Semicrystalline Nanostructuring Polymers"

FIELD: Materials Science

MENTOR: Dr. Miriam Rafailovich, Distinguished Professor and Undergraduate Program Co-Director, Materials Science and Chemical Engineering, Stony Brook University

Ketan and Hari discovered a potential new use for certain plastics that could significantly improve the efficiency of organic solar cells, which are cheaper and more widely accessible than silicon solar cells.



NAME: KETAN AGRAWAL

YEAR: Senior

HOMETOWN: New Albany, OH

"I love that scientific inquiry places you at the nexus of creative and analytical thinking."

Ketan chose research in the area of organic solar cells because he believes that making affordable, efficient renewable energy will be essential to powering humanity sustainably into the future.

Ketan has always had an appreciation for the structure that permeates our world. In middle school, while other students groaned at the prospect of grammar packets, Ketan loved building the intricate and functional diagrams of sentences. Sometimes while his teachers spoke or in conversations with others, he would diagram their sentences in his head as they talked.

It is because of Ketan's love of language and structure that he first became interested in computer science, a subject that combines both language and structure and his favorite in school. He spends significant time - both in school and out - working in computer science. He is the lead computer-aided designer on a robotics team that designs, models and creates custom robots, and even 3D-prints custom parts. One of his proudest accomplishments is programming a working statistical machine translator, a computer program that learns to translate text from one human language to another.

In addition to his busy academic schedule and work with his robotics team, Ketan is first violin in the Youth Philharmonic of Central Ohio. He also helped revitalize and serves as president of his school's Desi Club - a club connects and celebrates the culture of South-Asian students, including chai-making and

mehndi drawing classes, sponsored school picnics and Diwali banquets. For one such banquet, the Hindu festival of lights celebrated in autumn, Ketan learned to make mutter paneer, a North-Indian vegetarian dish – another one of his proudest accomplishments.

Ketan hopes to continue to pursue computer science as a career path and possibly combine computer science with another academic field such as mathematics, linguistics, or space – a topic he has been enthralled with since he was kid with models of planets, space shuttles and the Mars rovers adorning his room.



NAME: HARI KOTHAPALLI
YEAR: Senior
HOMETOWN: West Roxbury, MA

"I value STEM's striking ability to better people's lives and to completely transform the way people live from generation to generation."

Hari has always had an interest in STEM, which he attributes to growing up in a technologically driven era and a particularly great chemistry teacher. He has enjoyed witnessing and studying the potential of developments like smartphones, as well as learning about the invisible and intricate forces that control the physical world around us. It was this interest in the physical world and his aspirations to help his community, country and eventually, the whole world that inspired him to pursue a research topic related to the environment.

Hari and his partner found a potential new use for certain plastics that could significantly improve the efficiency of organic solar cells. Organic solar cells are cheaper and more applicable than silicon solar cells, and thus could revolutionize alternative energy, if further research can continue to enhance their effectiveness.

Hari balances his academics with a busy schedule outside of the classroom. He is editor-in-chief of his school newspaper, vice president of the Debate Society and a member of the Mayor's Youth Council in Boston. He is also a varsity soccer and track athlete and enjoys music, playing the flute and singing bass in his school's Glee Club.

TEAM COMPETITORS

KATHERINE CAO, Homestead High School, Mequon, WI

WILLIAM HU, Saratoga High School, Saratoga, CA

ALICE WU, Half Hollow Hills High School West, Dix Hills, NY

PROJECT: "Characterizing Novel, Spun-Cast PLA/Polystyrene Substrates of Differential Nanoscale Surface Topographies and Optimizing Cell-Plating Density to Promote Dental Pulp Stem Cell Proliferation and Differentiation in vitro"

FIELD: Materials Science

MENTOR: Dr. Miriam Rafailovich, Distinguished Professor of Materials Science & Engineering, Stony Brook University

Katherine, William, and Alice developed a novel technique for growing dental pulp stem cells, which could potentially improve bone and teeth regeneration.



