

**2017 SIEMENS COMPETITION IN MATH, SCIENCE & TECHNOLOGY  
Regional Finalists – California Institute of Technology**



**ARNOB DAS**

**SCHOOL:** Jesuit High School, Portland, OR

**YEAR:** Senior

**HOMETOWN:** Portland, OR

**PROJECT:** “Room Temperature Tunable Ferromagnetism in Solution Grown Mesoscopic Doped Conjugated Polymer Rings”

**FIELD:** Materials Science

**MENTOR:** Dr. Shankar Rananavare, Portland State University

*“I find that we often don't listen to the people without a voice in society and think we have all the answers to solve their problems, but we first need to listen so we can change unjust social structures.”*

Arnob found a way to make practical, metal-free magnets that could potentially have a variety of uses to improve cancer therapy, targeted drug delivery inside the body, data storage, environmental remediation and more.

He was inspired to pursue this research after learning about an experimental form of cancer therapy that relied on iron-based magnetic nanoparticles to “cook” cancer cells. The treatment showed promise in preliminary studies, but the toxicity of the metal made the risks outweigh the benefits. Arnob wanted to solve this problem by creating magnets that did not have metals.

Arnob has been hooked on science since he participated in his first science fair at age seven. Since then, he's been a three-time grand award winner at the Intel International Science and Engineering Fair, and he was selected to participate in the 2017 Research Science Institute at MIT.

Arnob enjoys playing piano, which he has done since first grade. When he is not working in the lab, Arnob volunteers at a shelter for women and children fleeing domestic violence, participates in Model United Nations and is the captain of the Science Bowl team. He also worked for a nonprofit called Ankur International, through which he remotely tutored children at an orphanage in rural Rajshahi, Bangladesh.

Fluent in Bengali and Spanish, Arnob aspires to be a university researcher in chemistry or materials science. He's passionate about social justice and would like to use his background in science to affect policy change that improves the lives of those marginalized by society.



**SOHINI KAR**

**SCHOOL:** Saratoga High School, Saratoga, CA

**YEAR:** Senior

**HOMETOWN:** Saratoga, CA

**PROJECT:** "Factorization of Recurrence Relations"

**FIELD:** Mathematics

**MENTOR:** Dr. Simon Rubinstein-Salzedo, Euler Circle

*"I have always been drawn to visual arts. Whether it is a 2-dimensional drawing or a 3-dimensional piece of pottery, creating gives me profound happiness."*

Sohini chose to focus her research on number theory. She presented a new integer sequence, also creating a corresponding pictorial representation. For this sequence, she also derived a recurrence relation and generating function.

She's been drawn to mathematics since middle school, when she enrolled in an extracurricular program for gifted students. She taught herself number and graph theory and famous mathematical patterns, such as the Fibonacci and Lucas Sequences. In high school, afterschool math programs led Sohini to delve into complex equations that equipped her with the theoretical tools she needed to pursue her research.

In her spare time, Sohini creates art. She loves experimenting with different artistic mediums and styles, and uses her skills in computer science to design pieces in the programming language, Java. Sohini's passion for art and helping others led her to found her own nonprofit called Art and Craft 4 All -- a volunteer-based organization with chapters in 12 states. Through the program, volunteers create and sell their art and use the proceeds to buy art supplies for schools in low-income communities. Many volunteers, including Sohini, teach art lessons at these schools.

Sohini is the president of her school's Women in STEM Club and vice president of the STEAM (STEM + Art) Club. Some of her proudest accomplishments include coming in second place in the mathematical sciences category of the California State Science Fair and recently ranking second place in the 2017 Synopsis Science Fair for the same research she entered in the Siemens Competition.

Sohini's involvement in STEM extends far beyond the classroom. She makes it her priority to engage with other young women in the STEM fields. From organizing research expositions to inviting female mathematicians to speak at school clubs and events, Sohini wants to empower young women to stay in the field. Sohini hopes to study computer science in college. She is especially drawn to machine learning and wants to conduct further research in this field.



