

2016 SIEMENS COMPETITION IN MATH, SCIENCE & TECHNOLOGY
Regional Finalists - Georgia Institute of Technology



MATTHEW DARDET

SCHOOL: Pine Crest School, Fort Lauderdale, FL

YEAR: Senior

HOMETOWN: Parkland, FL

PROJECT: “Utilizing a *D. melanogaster* Electroconvulsive Assay to Screen for Novel Antiepileptic Compounds”

FIELD: Biochemistry

MENTOR: Ms. Jennifer Gordinier, Research Coordinator, Pine Crest School; Ken Dawson-Scully, PhD, Assistant Professor in Department of Biological Sciences, Florida Atlantic University

“Whether trying to determine the optimal temperature and time at which to bake cookies or the quantity of fuel needed to produce a thrust that will lift 185,000 pounds of rockets into space or what compound will make a drug that will most effectively cure a disease, the principles of STEM and experimentation can be used to solve almost any quandary.”

Matthew first became interested in the issue of epilepsy when he met his uncle, who was diagnosed with the disorder as a child. His uncle was unable to do routine tasks without being accompanied by another person. One day on his way to school, Matthew heard a news story on National Public Radio (NPR) involving a professor talking about how neurodegenerative diseases such as Alzheimer’s and Parkinson’s could be investigated with the assistance of a fascinating creature—the fruit fly. The primary rationale behind this, explained the man, was that fruit fly brains were similar in structure to those of humans and could be genetically engineered to model the same ghastly diseases of the human brain. This sparked Matthew’s curiosity, “How could these fruit flies be used to understand the processes behind epilepsy and find new treatments that actually work?”

This question inspired him to research further. For his project, Matthew employed a modified test that electrically shocks fruit flies and analyses how long it takes for them to recover from seizure. His research could lead to the development of new drug treatments for epilepsy.

Matthew’s favorite non-academic pursuits are playing the double bass in orchestras and jazz bands across Florida, organizing and participating in charitable initiatives with the Beta Club, and engaging in science and math competitions as the president of his school’s Science Club. His notable accomplishments include performing as a principal double bassist with the New World Symphony and winning the Cellular and Molecular Biology category of the Sigma Xi Online Research Showcase.

One day, Matthew would like to obtain his Ph.D., run his own laboratory/operate an oceanic research yacht, and write science fiction novels on the side.



ALEXANDER KIROV

SCHOOL: Greenbrier High School, Evans, GA

YEAR: Senior

HOMETOWN: Evans, GA

PROJECT: “Exosomes in Amyloid Aggregates Promote Neuronal Damage: A Mechanism of Alzheimer’s Pathology”

FIELD: Biology

MENTOR: Erhard Bieberich, PhD, Department of Neuroscience and Regenerative Medicine, Medical College of Georgia at Augusta University

“Over 5 million Americans have Alzheimer’s Disease, and in less than 10 years, there is expected to be a 40% increase in Alzheimer’s patients. Very little is known about its development, and I feel that my work has contributed to scientific knowledge by pinpointing a place where its progression can be interrupted.”

Alexander Kirov’s research aims to uncover the mechanism of the progression of Alzheimer’s Disease. Not only is the disease already quite prevalent in the elderly, but the number of Alzheimer’s patients is rising at an astounding rate. Today, one out of 10 Americans age 65 and older is diagnosed with Alzheimer’s Disease. Alexander hopes his research can contribute to reversing this trend.

As captain of his school’s Science Bowl and math teams, Alexander sees himself as a leader in STEM activities. Most recently, his teams were selected as Regional Runner-Up and 3rd place in the Science Bowl. And last year, Alexander competed in the US National Chemistry Olympiad as a top 9 scorer in his region of over 300 participants. Alexander is also a member of his school’s chapter of the Mu Alpha Theta Mathematics Honor Society, where he tutors younger students in math and physics.

Outside of his academic pursuits, Alexander plays number 1 for the varsity tennis team, and volunteers at tennis camps and school clubs to teach rising players to enjoy the sport. Alexander’s favorite professional tennis players are Serena Williams and Stan Wawrinka, who he tries to learn from when he watches them play. His favorite book is “Siddhartha” by Herman Hesse, and he enjoys listening to the German metal band, Scorpions.