NAME: KATHERINE CAO

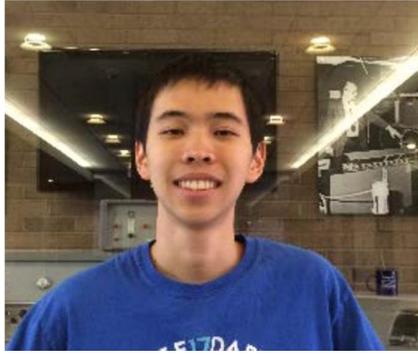
YEAR: Senior

HOMETOWN: Mequon, WI

"I think that what makes science great is not just that it demystifies the universe, but that it wields the power to craft a solution for every problem that is discovered."

When Katherine first met her teammates, they connected through a mutual desire to use materials science to help improve the field of medicine. As they thought about potential problems they could solve together, bone and dental disease stood out personally for Katherine. Her parents, both immigrants, have rapidly decaying teeth due to poor childhood care, and their options for treatment are limited to teeth removal and dental implants. Katherine sees the rising field of dental pulp stem cell research as an amazing opportunity for patients with tooth decay, osteoporosis and many other conditions.

Katherine's favorite subject in school is chemistry and she credits it for helping her build an understanding of the natural world. Outside of the classroom, Katherine is president of student government and a member of the National Honors Society. She is varsity captain of the debate team, president of her school's service club, and a pre-professional dancer. Katherine hopes to one day start a career as an entrepreneur in the life sciences. Her favorite author is Charles Dickens.



NAME: WILLIAM HU
YEAR: Senior
HOMETOWN: Saratoga, CA

"I find myself most enamored by the inherent creativity in STEM. Each problem requires an innovative approach, and discovering this approach is what makes me excited."

William has always had a bias towards the STEM subjects, even as a child. From building with Legos to marveling at the fifth graders' science fair projects, he was amazed by the possibilities with science, technology, engineering, and math. As he entered high school, William's interest became more solidified and he applied what he had learned to compete in local and national competitions and became eager to explore more. William found himself enamored by the inherent creativity in STEM. Each problem requires an innovative approach, and discovering this approach is what makes him excited.

After meeting his teammates through the Garcia Summer Program, they instantly connected through a passion for utilizing materials science in biomedical applications. William was interested in the junction of polymers and stem cells, and using previous research as a guide, they managed to come up with a topic for dental pulp stem cells. Having suffered from slight dental decay himself, he remembers the excruciating pain of having a tooth extracted. In addition to his personal experiences, William's father suffers from periodontal disease and his mother has slight problems with her teeth as well. William personally believes that the rising field of regenerative medicine holds amazing potential in developing solutions to these problems. Dental pulp stem cells are pivotal to bone and dental therapy and researching the control of critical cell behaviors can shed light on the possibilities in this field.

In his free time, William volunteers for Second Harvest Food Bank, plays on the varsity volleyball team and plays tennis. He also received the Bausch + Lomb Honorary Science Award and the USA Computing Olympiad Gold Division. William would like to be an engineer one day.



NAME: ALICE WU
YEAR: Senior
HOMETOWN: Dix Hills, NY

"Bone and tissue engineering are the future. Organ regeneration, wound healing, biomaterials... discoveries are made every day in these two fields, and it feels as if I am in the midst of a revolution."

Alice Wu is excited to be contributing to the field of bioengineering through her team's research, and is hopeful that bone cell and teeth regeneration will one day become available to patients in our lifetime.

She is a proud student ambassador of Millennial Ambition, an initiative launched by the Women's Fund of Long Island to develop the next generation of young women leaders and promote youth philanthropy. Through this program, Alice leads workshops for young girls in self-esteem, networking, and feminism. She is also a four-year varsity athlete and captain of the cross country, winter track, and badminton teams at her school.

Alice hopes to study computer science in college. Her favorite author is Philip K. Dick, and her favorite song is "The Scientist" by Coldplay. It reminds her of summers spent conducting research, and is one of the songs she loves listening to in the lab.

