

2016 SIEMENS COMPETITION IN MATH, SCIENCE AND TECHNOLOGY
Regional Finalists – Massachusetts Institute of Technology



NAME: JACY FANG

SCHOOL: Bergen County Academies, Hackensack, NJ

YEAR: Senior

HOMETOWN: Ridgewood, NJ

PROJECT: The Living Drug: A Novel Method of Inducing Stem-Like Memory T Cells from Antigen-Experienced Cells for CAR-T Immunotherapy

FIELD: Biology

MENTOR: Michel Sadelain, MD, PhD, Director, Center for Cell Engineering, Memorial Sloan Kettering Cancer Center and Dr. Sjoukje Van der Stegen, postdoc, Memorial Sloan Kettering Cancer Center

"To conduct research is to be at the forefront of new discoveries and I want to express my ideas to ensure that others do not have to endure the abhorrent tragedy of losing a loved one."

To help prevent relapse in leukemia patients, Jacy Fang found a new way to create stem-like memory T cells for genetically engineered cell therapy. T-cells are white blood cells that are part of the body's immune response system to fight off diseases like cancer.

Since she was little, science has always been a passion and medicine in particular interested Jacy. She was enchanted by how a small pill could reduce a fever, or alleviate a cough, and how doctors could figure out what your body needed. But her true motivation in pursuing medicine stems from the early years that she spent with her grandfather that were cut short when he was taken away by cancer.

Jacy began her research eighteen months ago with a simple idea of improving a current cell treatment that has shown promise in treating cancer. She was inspired by the work of Dr. Michel Sadelain, who has been a pioneer in the field of cancer immunotherapy. She has immersed herself in rare science classes such as Biotechnology Lab, Immunology, Oncology and Hematology, and taken courses at the Columbia Science Honors Program to build a foundation of knowledge.

Jacy speaks Chinese and is a member of the National Honor Society and earned a first place scholarship from the Association for Women in Science. She enjoys tutoring underclassmen at her school in biology, math, chemistry, physics and literature and has run a local science competition. She is also a counselor for The Gifted Child Society and leads counselors-in-training/volunteers in supervising groups of young campers in summer programs. Jacy also plays tennis and the piano.

She wants to pursue a career as a research scientist because she is intrigued by research and loves to probe into problems with the brightest people in the field.



NAME: VEDA MURTHY

SCHOOL: Lexington High School, Lexington, MA

YEAR: Senior

HOMETOWN: Lexington, MA

PROJECT: Towards a More Accurate Convolutional Neural Network (CNN) to Classify Glioma Nuclear Images

FIELD: Computer Science

MENTOR: Professor Dimitris Samaras, Associate Professor, Stony Brook University

"I personally love the methodical approach of solving math and science problems. I find it incredibly rewarding to test various methods, synthesizing your daily findings to ultimately create solutions."

Veda Murthy's research improved an algorithm so it could classify images of cell nuclei from a type of brain tumor called glioma. Her algorithm could help medical professionals to automatically analyze brain biopsy results more accurately, supporting quicker diagnosis and delivery of care to a patient.

Veda's research was conducted through the Simons Summer Research Program at Stony Brook University. The interdisciplinary focus of the University allowed her to conduct a computer science project in medical image analysis.

Veda is a member of the National Honor Society and co-captain of the mock trial team at her high school. She is a fan of the Boston Red Sox and New England Patriots, and plays percussion with the Lexington High School Wind Ensemble. Veda hopes to one day develop medical technologies and collaborate with professionals from the life sciences, such as experts from the National Institutes of Health.



NAME: MANAN SHAH

SCHOOL: Harker Upper School, San Jose, CA

YEAR: Senior

HOMETOWN: Los Altos, CA

PROJECT: Deep Learning Assessment of Tumor Proliferation in Histopathological Images for Categorical and Molecular Breast Cancer Severity Diagnosis

FIELD: Computer Science

MENTOR: Dayong Wang, Research mentor, Beth Israel Deaconess Medical Center, Department of Pathology

Manan Shah, born in Philadelphia and raised in the Silicon Valley area, is an aspiring computer scientist and applied mathematician interested in how big data analytics and machine learning can accelerate scientists' ability to solve complex medical problems.

For his project, he developed a computational model that used tissue images of breast tumors to rapidly and accurately assess the severity of breast cancer tumor growth and spread. His model could help speed diagnostics, improve the molecular understanding of the growth of breast cancer, and help determine more accurate treatments and diagnosis. His model is a major improvement over the current inefficient, expensive, and laborious tumor grading systems. Tools like the one Manan created are critical to the future of disease diagnosis and prevention.