One day, Alexander hopes to study in an MD/PhD program and help advance research in the Biomedical Sciences.



EMILY JIAYUAN LIU

SCHOOL: DuPont Manual High School, Louisville, KY

YEAR: Senior

HOMETOWN: Louisville, KY

PROJECT: “Quantum Mechanics-Based Computer Simulations of Collisions of a Bucky ball with Graphene and Silicon Carbide Sheets”

FIELD: Physics

MENTOR: Dr. Ming Yu, Associate Professor, University of Louisville

“What I like most about math, science, and technology is that new discoveries can be applied to change our world for the better.”

Emily Liu’s research idea was originally sparked by a question she thought of after watching bulletproof vest testing videos on YouTube: How would a very strong material like graphene - thin layers of pure carbon - respond to a collision with a fast-moving foreign object, such as the buck ball (a specific nanoparticle)? Emily decided to answer the question herself using quantum mechanics-based simulations. She discovered a rich spectrum of phenomena at the atomic level during the collision process. Her findings have potential applications in the synthesis of new nanomaterials. She plans to continue doing research in the development and understanding of nanotechnology, which has wide-ranging applications in many fields, including medicine, computing, defense, and astronomy.

At school, Emily’s favorite subject is physics and she is a senior officer of the Science Olympiad Team, and president of the mathematics honor society, Mu Alpha Theta. Emily has played the clarinet since fifth grade and serves as principal clarinetist in both the Youth Performing Arts School and the Louisville Youth Orchestra. In her free time, Emily tutors clarinet students at a local middle school.

In addition to her extracurricular science research, Emily participates in the American Mathematics Competitions and qualified for the American Invitational Mathematics Examination for all three years of high school. She is proud of teaching herself computer programming, and sees it as an important skill for every field. Emily used her programming skills to develop computer simulations in her research, and hopes to take it with her to college and beyond.



NIMISHA PLANT

SCHOOL: North Carolina School of Science and Mathematics, Durham, NC

YEAR: Senior

HOMETOWN: Charlotte, NC

PROJECT: “Photocatalytic Properties of Novel Cu₅(Ta/Nb)₁₁O₃₀ Photocatalyst”

FIELD: Chemistry

MENTOR: Paul Maggard, PhD, North Carolina State University; Myra Halpin, PhD, North Carolina School of Science and Mathematics

“The fact that elements of nature, like water and sunlight, can be harnessed to produce gases for use as fuel is fascinating to me.”

Nimisha’s research let her to discover a novel photo catalyst with the potential for visible light water splitting. She is passionate about encouraging environmental sustainability by teaching people that living sustainably is both affordable and rewarding in the long run. She hopes to become an engineer and use chemistry to produce reliable alternative energy systems.

Nimisha speaks Hindi. She became inspired to pursue STEM when her brother brought home a small solar panel he was using in a science fair project. She placed third in nation and first in North Carolina in the HOSA Biomedical Debate. She was a summit diplomat at Conrad Spirit of Innovation, where she presented an idea for an innovative fracking wastewater filtration system. At school, Nimisha is debate captain and competes in varsity swimming.



AMBER ZOE YANG

SCHOOL: Trinity Preparatory School, Winter Park, FL

YEAR: Senior

HOMETOWN: Orlando, FL

PROJECT: “Orbital Recognition System for Space Debris Tracking Using Artificial Neural Networks – A Journey from Inner-Brain GPS to Outer-Space GPS”

FIELD: Engineering

MENTOR: Dr. LiFarn Yang, Lockheed Martin; Michael Arney, Trinity Preparatory School

“I’m excited about the new frontiers of space that mankind will soon be able to explore because of advancements in STEM. The desire to explore the unknown is an intensely human desire and as we advance forward into space, technologies that are functional here on earth must be reapplied to work in space as well.”

