

2015 SIEMENS COMPETITION IN MATH, SCIENCE & TECHNOLOGY
Regional Finalists – Georgia Institute of Technology



NAME: AKSHAYA ANNAPRAGADA

SCHOOL: Michael E. DeBakey High School for Health Professions,
Houston, Texas

YEAR: Senior

HOMETOWN: Manvel, Texas

PROJECT: The Giant Protein AHNAK Traffics Aptamer Targeted
Nanoparticles Specifically Into Oral Cancer Cells

FIELD: Engineering

MENTOR: Dr. Ananth Annapragada, Professor and Director, Basic
Radiology Research, The Singleton Department of Pediatric Radiology,
Baylor College of Medicine and Texas Children's Hospital

"I developed a new way of designing particles for drug-delivery, and used it to develop an improved platform for delivering chemotherapeutics to oral cancer, and other solid tumors."

Akshaya Annapragada's research aims to uncover ways so patients can experience fewer side-effects from chemotherapy. She developed a new way of designing particles for drug-delivery, and used it to develop an improved platform for delivering chemotherapeutics to oral cancer, and other solid tumors. The experiences of friends and family affected by cancer led her to want to work in oncology.

Akshaya is fascinated by the human body – her favorite subjects are biology and chemistry. She first became interested in STEM thanks in part to her scientist parents. She aspires to pursue MD and PhD degrees and work as a physician-scientist at a large academic hospital, and plans to major in biomedical engineering and public policy in college. Akshaya is a National AP Scholar and a National Merit Semifinalist in addition to competing in martial arts on a global stage – winning the world title at the Sport Karate International League Finals in 2013 and 2014 and as a member of Team USA in 2015.

If Akshaya could speak with anyone from history, it would be Marie Curie because her interdisciplinary work exemplifies what Akshaya strives for in her own career. She believes that in order to encourage students to pursue STEM disciplines, high-quality resources are paramount, including diverse course selection, talented teachers, and access to laboratory equipment.



NAME: BEVERLY GE

SCHOOL: F.W. Buchholz High School, Gainesville, Fla.

YEAR: Senior

HOMETOWN: Gainesville, Fla.

PROJECT: Novel Chromogenic Vapor Sensors Enabled by Shape Memory Polymers

FIELD: Materials Science

MENTOR: Dr. Peng Jiang, Professor of Chemical Engineering, University of Florida

"Through STEM, humanity will be able to resolve many of the most significant global challenges today - most prominently, climate change."

Beverly Ge's project focuses on the development of a new type of vapor sensor which can detect harmful chemical vapors. The vapor sensor, which is compatible with a smartphone, has a variety of applications ranging from diabetes detection to environmental monitoring.

Beverly's pursuit of research at the University of Florida and work in its chemical engineering department has allowed her to explore her passion for environmental science and work in the area of nanomaterials and polymers. Her interest in STEM was nurtured at an early age – her father is an astronomy professor, and she often found herself engrossed in many scientific books lying around the house. Beverly believes it is important to engage more female students in STEM and imperative to nurture girls' self-confidence and eliminate the social stigmas that inhibit a large female presence from pursuing STEM-related fields.

Beverly aspires to be a scientific research and university professor. To date, her proudest accomplishments are a Best-in-Fair Grand Award Winner in the Senior Physical Sciences Division at the 2015 Florida State Science and Engineering Fair, as well as a first place Chalk Talk (a speech using mathematics to present a specified topic) at the 2014 National Mu Alpha Theta Convention. Beverly anticipates majoring in environmental engineering and/or chemical engineering in college. She is interested in attending Harvard University, Princeton University, Yale University, Stanford University, the University of Chicago, or the University of Florida.

Outside of the classroom, Beverly serves as Vice President of Buchholz High School's Math Team and is a Junior Volunteer at the Florida Museum of Natural History. She is also an accomplished violinist and is co-concertmaster of Alachua County's Youth Orchestra.

Beverly's favorite actor is Benedict Cumberbatch, and she was able to see him perform live in London this past August in Hamlet, which is also her favorite play.