**SRIHARSHITA MUSUNURI**

**SCHOOL:** Henry M. Jackson High School, Mill Creek, WA

**YEAR:** Senior

**HOMETOWN:** Mill Creek, WA

**PROJECT:** “Computational and Experimental Design of MIP Nanoparticles: A Novel Theranostic Solution to Detect and Neutralize Endotoxins”

**FIELD:** Chemistry

**MENTOR:** Christopher Lausted, Institute for Systems Biology

*“I strongly believe that most advances we make in the future will rely on the cross-pollination between wildly-different fields, and I'd love to be a part of that.”*

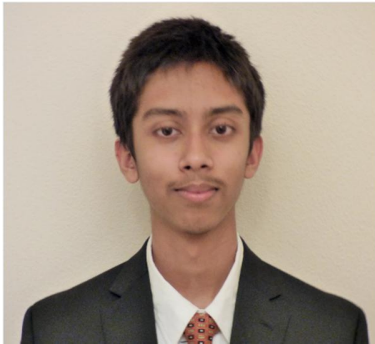
Sriharshita designed a new polymer nanoparticle that captures bacterial toxins that could potentially treat and diagnose a deadly form of sepsis caused by gram-negative bacterial infections.

Curiosity was the initial draw for Sriharshita’s interest in science, which sparked her affinity for answering different questions she had about the world. Her interest in STEM was originally stimulated by a book called “Why is Snot Green?”, which introduced her to the breadth of knowledge that scientists could pursue.

Sriharshita is very active in school activities, leading the Technology Student Association, Science Research and Engineering, and Math Honor Society at her school. Through these clubs, she has had the chance to further develop her interests.

Sriharshita volunteers her time as the curriculum director of an organization called Girls Rock in Science and Math that aims to spark an interest in STEM amongst 3rd-5th grade girls. She is also the founder of a non-profit organization dedicated to raising sepsis awareness called InflammAid. Sriharshita had the amazing opportunity to work at the NASA Jet Propulsion Laboratory on their Advanced Thermal Energy Conversion team for an entire summer. She is also a Davidson Fellow Laureate which gave her the chance to speak with senators and representatives in Washington D.C. about her research.

Outside of science, Sriharshita has been learning and performing Bharatanatyam, a form of Indian classical dance, for the past 9 years. Sriharshita also speaks Telugu.



**MUHAMMAD RAHMAN**

**SCHOOL:** Westview High School, Portland, OR

**YEAR:** Senior

**HOMETOWN:** Portland, OR

**PROJECT:** "A Smart-Burn/Spill Proof 'SAFE' Microwave That Spares the Salad: Novel Application of Levenberg-Marquardt Algorithms and Machine Learning for Real-time Thermodynamic Modeling"

**FIELD:** Engineering

**MENTOR:** Mourad Souag, Intel Corporation

*"I ultimately want to make a positive impact on people through what I create."*

Muhammad was inspired by a commonplace appliance used by millions worldwide-- the microwave. The design and technology of the product had not changed much since commercialization, but Muhammad aimed to make it "smarter." His research led to a tangible invention: a new and improved smart microwave oven that can detect the type of food it heats and warm it up for desirable consumption. It is intelligent enough to warm different items on the same plate at the same time, giving each item just the right amount of heating.

Muhammad has always been curious about the world around him. From cars to televisions to microwaves, Muhammad tried to decipher how they worked. Lego robotics in elementary school set him on the path of engineering; through this, Muhammad learned how the creative aspect of engineering can be fun and productive.

Muhammad's dream job is to be an engineer. Most passionate about innovation, Muhammad aims to create new technology that is revolutionary and further progresses life on earth.

Outside of academics and research, Muhammad runs on the cross country and track and field teams. He loves the arts, including origami and drawing.

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**PUSHKAR SHINDE**

**SCHOOL:** Oregon Episcopal School, Portland, OR

**YEAR:** Senior

**HOMETOWN:** Portland, OR

**PROJECT:** “Aptamer Based Disruption of the CD47:SIRP $\alpha$  Interface for Anticancer Applications”

**FIELD:** Biochemistry

**MENTOR:** Dr. Monika Davare, Oregon Health & Science University and Bettina Gregg, Oregon Episcopal School

*“I’ve always been curious about how things work, and I am interested in the sciences because they explain the world around me”*

Pushkar’s research looked at the ways the human body’s own defense systems can attack cancer. He was inspired to do this research because of his prior experience studying DNA switches, which turn genes and what they code for “on” and “off”. He realized that he could apply this idea to certain types of cancers.

An active leader at his high school, Pushkar was elected as a member of the Honor Council and is a leader of the Service Learning Action Committee. He also is a captain of his school’s tennis team and has competed at the local and national level, and he looks up to Roger Federer for his skill and class on the tennis court.