Amber Yang’s research aims to create a new method of targeting and tracking space debris to create a spacecraft collision avoidance system that relies on machine learning - or computers finding hidden insights that they may not have been explicitly programmed to do. She was inspired by the 2013 film Gravity and the dangers space debris imposed on astronauts and spacecraft in orbit. She has spent over 1000 hours on her project and is passionate about encouraging girls to pursue STEM careers. She

founded a club at her high school, Trinity Preparatory School, called Girls in STEM. Their goal is to provide enrichment STEM activities to girls to tap into their talents and potentials.

Amber was invited to speak at the 2016 TEDxJacksonville Fear Less Conference about her research and the importance of encouraging girls' involvement in STEM fields. She won the CERN Special Award at the 2016 Intel International Science and Engineering Fair and has been invited to attend and discuss her research at the 2016 White House Frontiers Conference.

Amber has been playing the piano for thirteen years and the violin for nine. Her favorite book is "The Picture of Dorian Gray" by Oscar Wilde, and she enjoys listening to Coldplay.

Team Competitors

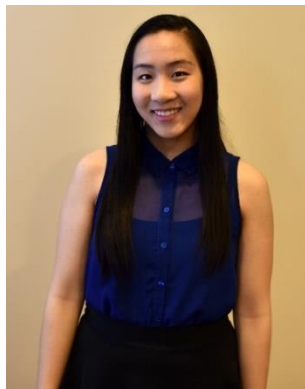
JASMIN GAO, Northview High School, Johns Creek, GA

ROSE HONG, Del Norte High School, San Diego, CA

PROJECT: "Effects of Fibrin Gel Scaffolds and Dexamethasone on the Differentiation of Human Dental Pulp Stem Cells for Applications in Regenerative Endodontics"

FIELD: Materials Science

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



JASMIN GAO

YEAR: Senior

HOMETOWN: Suwanee, GA

"I relish the thrill of creating something unique and beautiful to change the world."

Jasmin and her teammate discovered a promising step for replacing injured dental tissue and restoring function to a tooth after severe damage. Jasmin became interested in this research after her friend underwent a root canal and described to her the drilling and invasiveness of the procedure. Jasmin began to wonder if there were better ways to save teeth and decided to investigate.

For as long as she can remember, Jasmin has always been curious about how the world works. Some of her earliest memories are of taking machines apart and attempting to put them back together, and pelting her family with questions about almost anything.

At school, Jasmin's favorite subject is science and she is active in student government, mock trial, and the Junior Classical League -- a national group of students interested in ancient Greek and Latin culture.

One of Jasmin's proudest achievements to date is founding Girls in STEM, an organization that provides free STEM classes to young girls and empowers them to defy gender roles. What started as a small group has now grown to over 100 participants with two additional branches located around the Atlanta metro area in Georgia for classes.

Jasmin sees herself as a passionate advocate for gender equality in the STEM fields. She hopes to continue helping young women and creating opportunities for them to grow and challenge expectations. Her message to every young girl is that "you can do anything you want!"



ROSE HONG

YEAR: Junior

HOMETOWN: San Diego, CA

"I enjoy STEM because it adds an energizing sense of clarity to the world and helps us explain phenomena that may initially seem unknowable."

Rose's research led her to team to discover a promising step for replacing injured dental tissue and restoring function to teeth after severe damage. Rose first became interested in this science after one of her and her teammate's friends developed a painful tooth infection from a root canal. To her surprise, Rose learned that such invasive procedures can often lead to harmful side effects, especially among younger patients. Her friend's painful experience inspired Rose to research further, and find a better long-term solution for dental trauma.

Outside of school, Rose is vice president of Science Olympiad, Academic League, and Math Club, and she is also a U.S. National Chemistry Olympiad semifinalist. She enjoys playing piano and plays on her school's varsity girls' tennis team.

Every summer, Rose volunteers as a counselor at the Fleet Science Center Camp, where she spends more than 200 hours mentoring younger students and helping them discover their passions in STEM. She is also an avid musician and has played at Carnegie Hall, winning first prize in the 2016 United States International Duo Piano Competition.

One of Rose's favorite books is "The Little Prince" by Antoine de Saint-Exupéry. She hopes to one day become a doctor or engineer.