Manan hopes to become a research scientist, using his interdisciplinary knowledge in physics, math, and computer science (his favorite subject) to better predict the behavior of complex systems like cancer development.

He has published in the Journal of Machine Learning Research and has given research presentations at many of the major professional international research conferences. He is also a tennis player, fan of the musical band Coldplay, and is a Golden State Warriors fan - local pride!



NAME: NISHITA SINHA

SCHOOL: Chatham High School, Chatham, NJ

YEAR: Senior

HOMETOWN: Chatham, NJ

PROJECT: Experimental Studies in Developing Safe Sanitation Solutions

FIELD: Biochemistry

MENTOR: Yelena Naumova

"Don't ever think you are too young or too inexperienced to tackle a problem. If you are passionate about something and are willing to put in the work, you will find a way."

Every year since Nishita was five, she has visited her ancestral village in Northern India and seen the harmful effects of open defecation firsthand. These experiences spurred her to learn more about the sanitation crisis and reach out to experts worldwide. Nishita started a social-service outreach to raise awareness and funds for toilet installations. But, as installation of the Sulabh International toilet systems, which are inexpensive and feasible for installation in villages in many countries, progressed, she became concerned that the filters present in Sulabh toilets were not completely effective. Because of her interests in STEM and motivation from her teachers, parents, and friends, she realized that she could fix this issue. For her project, Nishita created filters that can be applied to existing toilet systems to make human-waste-management more economic, safe, and feasible in the developing world. So far, 100 toilets have been installed in Northern Indian villages, and she has future plans for global deployment.

Outside of the classroom, Nishita loves to swim, golf, rock climb and ski. She is the founder of the App Inventor Club and Research Club to encourage other students to pursue research, organizes piano concerts at the local senior center, and has been a member of Girl Scouts since fifth grade. Nishita is a US Stockholm Junior Water Prize National Winner and received first place in the New Jersey Science League for AP Physics C. Nishita was also chosen to attend a six-week Research Science Institute at MIT this summer. Every day, she finds new ideas for future exploration, which encourages her to continue researching.

Ideally, Nishita wants to apply her engineering and math interests to other fields, like medical research or environmental microbiology. She plans to research across fields, and hopefully use her interests to help a lot of people and effect real change on the world.



NAME: ALBERT YUE

SCHOOL: Phillips Academy, Andover, MA

YEAR: Senior

HOMETOWN: Andover, MA

PROJECT: Remineralization of Enamel using Leucine-Rich Amelogenin Peptide and Pyrophosphate

FIELD: Biochemistry

MENTOR: Dr. Seo-Young Kwak, Assistant Member of the Staff, Forsyth Institute

"I love the power of STEM to change the world."

Albert Yue developed a chemical method to regenerate enamel that could replace dental fillings and crowns in treating cavities and enamel loss. He became interested in oral health issues and enamel regeneration after watching many of his friends growing up needing to have entire teeth replaced with metallic crowns.

Albert's favorite subject in school is chemistry because of its ability to predict how and explain why certain compounds interact the way they do. But it was Albert's early exposure to mathematics that led him to be interested in the STEM field as a whole. In the future, Albert hopes to be able to conduct more research, especially in the biomedical field, to treat diseases like cancer or Alzheimer's.

Outside of the classroom, Albert is president to both the Physics Club and the Art Exchange Club. He enjoys drawing, painting, and playing squash and ultimate frisbee. He, like the rest of the country, is a big fan of the musical "Hamilton."

TEAM COMPETITORS

GARYK BRIXI, Winston Churchill High School, Potomac, Maryland
GORDAN BRIXI, Saddlebrook Preparatory School, Wesley Chapel, Florida
PROJECT: Investigating Alternative Cost Effective Relief Foods
FIELD: Biology
MENTOR: Virginia Brown, Winston Churchill High School, Potomac, Maryland

Garyk and Gordan designed new cost-effective and improved relief food formulations to treat and prevent malnutrition.



GARYK BRIXI
Year: Sophomore
Hometown: Potomac, Maryland

"Science is my favorite school subject. I am always inspired to learn about the how and why of the natural world. I wish to dedicate my career to meaningful research towards solving some of the difficult issues still facing humanity."