Pushkar is interested in all fields of science, as it has always provided a way to understand and explain the world around him. He also finds value in the subject of history. He notes that “by understanding the past we can understand the future.” He has twice placed 4th at the Intel International Science and Engineering Festival and has won state level competitions for his piano playing.

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## TEAM COMPETITORS

**CHARLES HUANG**, Lynbrook High School, San Jose, CA

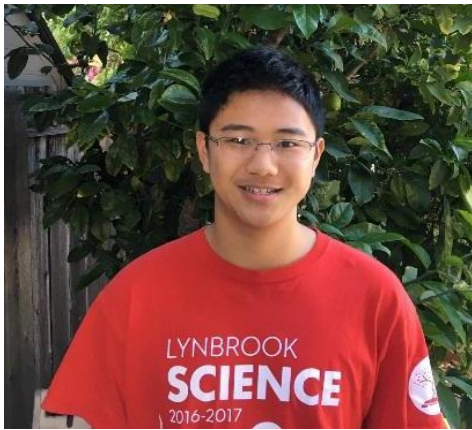
**ETHAN HSIAO**, Cupertino High School, Cupertino, CA

**PROJECT:** “Characterization of 2D Molybdenum Disulfide CVD Crystal Growth for Nano Scale Photonics and Transistors”

**FIELD:** Chemistry

**MENTOR:** Mervin Zhao, University of California, Berkeley

Charles and Ethan found a new, unprecedented crystal structure while analyzing the ratios of the amount of chemicals (precursor molar ratios) in the chemical reaction that results in the product MoS<sub>2</sub>, a 2D material. Their results could have implications on the industrial implementation of transistors and nano-LEDs, as well as lead to better understanding of how MoS<sub>2</sub> synthesis works.



**CHARLES HUANG**

**Year:** Junior

**HOMETOWN:** San Jose, CA

*“The main aspect of nanotech/matsci that constantly interests me is the interdisciplinary component. With elements of chemistry, physics, and biology in these fields, there is an extremely wide range of topics to learn about.”*

Charles has been interested in science ever since he began birdwatching in the third grade. Since then, he’s developed a strong passion for the fields of nanotechnology and materials science—particularly how they work together with fields like chemistry, physics, and biology—and cites one of his biggest inspirations as the time he synthesized gold nanoparticles during a summer camp.

Charlie has also conducted research on chitin-calcite hybrid materials. This project focused on synthetic bone grafting. When he grows up, he hopes to continue this work, focusing on 2D materials and polymers.

Charles has also competed in his school’s Science Bowl, placed in the top 2% for the Toronto National Biology Competition, and participated in the science, astrophysics, and neuroscience club. He also plays saxophone in the El Camino Youth Symphony and enjoys wood carving.

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**ETHAN HSIAO**

**Year:** Junior

**HOMETOWN:** Cupertino, CA

*"I spent a lot of my early childhood watching nature and science documentaries like NOVA—they really sparked my curiosity about physics and computer science and made me take interest in my surroundings."*

Ethan is particularly passionate about chemistry and physics and is fascinated by the way computer science can be used to simulate and calculate scientific processes. He's already using these interests as his school's webmaster and while working at a small web startup company. Someday, he hopes to apply these passions as a professor or software engineer.

Ethan speaks Mandarin and uses his math skills as a volunteer math instructor at local elementary schools. He serves as the education lead of the local MIT Launch Club chapter, and he enjoys attending hackathons on occasion. In addition, Ethan has conducted research on machine learning-based simulations.

In his spare time, he is on his school's badminton team, and loves to ski, bike and birdwatch. He has played the piano since kindergarten and especially loves jazz and ragtime.



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## TEAM COMPETITORS

**ARJUN SUBRAMONIAN**, Monta Vista High School, Cupertino, CA

**KELLY HO**, Cupertino High School, Cupertino, CA

**PROJECT:** "A Novel Method for Age Estimation in Solar-Type Stars Through GALEX FUV Magnitudes"

**FIELD:** Physics

**MENTOR:** Dr. Graeme Smith, University of California, Santa Cruz

Arjun and Kelly established a new method to estimate the age of stars like the Sun. The team does so by using data on the stars' far ultraviolet brightness. They believe this method is simpler and more efficient for astronomers to employ than existing techniques.