NAME: MARIA ELENA GRIMMETT

SCHOOL: Oxbridge Academy of the Palm Beaches, West Palm Beach, Fla.

YEAR: Senior

HOMETOWN: Jupiter, Fla.

PROJECT: Adsorption of Sulfamethazine from Environmentally Relevant Aqueous Matrices onto Hypercrosslinked Adsorbent MN250

FIELD: Environmental Science

MENTOR: Dr. Hui Li, Associate Professor of Environmental and Soil Chemistry, Michigan State University

"For me, science has always been about the excitement of discovering something new."

Maria Elena Grimmert's research found a new method to remove sulfamethazine from water using small plastic beads. Sulfamethazine is the most commonly used veterinary antibiotic to promote both the health and growth of livestock. However, the antibiotic commonly contaminates surface and groundwater, enters the human food chain, and causes both soil and aquatic ecosystem damage. Maria Elena's beads can be reused, applied at scale, and implemented using delivery systems already in place for treating drinking water.

Maria Elena first became interested in her topic because she wanted to know why her well water was brown. That year, she performed a science project on removing fulvic and humic acids, or color, from water, using three different anion exchange resins. She presented this research at the 2009 Palm Beach County Science Fair where she saw another student's project describing pharmaceutical contamination of the Florida Everglades, which steered her to her current research on sulfamethazine.

Maria Elena anticipates majoring in engineering in college, and her favorite course right now is computer science. She is also a member of her school's weekly Computer Science Club. Maria Elena believes computer modeling and programming skills will prove useful in any scientific or engineering discipline.

Outside of the classroom, Maria Elena is a mural artist and Art Club teacher's assistant at the Weiss Elementary School. In this capacity, she paints murals in the school hallways and helps students with art projects. She also plays clarinet and is a member of her school's fencing club. In January 2013, she became the youngest author to publish original research in the 43-year history of the Journal of Environmental Quality.

Maria Elena believes that in order to encourage more students to pursue STEM, elementary school science teachers need to make science fun and hands-on.



NAME: SHREYA PATEL

SCHOOL: North Carolina School of Science and Mathematics, Durham, N.C.

YEAR: Senior

HOMETOWN: Charlotte, N.C.

PROJECT: Development of a Functional Electrochromic Device and Syntheses of $[\text{Si}(\text{tolylterpy})_2](\text{PF}_6)_4$ and $[\text{Si}(\text{bpy})_3](\text{PF}_6)_4$

FIELD: Chemistry

MENTOR: Dr. Thomas A. Schmedake, Associate Professor of Chemistry, University of North Carolina at Charlotte

"I love chemistry as it serves as the fundamental basis for all things."

Shreya Patel created a small-scale functional prototype of an electrochromic window made with two silicon complexes – a “smart window,” capable of adjusting its opacity according to the light outside. The applications of such a window could save households each year on heating and cooling, and it could potentially slow global warming due to the resulting reduction in energy demand.

Shreya’s inspiration comes from two main sources: environmental science and chemistry. As she learned more about the current condition of global warming and the problems with fossil fuels, she took to environmental science. Shreya is also interested in chemistry, as it is the building block of life. Her STEM interests were piqued at an early age, when she created a model of a hydroelectric generator for a science fair.

Shreya aspires to be a research professor in computational biochemistry. She anticipates majoring in chemistry, computational biology and/or bioinformatics. Shreya is currently considering attending either Duke University or the University of North Carolina at Chapel Hill.

Outside of the classroom, Shreya develops audiobooks for a children’s hospital and is on the swim team. She also plays guitar, piano and likes to sing. She has also tutored under-privileged kids in math and science in a local school in India.

If Shreya could speak with anyone from history, it would be Mahatma Gandhi because of his ability to inspire a country with nonviolent resistance.



NAME: MICHAEL YOU

SCHOOL: Thomas Jefferson High School for Science and Technology,
Alexandria, Va.

YEAR: Senior

HOMETOWN: Alexandria, Va.