Through Garyk's travels in rural China, he saw many impoverished children. He began to think of the millions of children suffering from hunger and malnutrition. Increasingly, he came to believe that there was something he could do. After exploring malnutrition treatments, he worked to find possible improvements.

Garyk speaks Chinese and Czech. He is the Science Bowl Captain and is a member of his High School's State Champion Golf Team, received the GENIUS Olympiad Gold Medal, and is a winner of the Montgomery Area Science Fair. His role models are the countless, often unknown, men and women who have dedicated their lives to the advancement of humanity through science. For example, Gregor Mendel's tireless experimentation which paved the way for modern genetics remained without any recognition for decades after the scientist's death. He admires Mendel's revolutionary use of quantitative analysis of heredity in a time when biology relied on qualitative observations.



GORDAN BRIXI
Year: Freshman
Hometown: Potomac, Maryland

Though his favorite subject is Math, Gordan loves the way science constantly improves the quality of people's lives. His life mission is to help people in need through science.

Just like Garyk, his brother and teammate, Gordan was inspired to research better ways to prevent malnutrition after a trip to rural china where he saw many undernourished children.

Gordan speaks Chinese and Czech. He enjoys playing golf and is a big fan of Real Madrid because they play with great speed and technique.

TEAM COMPETITORS

JANG HUN CHOI, Jericho Senior High School, Jericho, NY

MATTHEW LI, Horace Mann School, New York City, NY

ELAINE MOON, Peddie School, Hightstown, NJ

PROJECT: "A New Lower Bound for the Fractional Chromatic Number of the Plane"

MENTOR: Professor Dan Ismailescu, Hofstra University



JANG HUN CHOI

YEAR: Junior

HOMETOWN: Jericho, NY

Jang Hun says he's astonished at how advances in technology and math can enable people to solve problems and improve efficiency. He has wanted to pursue the STEM fields since he was in middle school and has understood the potential of the field to improve the world around us because his parents have always tried to demonstrate the power of science and technology.

The research for this project was driven by a desire to set a new record in improving the lower bound for the minimum number of colors needed to color a graph such that no two adjacent vertices are assigned the same color, otherwise known as the fractional chromatic number. As a result of this research, they aspire to resolve activity scheduling on transportation.

In addition to his passion for math, physics and technology, Jang Hun is also a competitive swimmer and plays clarinet.



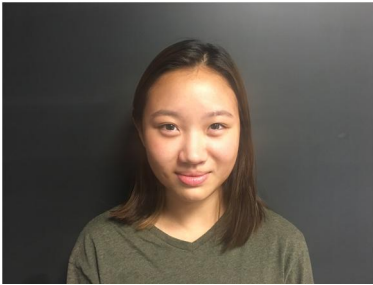
MATTHEW LI

YEAR: Sophomore

HOMETOWN: New York City, NY

Down the road, Matthew wants to be a lawyer. But before law school, he's focused on finding a better answer to a 50+ year old math problem that has the potential to have real work impacts--from changing flight patterns and how people move. With his partners, Matthew improved upon past efforts to solve a problem of patterns and colors that leads to real world impacts.

Matthew was named to the Top 10 of the Individual Number Theory competition at the Princeton University Mathematics Competition (PUMAC) in 2015 and participated in the United States of America Mathematical Olympiad in 2016. In addition to his interest in math and physics, Matthew also attends the Manhattan School of Music's pre-college program for voice, speaks Mandarin and does karate.



ELAINE MOON
YEAR: Junior
HOMETOWN: Hightstown, NJ

Elaine's interest in math and using it to solve problems in unexpected ways was sparked early by watching her father's passion for the topic. As a field hockey player, she decided to tackle what many would think is a simple question: what is the fewest number of uniform colors needed in a round robin tournament? To answer this question, she and her partners tackled a decades-old complex mathematical question: what is the fewest number of colors needed to color a two dimensional space without any color appearing twice within two spaces?