TEAM COMPETITORS

HARRIET KHANG, Thomas Jefferson HS-SCI & TECH, Alexandria, Virginia

KELLY CHO, Thomas Jefferson HS-SCI & TECH, Alexandria, Virginia

SHINBE CHOI, McLean High School, McLean, Virginia

PROJECT: "All-in-one Biosensor for the Prevention of Arrhythmias through the 2-min Analyses of Coagulation Factors"

FIELD: Biochemistry

MENTOR: Dr. Jihoon Lee, CEO, Luminescent

Harriet, Kelly, and Shinbe developed a cost effective all-in-one biosensor for the diagnosis of heart related diseases. Since the biosensor is sensitive, it allows medical personnel to detect and respond to heart related diseases in their earlier stages.



HARRIET KHANG

YEAR: Junior

HOMETOWN: Great Falls, Virginia

"I am most passionate about making the world a better place-- as cheesy as it sounds. To be more specific, I would like to apply STEM as a way to improve the quality of life for people all around the world."

Harriet's love for biochemistry began at an early age when she was introduced to a Bio-Med course during summer camp in the 7th and 8th grade. She learned about the human body which sparked her interest to learn about other STEM fields. That interest evolved into a passion because of her grandfather. Although he is still alive, he suffers from a brain clot and there are many things he cannot do that he used to. Harriet believes she can use STEM to improve the quality of life for people who may be suffering just like him.

In her free time, Harriet plays the violin in a volunteer orchestra that plays once a month at a senior center. She serves as the secretary for Active Science Alliance and is a member of Hope Cards which creates cards and sells them to make funds for an organization of choice. Harriet plans to pursue a major in college in something related to biotechnology.

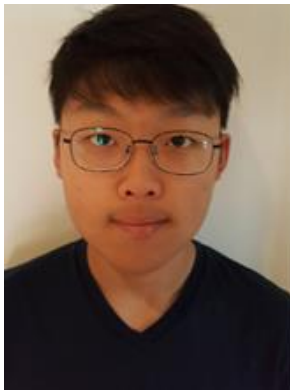


KELLY CHO
YEAR: Junior
HOMETOWN: McLean, Virginia

“Early detection is crucial for a great number of diseases, so I believe it should be the first step to combatting diseases.”

Kelly admittedly wasn't always interested in STEM. It wasn't until she started preparing for the USA Biology Olympiad, that she began to love biology. However, her passion goes beyond science. She likes that there are so many layers of math, science, and technology that correspond with not only each other, but also arts and history, both subjects she loves. Although she doesn't aspire to become a poet, she hopes to write like the poet, Rudy Francisco and create beautiful, forceful poems. She's also a big fan of Stephen King because his books are perfectly spooky and extremely well written. Outside of the classroom, Kelly volunteers and mentors kids from low-income families at The Other Side of the World (TOSOW), a non-profit in Mclean, VA. She hopes to create meaningful, lasting relationships with the kids she mentors.

What inspires Kelly Cho's work? The fact that there aren't many convenient biosensors, like the pregnancy test, that can be used by the public. She believes early detection is crucial for a great number of diseases, so it should be the first step to combatting them.



SHINBE CHOI
YEAR: Junior
HOMETOWN: Falls Church, Virginia

“I love learning the intricate details of biological studies because it satiates (not completely) my hunger for knowledge about how and why life works.”

Dissecting frogs, pigs, sharks, and sheep brain and hearts might be a squeamish task for most people, but for Shinbe it inspired an interest into the anatomy and physiology of organisms. Shinbe's love of biology and desire to pursue medicine led him to research about disease diagnoses through applications

of biological processes. He hopes one day he can use his research to improve public health for people in less-privileged areas who do not have access to good health care.

Beyond his hobby of dissecting animals in class, it's important to Shinbe to act on his faith and mission, a lesson he learned from his role model, missionary Rev. Everett Swanson. Shinbe plays contemporary Christian music on his guitar and volunteers at KLEMA, a ministry for the disabled at his church. Shinbe admittedly never ceases to crack jokes and always tries to make friends, family, and strangers laugh.