PROJECT: Two-degree-of-freedom Bubble Oscillations in Elastic Vessels and
its Application in Sonar-induced Marine Mammal Injuries

FIELD: Physics

MENTOR: Dr. Xuemei Chen, Patent Examiner, United States Patent and
Trademark Office

"I aspire to become an engineer that helps design intelligent machines that simplify some of our everyday tasks."

Michael You investigated how bubbles in blood vessels can contribute to the injuries of whales exposed to SONAR, by creating a mathematical model that tests the effects of high-energy sound sources on bubble oscillation in small tubes. His inspiration for pursuing this research originated after stumbling across the Save the Whales campaign and discovering some articles about whale beachings. It was then when Michael realized that SONAR-related whale beachings were a legitimate, growing problem, yet one that was also relatively ignored as a research topic. He hopes that his project can help people become more aware of the human impacts on the ocean and galvanize them to protect vital marine ecosystems.

Michael's favorite subject in school is Artificial Intelligence because of its diverse applications. He is particularly interested in the development of self-driving cars because it is a field that requires both programming and engineering skills. Michael's current course load includes Complex Analysis, Differential Equations, Quantum Mechanics and Oceanography. He first became interested in STEM when he began to break down an old computer into its components.

Michael aspires to become an engineer that helps design intelligent machines that simplify everyday tasks. He anticipates majoring in electrical engineering and/or computer science in college.

Outside of the classroom, Michael is a competitive swimmer and plays the violin and piano. His piano teacher helped prepare Michael for his broader pursuits because he learned to be organized, prepared and detail-oriented during the learning process. Michael also teaches competition math at his local Chinese School on Sundays – focusing on number theory, combinatorics, algebra and geometry.

In a summer program, Michael had the opportunity to attend a lecture given by and eat dinner with Nobel Laureate Wolfgang Ketterle – the German physicist and professor of physics at the Massachusetts Institute of Technology most well-known for his research around the cooling of atoms to temperatures close to absolute zero.

TEAM COMPETITORS

DANIEL CHAE, Thomas Jefferson High School for Science and Technology, Alexandria, Va.

ALAN TAN, Irvington High School, Fremont, Calif.

SIDHARTH “SID” BOMMAKANTI, Amador Valley High School, Pleasanton, Calif.

PROJECT: A Novel Study on the Effect of Surface Topography of 3-D Printed PLA Scaffolds on Dental Pulp Stem Cell Proliferation and Differentiation in vitro.

FIELD: Materials Science

MENTOR: Dr. Adriana Pinkas-Sarafova, Adjunct Assistant Professor, Stony Brook University

“With [our] project, the world can have more cost-effective and improved bone implants.”

Daniel Chae, Alan Tan and Sidarth Bommakanti’s research project, assesses 3-D printed structures as an alternative to plating dental pulp stem cells (DPSCs) for use as implants. The team found that DPSCs are able to differentiate substantially more on 3-D prints than on currently used structures, suggesting that 3-D printed structures could be a cheaper and better alternative for bone or dental implants. The team was able to convert the challenge of having two different kinds of 3-D printers in the lab into an opportunity by comparing the structures from the two printers, which helped draw conclusions about the reproducibility of 3-D printers.

A common interest in the rapid rise of 3-D printing applications and the potential for stem cells to dramatically evolve the medical field inspired the team to pursue this research.



DANIEL CHAE

YEAR: Senior

HOMETOWN: Oakton, Va.

Daniel’s favorite subject in school is math because of its variety and depth. He first got excited about mathematics in 6th grade, when he began to get involved in his school’s MathCounts team. In college, he anticipates to channel this passion as a biology or chemical engineering major. He ultimately aspires to be a physician.

Daniel’s interdisciplinary mind has led him to pursue a wide range of interests, as he currently serves as the co-president of his school’s Latin Honor Society, is proficient in Korean and also enjoys archery. After school, Daniel serves as the chemistry and biology tutor for students. He believes that if there were to

be a dramatic advancement of society using discoveries in science, then more people would become engaged in science and math.

Daniel's role model is American scientist Linus Pauling, and if he could speak with any person in history, it would be Roman poet Vergil.



SIDHARTH "SID" BOMMAKANTI

YEAR: Senior

HOMETOWN: Pleasanton, Calif.