TEAM COMPETITORS

SHIVANI KONDURU, Troy High School, Troy, MI

TIFFANY GUO, Troy High School, Troy, MI

SARA HUANG, Troy High School, Troy, MI

PROJECT: "The Mechanism and Diagnostic Significance of Surface Immunoglobulin Light Chain Negative Mature B-Cells"

FIELD: Biology

MENTOR: Dr. James Huang, William Beaumont Hospital

This trio of sophomores from Troy, Michigan found a new way to diagnose B-Cell lymphoma, a type of Non-Hodgkin's lymphoma, one of the most common forms of cancer.



NAME: SHIVANI KONDURU

YEAR: Sophomore

HOMETOWN: Troy, MI

"My favorite subject is math, because I enjoy looking for new and elegant ways to solve problems."

Shivani loves math. She always enjoyed the sciences and math because she was a very curious kid and she wanted to know everything about the world around her. She attended many math competitions at different universities, and in the Science Olympiad her team went to the national competition. She speaks Spanish and Telegu, and swims competitively on her high school team.



NAME: TIFFANY GUO
YEAR: Sophomore
HOMETOWN: Troy, MI

"I would like to incorporate my passions of biology and medicine into my career."

Tiffany caught the science bug early on when her sister would bring home heaps of anatomy textbooks from medical school every year. When she was bored she read them and thus began her love affair with biology, the human body and evolution. She was inspired to do her research by learning about the struggles that cancer patients face. She believes innovations and technologies help improve the lives of so many people across the globe, advancing civilization. She is particularly proud to see more young women getting involved in science in what has traditionally been a male-dominated field. Tiffany plays flute, runs track and plays tennis and speaks fluent Mandarin.



NAME: SARA HUANG
YEAR: Sophomore
HOMETOWN: Troy, MI

"I was always interested in STEM subjects, even when I was younger, because it seemed a lot more applicable to real life than any other subjects."

Sara knows that cancer is a significant problem around the world, and because so many are affected by it, she was inspired to find a way to help them. She is particularly fascinated with chemistry and loves to address challenging problems, and is a chemistry club officer. She also plays flute and piano and enjoys playing music at nursing homes. She keeps active with dance and runs track.

TEAM COMPETITORS

EMILY SUN, Park Tudor School, Indianapolis, IN

JESSICA MO, Carmel High School, Carmel, IN

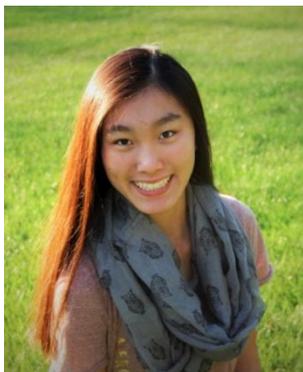
JOHN WANG, Carmel High School, Carmel, IN

PROJECT: Using a novel AlphaLISA technique to discover PRMT5 inhibitor to treat colon cancer

FIELD: Biology

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

Emily, Jessica and John developed a novel technique to discover a targeted therapy –a small molecule inhibitor–that could serve as a basis for future drug development to treat colorectal cancer.



NAME: EMILY SUN

YEAR: Sophomore

HOMETOWN: Carmel, IN

“What I love the most about science is that there is always potential for new discoveries and the excitement of finding answers to the unknown.”

Emily Sun was exposed to a wide variety of STEM subjects growing up. Her father is a mathematician and her mother is a scientist, so her love for science came at an early age. When she grows up Emily would like to be a medical doctor or a scientist, but most of all, be someone who is innovative and who brings positive change to the world. Her interest in cancer research comes from her determination in wanting to discover new treatment approaches for the deadly disease.

Outside of the classroom, Emily plays the cello and was a state gold medalist in the solo competition. She is also a Liaison Officer for Model United Nations, plays on the varsity tennis team and volunteers with the Special Olympics. She speaks Chinese and German.



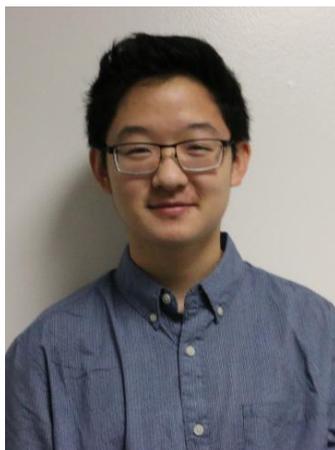
NAME: JESSICA MO
YEAR: Junior
HOMETOWN: Carmel, IN

"There is always something new to learn, no matter how much you think you know."