TEAM COMPETITORS

YOSHIHIRO SAITO, Marriotts Ridge High School, Marriottsville, Maryland

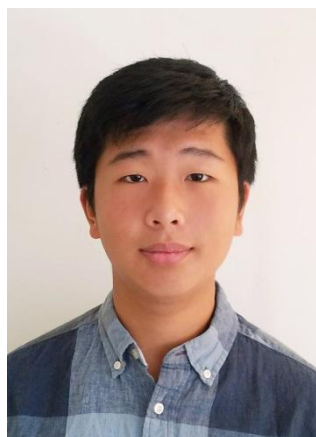
LAURYN WU, Thomas Jefferson High School for Science & Technology, Alexandria, VA

PROJECT: New Discovery of Large Bulk Band Gap Topological Insulators in Chemically Functionalized Two-Dimensional Compounds

FIELD: Physics

MENTOR: Xuan Luo, The National Graphene Research and Development Center

Yoshihiro Saito and Lauryn Wu found a new material that helps quantum computers process quantum information more efficiently and effectively. It allows two-dimensional topological insulators (2D TIs) to be used at room temperature which solves the problem that 2D TIs are only usable at an extremely low temperature. This material could potentially be used as an efficient nanowire or store information in quantum computers.



YOSHIHIRO SAITO

YEAR: Sophomore

HOMETOWN: Ellicott City, MD

"My passion belongs in science and mathematics because I believe it is a universal language for everyone. Throughout history, human lives have been supported by scientific discoveries and breakthrough. I find tremendous value in "standing on the shoulders of giants." Science today has been built by the collaboration of knowledge and discoveries that previous scientists have uncovered. It is our duty to build upon those records and further the understanding for the sake of our generation and the next."

Yoshihiro has been interested in STEM since he was very little and credits his parents' jobs as physicians for sparking the interest but his real interest lies in physics and chemistry which can describe this physical world by rather simplistic equations.

Yoshihiro was first exposed to the wonderful world of physics through a documentary hosted by Neil deGrasse Tyson and was captivated by the idea of physics because of its power to understand the physical world through mathematics. Through venturing the world of physics using online resources and books, he was influenced by many physicists, not only the great Isaac Newton and Einstein, but also contemporary theoretical physicists and astrophysicists, such as Stephen Hawking, Michio Kaku, and

Tyson. He likes that there are many things that one physicist can bring to the table to complete a grand picture.

Yoshihiro has competed in the Science Olympiad and received 1st Place in Cell Biology and a 3rd Place award in Astronomy at the regional competition. He has also been a qualifier at American Invitational Mathematics Examination (AIME) since the 6th grade. He enjoys reading Stephen King novels because of the tension and suspense. A Real Madrid fan, Yoshihiro also plays soccer for his high school team and for a club team as well.

Outside of school, he volunteers for an organization called Social Contract Corporation that helps to gather leftover food from different stores to donate to a local food bank and coordinates events to provide support to those in need.

Yoshihiro would like to have a job that involves physics in some way.



LAURYN WU

SCHOOL: Thomas Jefferson High School for Science & Technology

YEAR: Sophomore

HOMETOWN: McLean, VA

"I love science because it's challenging and has practical applications in the real world. Technology has revolutionized modern society and has solved countless real world problems. Technology shapes our world, and computers in particular are essential to people because of their efficiency and productivity."

Lauryn's love of science and math began in elementary school where she began competing and winning in several math competitions, including MathCounts, Math Olympiad, and AMC. She soon began attending math sessions and clubs outside of school. She finds math intriguing because it involves creativity to solve problems and finds it exciting to put together all the pieces of the puzzle to solve a problem.

In Lauryn's research, she found that topological insulators, which allow for electrons to move along the surface of a material, are currently a major field of study in physics and are applied in quantum computers. Since they help quantum information be transported without being degraded - a key to making quantum computers more efficient and powerful, Lauryn wanted to further research them. And she and her teammate Yoshihiro Saito are in good company, as the Nobel Prizes awarded for physics in 2016 recognized achievements in topology.

Lauryn's proudest accomplishments include being a qualifier in the American Invitational Mathematics Exam (AIME) in sixth grade and serving as Vice President of the National Junior Honor Society.

Lauryn plays tennis at a national level and is a top player in the Mid-Atlantic region. She also volunteers for Stop Hunger Now and raised money for it by organizing a 5K run.

Lauryn wants to pursue a career in science or computer programming.

TEAM COMPETITORS

AMIR SIRAJ, Brookline High School, Brookline, MA

SHIVA MUDIDE, Acton Boxborough Regional High School, Acton, MA

PROJECT: The Relationship between Infrared Dark Cloud Mass Distributions and Young Stellar Object Populations

FIELD: Physics

MENTOR: Dr. Joseph Hora, Harvard-Smithsonian Center for Astrophysics, Harvard University

Amir and Shiva discovered that small dust clouds in space are equally efficient at star formation as larger dust clouds.