Sidharth Bommakanti wants to pursue a career in medicine. His interest in the field has been fueled by his passion for biology, and the potential for biological science to impact lives. Similarly, Sidharth also tutors underclassmen in chemistry and biology. He anticipates majoring in molecular and cellular biology.

Sidharth's inspiration comes from a number of sources – his sister's success in a local science fair in middle school originally motivated him to pursue STEM subjects. Her later pursuits in medicine also inspired Sidharth to take an interest in pursuing a future in medicine. One of his earliest STEM memories was when he won first place in Science Olympiad as a 6th grader. His proudest accomplishments to date are a 4th place finish at the California State Science Fair and a 3rd place finish at the International Career Development Conference.

Outside of school, Sidharth participates in Project Wellness Water, a dual filtration system that purifies contaminated water in rural communities. He also serves as Vice President of his school's Environmental Club, and volunteers at Valley Care Hospital.

In his free time Sidharth enjoys tennis and basketball. And though he is a Californian, his favorite player is Dallas Maverick's all-timer Dirk Nowitzki, known for his cool on the court and smooth shot.



ALAN TAN

YEAR: Senior

HOMETOWN: Fremont, Calif.

Alan Tan aspires to be a medical researcher. More specifically, what interested him in his current area of research is the potential for dental pulp stem cells (DSPCs) to circumvent ethical concerns about using stem cells for research. He soon found himself engrossed in the subject, learning that DSPCs are a source of stem cells that could be very useful in the regeneration of various body parts, including bones.

Outside of the classroom, Alan has been recognized for his volunteer service – earning a Presidential Service Award. He is also a mentor in STEM subjects at school, serves as Vice President of his school's science club, plays the piano, and likes to shoot hoops

Alan anticipates majoring in either chemistry or biochemistry in college. If he could talk to any figure in history, Alan would love to speak with Isaac Newton, the father of early physics and calculus.

TEAM COMPETITORS

KELLY CHO, Thomas Jefferson High School for Science and Technology, Alexandria, Va.

HARRIET KHANG, Thomas Jefferson High School for Science and Technology, Alexandria, Va.

PROJECT: All in one biosensor for early diagnosis and prognosis of breast cancer

FIELD: Biochemistry

MENTOR: Dr. Jihoon Lee, CEO, Luminescent M.D.

"We found an inexpensive and uncomplicated method for a biosensor for breast cancer that could potentially be slightly modified for other diseases as well."

KELLY CHO and HARRIET KHANG's research could improve the problem of early detection of fatal diseases, which would increase the number of survivors and decrease the time of suffering. With breast cancer being such a huge issue, Kelly and Harriet felt it important to try to collectively alleviate the problem.



KELLY CHO

YEAR: Sophomore

HOMETOWN: Mclean, Va.

Kelly Cho first got interested in STEM at CTY Camp – the Center for Talented Youth. She aspired to work in a career involving law and science. She anticipates majoring in forensic science and would like to attend the Georgia Institute of Technology, the University of Chicago, Georgetown University, the University of Southern California or New York University, among others.

Kelly's favorite subject is biology, as she especially enjoys the interconnected structures and functions that are essential to the discipline. She is currently taking AP Biology and enjoys that depth at which she is able to explore the subject.

Outside of the classroom Kelly plays the cello and is involved in The Other Side of the World (TOSOW) – a non-profit volunteer service. Kelly is fascinated by the religions of the world, and enjoys listening to various religious beliefs and their histories.



HARRIET KHANG

YEAR: Sophomore

HOMETOWN: Great Falls, Va.

Harriet Khang aspires to be a computer engineer. Her interest in STEM goes back to the second grade, when her class dissected a frog, but it was a field trip to the National Institutes of Health that really piqued her interest in the field. Harriet was inspired to research breast cancer due to the fact that it is heavily prevalent in women, and that she has a chance of acquiring it herself.

Harriet's favorite subject in school is computer science because she enjoys its problem-solving aspects. In addition, Harriet likes that computer science is versatile and can be applied to many different fields, such as biotechnology. She anticipates majoring in computer science and/or biotechnology, and is considering Cornell University, the Massachusetts Institute of Technology, the California Institute of Technology and the University of Virginia.