Team Competitors

RICHARD LAWRENCE LUN, Thomas Jefferson High School, Alexandria, VA

ELIZABETH LING, Thomas Jefferson High School, Alexandria, VA

PROJECT: "Searching for new lead-free organic perovskite photovoltaics"

FIELD: Materials Science

MENTOR: Dr. Xuan Luo, Principal Investigator, National Graphene Research and Development Center; Dr. Gefei Qian, Director, National Graphene Research and Development Center



RICHARD LAWRENCE LUN

YEAR: Sophomore

HOMETOWN: Ashburn, VA

"I am passionate about learning new, challenging things and self-improvement of my skills. I always enjoy having a challenge in whatever I am doing, whether it's research or tennis or a hard math problem, because it helps me gain more experience and proficiency. Even if I fail at something, I know I am improving and it will only make the ultimate success even better."

Richard Lun's research led him and his teammate to find a cheaper, lead-free alternative to standard perovskite solar cells - which currently contain lead and create environmentally hazardous residue and waste. Their alternative could allow considerably greater future production of clean and renewable energy.

Richard was inspired to pursue his research by a trip to China in 2014, where he experienced first-hand the effects of air pollution. His trip really motivated him to try and find a clean, environmentally friendly energy source for the world. He then explored affordable solar power as an alternate way to fight pollution, and discovered the benefits of perovskite solar cells through his initial research.

Richard is the president and founder of his high school's Science Fair Club, a member of the Varsity Math Team and physics team, and enjoys playing competitive tennis and doing math competitions such as the AIME. He speaks Mandarin, and names his role model as his grandfather, who lives in China. He became interested in STEM when he and his father assembled a desktop computer in second grade. He hopes to pursue a career in computer science.



ELIZABETH LING

YEAR: Sophomore

HOMETOWN: Lorton, VA

“My favorite thing about math is that there are so many cool strategies you can use to solve problems, many of which require you to look at it from a different perspective and be creative.”

Elizabeth and her teammate tested new materials to be used in solar cells to make them more efficient, safer for the environment, and available for commercial use. She began learning about the environment through the Science Olympiad in middle school, and soon after became interested in finding ways to improve and conserve the environment.

Elizabeth's favorite subject is math. She's passionate about teaching kids STEM topics, and believes with the right guidance, students can get excited and learn about STEM instead of viewing it as a chore. She currently assists in teaching a Python class to 4-8th graders, and has been involved with various programs in the past to expose kids to more advanced math and science topics.

Elizabeth speaks Mandarin and plays lacrosse. She admires New Zealand singer-songwriter Lorde, and plays violin, piano, guitar, and the ukulele.

Team Competitors

MARK RAJ, Dupont Manual High School, Louisville, KY

RUCHIRA SUMANASEKERA, Dupont Manual High School, Louisville, KY

Project: “The Effect of Nitrogen Doping of Graphene on the Effectiveness of Supercapacitors”

Field: Chemistry

MENTOR: Dr. Gamini Sumanasekera, Energy Storage Theme Leader, University of Louisville

Ruchira and Mark discovered through their research the potential of a more efficient version of the battery. They studied how adding nitrogen to graphene can make battery-like devices function at a higher rate. Their research could potentially improve the mass production of electric cars in the future.



RUCHIRA SUMANASEKERA

YEAR: Sophomore

HOMETOWN: Louisville, KY

“What I like most about math is that you have the opportunity to put to work all the knowledge that you have acquired to solve a certain problem.”

Ruchira was inspired by his father’s work to pursue his research. He was eager to work with batteries and capacitors due to the impact they have on everyday life. He aspires to one day be an engineer or a doctor. Ruchira’s favorite author is J.K. Rowling, and he plays the guitar and trumpet. He has won first place on his school’s chess team for the past three years, and is a member of the Louisville Soccer Association (LSA). He hopes to someday win the state team championship for chess.



MARK RAJ

YEAR: Sophomore

HOMETOWN: Louisville, KY

“No matter how many times you fail, STEM fields always encourage you to get back up and try again. As long as you learn from your mistakes and improve upon what you've done, all is forgiven.”