**ARJUN SUBRAMONIAN**

**YEAR:** Senior

**HOMETOWN:** Cupertino, California

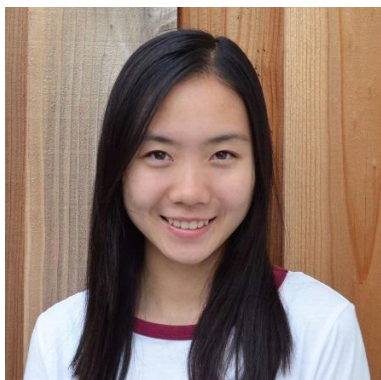
*"I am most passionate about teaching. I always get an adrenaline rush when I learn something and feel the urgent need to share my newly-acquired knowledge with others."*

Arjun loves math, science, and teaching. Whether it's teaching programming through Python classes, a programming language commonly used in the tech industry, or Taekwon-Do, Arjun finds joy in working with others. He was interested in math from an early age and after a freshman year class on Java computer programming, he realized the power of combining programming and math to solve real-world problems. When he grows up, he wants to be a researcher in theoretical computer science and to teach at a university.

His fascination with space began in elementary school when a neighbor invited him to view Venus through his telescope. Arjun's interest was fostered by books on constellations and a telescope from his parents, and he eventually dove into the topics of gravitational fields in physics and recently attended a presentation on gravitational waves and LIGO (Laser Interferometer Gravitational-Wave Observatory).

Arjun has a Certificate of Achievement from the Association for Computing Machinery, San Francisco Bay Area Professional Chapter for his project at the SYNOPSIS Science Fair for developing a digital music transposer. He is fluent in Spanish and plays violin in his high school's chamber orchestra and the California Philharmonic Youth Orchestra. He is the president of Spanish Honor Society and a fan of the books of Sinclair Lewis and the music of Simon and Garfunkel.





**KELLY HO**

**YEAR:** Senior

**HOMETOWN:** Cupertino, California

*"I am most passionate about exploring the world around me and having new experiences. Whether I am travelling to new places or picking up different skills, I never want to cease learning."*

Kelly's love of astronomy started as a child, watching the waxing and waning moon with her father through a simple pair of binoculars. With time, her focus expanded to the solar system and beyond. After competing in her first science fair in high school, her interest in scientific research grew. She became involved in astrophysics research to learn more about these topics. One day, she hopes to be a researcher working on discoveries and innovations through computer science.

Kelly also works to help grow a more inclusive scientific community as an executive officer in her high school's STEM club, which hosts guest speakers, creates lab demonstrations and provides mentorship. She also tutors through the AVID (Advancement Via Individual Determination) program at her school to help students develop skills for college. Kelly has been a competitive dancer for the last 10 years.

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## TEAM COMPETITORS

**ANLIN ZHANG**, Canyon Crest Academy, San Diego, CA

**RACHANA MADHUKARA**, Canyon Crest Academy, San Diego, CA

**KEVIN REN**, Torrey Pines High School, San Diego, CA

**PROJECT:** "Epidemic Dynamics on Symmetric Networks"

**FIELD:** Mathematics

**MENTOR:** Dr. Laura Schaposnik, University of Illinois at Chicago

Anlin, Rachana, and Kevin created a new mathematical model to more precisely analyze the spread of infectious disease.



**ANLIN ZHANG**

**YEAR:** Senior

**HOMETOWN:** San Diego, California

*"My parents discussed their work in computer science and biology at the dinner table when I was a child. They mentioned different enzyme pathways and algorithms behind their programs, which left me fascinated."*

Anlin loves math. Her 9th grade math teacher sealed the deal for her when he exposed her to the endless possibilities behind every math problem. She qualified for the USA Math Olympiad, and she also mentors local elementary and middle school students in the Science Olympiad programs.

Anlin is the president of her high school's Girls @ ExpII, an initiative to encourage girls' growth in math. She is also president of the Linguistics club and an officer of the Math Team, Girls Learn International, and Human Rights Club. Anlin enjoys dancing, playing piano and drawing.

She hopes to pursue a career in applied math, such as statistics, biomathematics and computational math because she wants to use her math skills to make a real-world impact.