Outside of the classroom, Harriet is a club leader in the Active Science Alliance, for which she is its publicist. She also plays the violin.

TEAM COMPETITORS

CHAEYEON "CARRIE" OH, Episcopal High School, Alexandria, Va.

YUJIN KIM, Stony Brook School, Stony Brook, N.Y.

PROJECT: On the Size of the Euclidean Sphere of Influence Graph

FIELD: Mathematics

MENTOR: Dr. Dan Ismailescu, Professor of Mathematics, Hofstra University

"Math is one of the few subjects in which an answer almost always exists."

Chaeyeon Oh and Yujin Kim's research project focused on finding a better estimation of maximum edges that a sphere of influence graph can have. This can help improve visual modeling technology, pattern recognition, and geographic information systems - ultimately leading to the potential development of higher-resolution images and more intelligent machines capable of better interacting with humans. The project required working from previous mathematicians' papers and trying to figure out a different, innovative way to approach the problem that would yield better results.



CHAEYEON "CARRIE" OH

YEAR: Senior

HOMETOWN: Alexandria, Va.

For Chaeyeon Oh's first science project, she designed and constructed a walking cane that was GPS- and LED-equipped, to help track the location of the user. Chaeyeon submitted the project for patent review earlier this past summer. Chaeyeon likes STEM because of its puzzle and problem-solving characteristics as well as its interdisciplinary nature. She is one of seven student tutors at the Episcopal Science and Math Tutoring Center.

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Chaeyeon Oh aspires to be a social entrepreneur. She anticipates majoring in applied mathematics, and her favorite subject in school is multi-variables because it has allowed her to approach complex mathematical concepts and problems more broadly and creatively.

Outside the classroom, Chaeyeon is the captain of her school's varsity crew team and plays volleyball. She has also solved four IBM Ponder This Monthly puzzles, won the John Prize for Eminent Academic Excellence at her school and is the head of Episcopal High School's Math Club. Captain of the varsity crew team, she also sits first-chair flute in her school's orchestra.

Chaeyeon's mom is a TV producer, so she has had the opportunity to meet several renowned musicians.



YUJIN KIM

YEAR: Senior

HOMETOWN: Stony Brook, N.Y.

Yujin Kim aspires to be a professor in mathematics. Her favorite part about STEM is that the development of mathematical concepts can be used to solve practical, everyday problems. First excited by a visit to a car museum where she saw the mechanics behind a moving car, Yujin thinks that in order to encourage more students to pursue STEM more seriously, more can be done to connect important discoveries to how they, too, can be empowered to make a difference.

Yujin anticipates majoring in mathematics, but her favorite class is art, because it allows her brain to rest, develop creativity and focus on academic subjects. Next to her pride in becoming a Siemens regional finalist, Yujin is also proud of starting her school's first Sandwich Club and Science Club. In the latter, the club does weekly newscasts about fascinating scientific discoveries to keep students interested in learning and applying science outside of school. She has also participated on a mission trip to Cambodia.

Yujin admires Fyodor Dostoevsky, particularly his book "The Brothers Karamazov." If she could talk to him about anything, the conversation would be about religion and morality.

TEAM COMPETITORS

CHRISTINA OH, Thomas Jefferson High School for Science and Technology, Alexandria, Va.

EDWARD OH, South County High School, Lorton, Va.

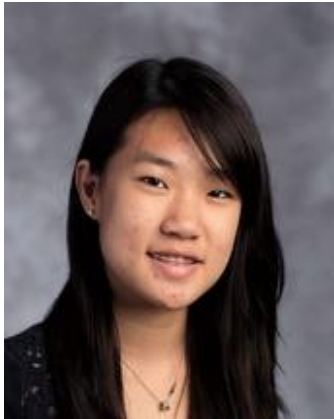
PROJECT: Investigating Interfacial Crosslinking to Combat Hard Foulants

FIELD: Biochemistry

MENTOR: Christopher Spillmann, Research Physicist, Naval Research Laboratory

"We found a potential method to mitigate the attachment of the barnacle which could help with drastically improving vessels' efficiency and in the future, possibly process a safe glue for surgical purposes."