Mark and his teammate studied how adding nitrogen to graphene can make battery-like devices last longer. Their research could potentially improve the mass production of electric cars in the future.

Mark is extremely passionate about the environment and combating climate change. In the past, he completed two science fairs involving projects about Louisville's urban heat island - a phenomenon where a city's center experiences much higher temperatures than its less developed and populated surroundings. He credits his first interest in STEM fields to Bill Nye the Science Guy- this program taught him that science can be fun, and doesn't have to be all data analysis and writing reports. Mark likes how applicable STEM is in today's world, and how projects like these have the potential to improve human lives.

Mark's favorite book is A Brief History of Time by Stephen Hawking. Mark speaks Tamil and he is currently studying Spanish. He is a state semifinalist in Public Forum debate and nationally ranked in the Academic Worldquest. He hopes to one day study environmental law.

Team Competitors

NIKHIL REDDY, North Carolina School of Science and Mathematics, Durham, North Carolina

CHARLES GOODMAN, North Carolina School of Science and Mathematics, Durham, North Carolina

PROJECT: "Passing Stones"

FIELD: Mathematics

MENTOR: Cheryl Gann, Instructor of Mathematics, North Carolina School of Science and Mathematics

Nikhil and Charles studied the end results of a combinatorial game played on the vertices of a complete graph that could potentially help solve other unsolved problems in mathematics.



NIKHIL REDDY

Year: Senior

Hometown: Cary, NC

"Perhaps the most interesting part of STEM for me is studying how different individual's mathematical models of the real world helped develop their field. These mathematical models are everywhere from infectious disease spread by the CDC to the laws of quantum mechanics."

Nikhil's interest in mathematics began when he unwittingly signed up for his school's MATHCOUNTS team in 7th grade. Unfortunately for Nikhil, he signed up with over a hundred other students, so particularly difficult tryouts were held. It was the single most difficult test he had ever taken. And yet there was something irresistible for him about the challenge.

Nikhil is the NCSSM's Math Club president, volunteers for the Distance Education Enrichment Programs to teach Durham Elementary School Students about various STEM fields, is the Math and Computer Science Editor for the Broad Street Scientific Annual Research Journal, and he plays the saxophone. Nikhil is a two time member of the Mathematical Olympiad Summer Program and he received 1st place Individual for the 2015 Duke University Mathematics Meet.

Linus Hamilton, a "combinatorialist", is Nikhil's role model not because he has produced numerous research papers in mathematics, but because of his outlook on life. He is always looking for new ways to optimize his lifestyle through various "lifehacks." These can range from rewarding himself by being able to arrange a random list of words, to setting an alarm ringtone to an unpleasant noise to compel one to turn it off. The sheer amount of creative and passion that Linus is capable of amazes him.

Nikhil believes in thinking beyond the textbook and the classroom and thinks that combinatorics is the purest of mathematics. He feels confident that his career possibilities are endless: anything from a modeler on Wall Street, a pure mathematician specializing in Combinatorics, or a programmer at Google.



CHARLES GOODMAN

Year: Senior

Hometown: Greenville, NC

“Honestly, the biggest reason I am interested in physics is all of the things that have yet to be discovered.”

For as long as Charles can remember, he has wanted to be a physicist. His dad who teaches physics used to visit Charles’ class in elementary school to show them neat experiments. In fifth grade, his class was able to see a Van De Graaff generator which generates static electricity that made all of their hair stand up. This experience sparked his initial interest in physics.

Charles speaks Slovenian and French. He is recognized for being the youngest Career College Promise AS completer in North Carolina. He has received both an Associate in Science and an Associate in Arts. Charles is captain of his school’s club League of Legends team. He’s also an avid whistler.

Recently, Charles has been very interested in robots and autonomy, as his robotics team, Zebracorns, has made a major step toward this by developing a real-time vision system that identifies key objects in the game. They use a neural network to develop an algorithm to be able to successfully identify an object regardless of lighting, distance, or angle. At the rate they are progressing, he believes they can have a fully autonomous robot within the next decade.