Both of Jessica Mo's parents are chemists, so she became interested in STEM at a young age playing with her mother's plastic molecule modeling set. She found it fascinating and would have fun scattering all of its tiny pieces on the floor around her. She says she loves science because whether you're a kindergartener or Stephen Hawking, there is always something new to learn.

When she grows up Jessica wants to become a doctor. She is currently interested in studying colorectal cancer because of how widespread and deadly it is.

Outside of the classroom, Jessica is a Science Olympiad Officer and was a National Scholastic Press Association Feature Story of the Year finalist. She enjoys art, listening to Hans Zimmer movie soundtracks, and watching her favorite gymnast, Aly Raisman, perform.



NAME: JOHN WANG
YEAR: Junior
HOMETOWN: Carmel, IN

"When many of my family members died from cancer, I became inspired to learn more about it and how to treat it."

John Wang has always been interested in STEM, but it was when he lost an uncle to cancer that he turned his interests into action. He likes science because of the many fields that are complex yet still interrelated. His favorite STEM subject is organic chemistry because he finds the complexity of it fascinating, and when John grows up he aspires to be a pharmaceutical scientist. Outside of the classroom, John plays the cello, the piano and tennis.

TEAM COMPETITORS

BRANDON WANG, University School, Hunting Valley, OH

JENNIFER WANG, Solon High School, Solon, OH

PROJECT: "Restoration of Ephrin-A1 Expression Negatively Regulates Malignant Behaviors of Prostate Cancer Cells"

FIELD: Biochemistry

MENTOR: Dr. Vera Hapiak, Brandeis University and Dr. Bingcheng Wang, Case Western Reserve University.

Brandon and Jennifer's research allowed them to learn how to tame the malignant behaviors of a cancer cell by restoring a protein normally lost during cancer development.



NAME: BRANDON WANG

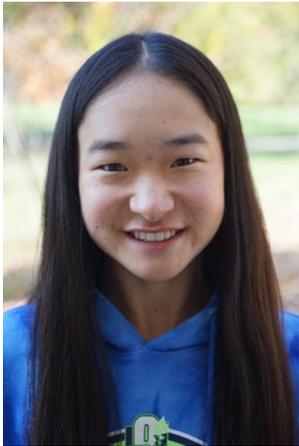
YEAR: Senior

HOMETOWN: Solon, OH

"What I like the most about math, science and technology is the potential these areas have towards advancing and improving our society."

Brandon's passion for medical research began in seventh grade, when he participated in a science fair with a research project on how glucose usage by cells from a normal brain differed from its usage by cells from brain tumors. Brandon volunteers at the Metro Health Hospital, and hopes to pursue a career in medicine or research.

Brandon is an avid cello player, and was a first prize winner in the American Protégé International Competition of Romantic Music 2016 and a Lakeland Civic Concerto Competition first prize winner. He is an assistant principal cellist in the Cleveland Orchestra Youth Orchestra. He is a national division varsity team squash player, and his favorite book is *The Great Gatsby*.



NAME: JENNIFER WANG
YEAR: Junior
HOMETOWN: Solon, OH

"I'm passionate about integrity, because through all of my experiences, whether its golf or school, I've learned that integrity is everything. It determines who you are as a person."

Jennifer was inspired to pursue her research when she learned cancer is one of the leading causes of death worldwide. Her parents are both scientists at the Cleveland Clinic, and they inspired her to pursue research in STEM. She likes how STEM allows scientists and researchers to discover and solve new problems relating to health issues. She hopes to become a physician scientist.

Jennifer has received awards for academic and athletic achievement and was selected to be part of the Student Leadership Academy program at her high school. She won first team all-state honors at the 2016 OHSAA Division One golf tournament. Golfer Jordan Spieth inspires her through his sportsmanship and calm demeanor during a golf tournament. Jennifer is also passionate dancer, and has competed nationally with her dance studio.