CHRISTINA OH and EDWARD OH's research could potentially allow marine vessels to operate more efficiently by inhibiting the attachment of foulants to ships. Christina's interest in biology and chemistry stemming from her coursework at school inspired her to pursue this research, and Edward was inspired by the fact that Christina had already been a Siemens semifinalist in 2013, and wanted to gain more experience with engineering.



CHRISTINA OH

YEAR: Junior

HOMETOWN: Lorton, Va.

Christina Oh aspires to be a research doctor. She anticipates majoring in neuroscience and bioengineering, and plans to apply to universities with strong bioresearch fields.

Outside the classroom, Christina is the founder of a community service group made specifically to teach middle school students STEM. She is also a varsity track athlete and is a member of her school's Biology Olympiad. Christina believes that in order to encourage more kids to pursue STEM careers, giving them hands on opportunities is vital. In this way, she believes the experience can impact the students more effectively.



EDWARD OH

YEAR: Freshman

HOMETOWN: Lorton, Va.

Edward Oh aspires to be an engineer. In the future, he anticipates majoring in astronomy, aerospace engineering and/or computer science. In addition to his research, Edward participates in the StemsforMustangs organization – a peer coaching organization that prepares middle school students for Science Olympiad – a STEM competition. He also plays soccer and runs track.

Edward believes that in order to encourage more kids to get excited about STEM, it is important for them to know how fun it can be and how applicable scientific knowledge is in solving real world problems.

Team Competitors

VAMSI VARANASI, Enloe High School, Raleigh, NC

VINIT RANJAN, North Carolina School of Science and Mathematics, Durham, NC

PROJECT: MgO-Promoted NiAl_2O_4 Spinel Nanostructures for Efficient Reforming of Biogas

FIELD: Materials Science

MENTOR: Fanxing Li, Assistant Professor of Chemical and Biomolecular Engineering, North Carolina State University

“The education system must facilitate the innate curiosity present in every student to encourage children to become STEM-oriented.”

Vamsi Varanasi and Vinit Ranjan implemented a nanoparticle catalyst that can produce a synthetic fuel precursor with drastically improved efficiency. This nanoparticle improves upon the commercial viability of a process that simultaneously removes harmful greenhouse gases from the environment and produces a source of clean burning fuels.



VAMSI VARANASI

YEAR: Senior

HOMETOWN: Apex, N.C.

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When he was a preschooler, Vamsi used to skip nap time to read about astronomy, aerospace science, biology, and more. Those first books introduced him to the marvels of science, and he's been hooked ever since.

Prior to his Siemens Competition research, Vamsi had already worked on two other nanoscience projects - explorations into carbon nanofiber growth processes and a study of light absorption by branched gold nanoparticles. Vamsi hopes to major in materials science and engineering as he is intrigued by the seemingly minute interactions between atoms and molecules that occur in everything around us.

Vamsi has applied to various schools with strong materials science programs, including Stanford University, California Institute of Technology, Massachusetts Institute of Technology, Princeton University, Harvard University, Yale University, University of Pennsylvania and more.

Aside from his research pursuits, Vamsi tutors math and science at his school and is an avid soccer fan.



VINIT RANJAN

YEAR: Senior

HOMETOWN: Cary, N.C.

Vinit first became interested in STEM when his kindergarten teacher brought in a battery, wires, and a lightbulb and tasked the class to make a light. Knowing nothing about circuits, his intellectual curiosity was piqued by the challenge and made him excited to learn.

Vinit is particularly interested in math, an interest that was cultivated at a young age when his father would bring him books of math problems that he eagerly worked through. He hopes to major in applied mathematics and has applied to various schools with incredibly strong mathematics programs, including Massachusetts Institute of Technology, California Institute of Technology, Duke University, Stanford University, Princeton University, Harvard University, University of Chicago, University of California – Berkeley, University of North Carolina - Chapel Hill, and North Carolina State University.

Vinit is fluent in Hindi and tutors students in physics at his high school.