AMIR SIRAJ

YEAR: Senior

HOMETOWN: Brookline, MA

"Sometimes the most incredible breakthroughs in STEM are surprises."

Amir Siraj is a National AP Scholar who became interested in STEM at an early age by participating in science fairs and attending the Lemelson-MIT prize events. He is particularly interested in the analytical and predictive abilities of new computing, data crunching, and visualization techniques.

Outside of the classroom, Amir plays the piano and represented the U.S. in the inaugural Van Cliburn Junior Piano Competition. He is also a varsity rower and took home a bronze medal at the 2016 Club National Championships.

To date, one of his proudest accomplishments includes organizing NPR's *From the Top & Music For Food* benefit for his local food pantry, which raised 5,000 meals. When Amir grows up he wants to be a physicist, an entrepreneur or a concert pianist.



SHIVA MUDIDE
YEAR: Senior
HOMETOWN: Acton, MA

"I want to use STEM to create inventions, build companies, and ultimately be as philanthropic as I possibly can."

Shiva Mudide first got interested in STEM as a young kid watching science shows on TV, his favorites being Nature and Nova. He believes that star formation is one of the most mysterious phenomena of our time, and that if we could accurately understand how stars form it would tell us so much about how life came to be in the first place.

Shiva's favorite subjects in school are physics and chemistry because they dictate our universe and everything within it. When he grows up Shiva wants to be an entrepreneur who solves problems and helps others. To date, he has already founded two organizations. His company GreyX helps students get access to high quality practice problems, and his nonprofit, Dongari Fragrances, spreads the love of reading by supporting libraries in underserved communities through the sale of handmade, natural perfumes.

When he is not running his businesses or working on his research, Shiva enjoys playing basketball, baseball, volleyball, badminton and the guitar.

TEAM COMPETITORS

YI ZHU, Thomas S Wootton High School, Rockville, Maryland

ROBERT YANG, Montgomery Blair High School, Silver Spring, Maryland

PROJECT: Systematically Profiling HIV-1 Env Trimer Mutations and Changes in Residue Function and Stability

FIELD: Biology

MENTOR: Yongping Yang , Vaccine Research Center, NIAID/NIH

Using computer science, Yi and Robert were able to find potential regions located in HIV that could be used for vaccine development.



YI ZHU

Year: Junior

Hometown: Potomac, Maryland

“What I like about STEM is unceasing inquiry from which these fields were born. Take physics: even the simple ability to predict whether a basketball will fall through a hoop is exciting as it reveals a deep understanding of the mechanics of our environment.”

Yi was first interested in STEM when his toy electric train broke as a child. Curious about how it worked, he took it apart and was hooked on learning how things work ever since. His favorite subject is Math as the concepts he has learned in math elegantly tie together all the other sciences which he enjoys equally as much.

Beyond his love for math, Yi enjoys the Robotics club and tutoring at a local middle school. He plays the cello and piano. His favorite song is “Do You Hear the People Sing” from Les Miserables because of its spirit and the revolution that it represents. His favorite book, 1984, appeals to his inner cynicism because of its stunningly accurate commentary on society. Yi placed 3rd and 2nd place respectively at a University of Maryland science fair called Chemathon during his freshman and sophomore years in high school.

The inspiration for Yi's team project came from his fascination of how even after a decade of research there is still not an effective HIV-1 vaccine. He believes that we could advance research in this field through the use of data analysis to expand our current knowledge.



ROBERT YANG

Year: Junior

Hometown: Potomac Maryland

"Recently, I've gotten interested in the humanitarian side of Science and how Science (like vaccine research) can be used to save and improve the lives of people."

Having parents who are both scientists, Robert was encouraged at a young age to go to local science fairs and conventions to get experience with STEM. He remembers how a local robotics team brought in their robots and allowed kids to play soccer with them. Later on, he started to grow fascinated with other topics such as Chemistry, Physics and Computer Science through watching shows on the Discovery Channel. Shows like Mythbusters really motivated him.

Robert first learned about HIV and its devastating effects from a scientific article that he read online. He was very curious about it because he realized just how special HIV was when compared to other viruses. During the summer he accepted a position in a lab that was next to the Vaccine Research Center in NIH, and that was where he and his teammate began discussing the project.

Robert likes how applicable STEM can be used to create new, cool technology or to expand human knowledge on advanced concepts. One day, Robert would like to become a bioengineer. Working in a lab is a dream of his.