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**RACHANA MADHUKARA**

**YEAR:** Sophomore

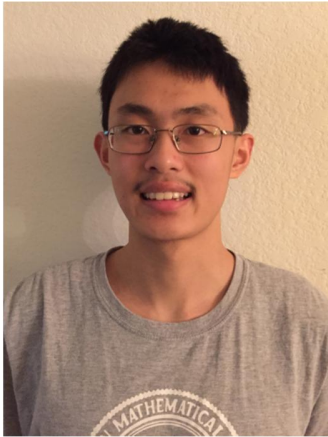
**HOMETOWN:** San Diego, California

*“What I like most about mathematics is that it teaches you problem solving skills. No matter how difficult the problem, there’s always a (clever) way to solve the problem.”*

Rachana wants to be a math pioneer just like her role model, Sophie Germain, one of the first women mathematicians. For her Siemens competition project, she used numerous number theory and complex analysis techniques to improve the way to model the spread of infectious diseases.

Besides her interest in math, she is an avid fencer, plays the violin, sings Indian Classical Carnatic music, and works with children who are disabled. She took first place and received a scholarship in the Mathematics Senior Division of the California State Science Fair, and she was a Broadcom Masters semifinalist. She speaks Kannada, Spanish, and reads Braille.

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**KEVIN REN**

**YEAR:** Senior

**HOMETOWN:** San Diego, California

*“Math is beautiful. One of the reasons why I gave up video games was because math problems were more fun and numerous. Once you beat all the levels of a game, you are finished; once you solve all the problems of a math contest, you can move on to the next year of the contest.”*

Kevin’s first exposure to STEM was from his grandmother who is a driving force in his life. They used to sit together for hours doing math problems from Chinese textbooks ranging from elementary school math to calculus. She trained his critical thinking and problem-solving abilities in ways, he says, were not tested in the classroom.

Kevin says you need a certain ingenuity and depth of thought to solve a Math Olympiad problem. He says that once you solve it, the feeling of satisfaction is “richly rewarding, just like the feeling of exhilaration and conquest one gets from climbing Mount Everest.” After being friends for years, he teamed up with Anlin and Rachana over the summer for their research project. He liked the idea of using graph theory tools to attack a problem with real-world applications.

His middle school teacher, Mr. Vaughn, inspired his math talent and motivated him to give back to the community. Kevin has become a teacher giving younger students the gift of passion for math. Kevin also enjoys physics, Quiz Bowl, chess, piano, swimming, and basketball. One day, he hopes to be a mathematics professor.

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## TEAM COMPETITORS

**ALEXANDER WANG**, Dougherty Valley High School, San Ramon, CA

**THOMAS CHEN**, Mission San Jose High School, Fremont, CA

**KEVIN GAO**, Amador Valley High School, Pleasanton, CA

**PROJECT:** "P12 Peptide's Suppressive Effects on Fibrinogen Fiber Formation and Novel Application of Machine Learning in Fiber Counting"

**FIELD:** Materials Science

**MENTOR:** Dr. Miriam Rafailovich, Stony Brook University

Alexander, Thomas, and Kevin researched and uncovered a new protein that prevents the formation of blood clots. This discovery has medical implications for preventing thrombosis and stroke.



**ALEXANDER WANG**

**YEAR:** Senior

**HOMETOWN:** San Ramon, CA

*"This is my favorite aspect of STEM: the inter-relatedness between all its fields and integral connections to the humanities."*

Alexander has always been interested in math; he notes problem solving as the foundation for not only his interest in math, physics, and computer science, but topics such as preserving coldwater fisheries, fly fishing and creative writing, too. Alexander and his team put their problem-solving skills to the test to uncover a new protein that prevents blood clots which can potentially stop strokes from occurring.

Alexander is a 2-time USA Physics Olympiad Gold Medalist and a 3-time Semifinalist. Outside of school and research, Alexander is passionate about fly fishing. In 2017-2018, he served as the California Representative for the Trout Unlimited Youth Leadership Council. He also plays the bassoon and clarinet, as well as badminton. He is an avid Arizona Cardinals fan.

Alexander hopes to become a physics researcher, but plans to "keep an open mind" about which area of science to pursue as a career.

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**THOMAS CHEN**

**YEAR:** Junior

**HOMETOWN:** Fremont, CA

*“Prior to doing math competitions, school was mostly memorizing a few seemingly unconnected facts. Now, I tend to see connections between facts, formulas, or even dates that I memorize.”*

Thomas’ interest in STEM began with math competitions in elementary school. He took it to the next level by entering computer science and physics competitions with his friends. Through their friendly competition, Thomas and his friends have encouraged each other to improve their STEM skills.

Thomas is most passionate about learning from research and reading books, as well as from other people. He cites that he has many role models, as he tries to emulate the strengths and good qualities of his friends and peers around him, ultimately leading to self-improvement. Beside academics, Thomas enjoys playing a variety of sports. In the past, he has competed in swimming, baseball, soccer, and badminton. Currently, he is part of his school’s cross-country team. He is also a dedicated eSports fan and frequently watches large Counter-Strike tournaments.

The protein Thomas and his team discovered could help prevent blood clots and strokes. His experience in research has sparked his interest in the biology field. His ultimate goal for the future is to start his own tech company.



**KEVIN GAO**

**YEAR:** Senior

**HOMETOWN:** Pleasanton, CA

*“What I like most is how versatile technology is. You can take the same scientific theory and make completely different technologies. There are just so many possibilities.”*

Kevin was inspired by STEM from an early age. He credits books like “Tell Me About Science and Technology” and “Death’s End” for encouraging his curiosity for science.

Kevin’s favorite subject is Chemistry because of its useful applications. He has been a Chemistry Olympiad Finalist and a Physics Olympiad Semifinalist. He is most passionate about “learning new things and being creative.”

Outside of academics, Kevin plays water polo and swims. He enjoys creating computer-aided designs, often using them in the making of his amateur video games. He plays the violin in the El Camino Youth Symphony. In 2016-2017, Kevin was the co-president of a nonprofit volunteer organization called Global Leadership Initiative.

Kevin aspires to one day be a research doctor, a career goal rooted in his principle of helping people by creating safer, more effective treatments.



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## TEAM COMPETITORS

**GUANPENG “ANDY” XU**, Phillips Academy, Andover, MA

**WENDY WU**, Phillips Academy, Andover, MA

**PROJECT:** “Higher Gonality of Erdős-Rényi Random Graphs”

**FIELD:** Mathematics

**MENTOR:** Dr. Guangyi Yue, Massachusetts Institute of Technology

Andy and his teammate, Wendy, studied the gonality, a property of the “chip-firing game” of computer science, of randomly chosen graphs. Their research connects two seemingly disparate areas of math—algebraic geometry and combinatorics.



**GUANPENG “ANDY” XU**

**YEAR:** Junior

**HOMETOWN:** Simpsonville, SC

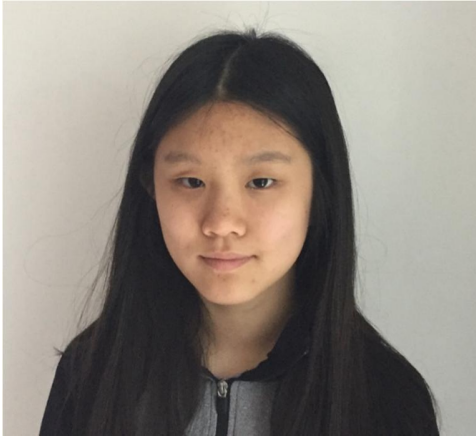
*“I am adamant about the beauty and potential of mathematics.”*

Andy is most passionate about mathematics, as it is a tool to not only help scientists discover new findings, but it is practical and vital to all fields of science.

Andy credits his family’s support and nurturing influence for his interest in STEM subjects and finds them interesting because so many different and “beautiful” fields with vast, important and practical applications. His favorite field of study is physics, but he has always had an interest in mathematics. Most recently, he has uncovered the field and his interest in combinatorics research.

Andy is a swimmer and cellist. His favorite sports team is the New England Patriots. In the future, he is interested in pursuing a career in the area of physics of mathematics, but he may consider economics because it is “an interesting blend of mathematical models with real-world unpredictability.”

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**WENDY WU**

**YEAR:** Sophomore

**HOMETOWN:** Andover, MA

*"I simply like how humans are gaining much more understanding in STEM fields, and using developments to improve quality of life."*

When Wendy was younger, her mother taught her math by giving her competition-level problems to solve. She expanded her interest in STEM through reading science articles and magazines. By doing so, she found her passion for research.

Wendy is most interested in math and computer science. She notes that the subjects are logical yet elegant, complex, and have many practical applications.

Wendy participates in many clubs at school. She is a member of the Chinese Association and Asian Society, multiple STEM clubs like the Research and Math clubs, and debate club. In addition, she plays a traditional Chinese instrument called the erhu and speaks Mandarin fluently. In her free time, she also enjoys sailing and hiking.