

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



**NAME: MICHAEL AI**

**SCHOOL: Canyon Crest Academy, San Diego, Calif.**

**YEAR: Senior**

**HOMETOWN: San Diego, Calif.**

**PROJECT: SIX6 Upregulation of P16/INK4a Linked to Retinal Ganglion Cell Death in Glaucoma**

**FIELD: Biology**

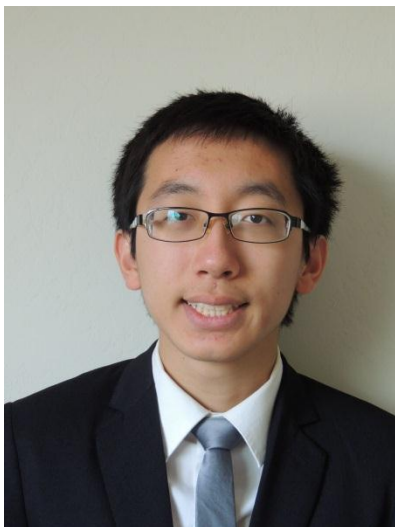
**MENTOR: Professor of Ophthalmology at University of California San Diego;  
Mr. Ed Gerstin, Science Teacher at Canyon Crest Academy**

*“Reading! My access to a large supply of books at school helped me define my interest in science.”*

Michael was inspired to find a cure for primary open-angle glaucoma because of his family history of bad eye sight. Both his grandparents have a form of glaucoma and his mother is legally blind without her glasses. Michael is at risk for developing degenerative eye diseases, so he is working to discover a solution.

Being fascinated by life and mechanisms, Michael’s favorite subject in school is biology. Michael plans to major in biology or biomedical engineering in college and he has applied to Yale University, Harvard University, the Massachusetts Institute of Technology, Stanford University, the University of California at Berkley, the University of California at Los Angeles, and the University of California at San Diego.

An avid runner, Michael participates in both cross country and track and field. He has played the piano for seven years and the clarinet for two years. Michael is a member of the Youth Care Club, an organization dedicated to raising money to fund the educators of underprivileged children in China. Being a huge supporter of Science Olympiad, Michael is a coach for the Fossils and Rocks and Minerals events and has taught students of all ages in the process. Michael looks to his father as his role model because of his exceptional work ethic and unconditional optimism.



**NAME: ANDREW CHEN**

**SCHOOL: Mission San Jose High School, Fremont, Calif.**

**YEAR: Senior**

**HOMETOWN: Fremont, Calif.**

**PROJECT: Enhancing Imaging Resolution and Depth With Adaptive Optics Focal Modulation Two-Photon Microscopy**

**FIELD: Engineering**

**MENTOR: Dr. Xiaodong Tao, University of California, Santa Cruz, W. M. Keck Center for Adaptive Optical Microscopy**

*“With my project, the world can observe the dynamic interactions of live biological tissues and make improvements to medicine and biology.”*

Andrew decided to focus his scientific research on vision and eye care because, as a glasses wearer, he understands just how important sight is to our daily existence. When faced with the prospect of losing his own vision, he decided to search for ways to improve imaging and the visualization of fine structures within biological samples. Andrew was able to develop a new way to carry out *in vivo* microscopy to better see the fine structures in deep tissue. He hopes that this research will help doctors and biologists to diagnose and treat deadly diseases like Alzheimer’s or cancer.

Andrew hopes to combine science and entrepreneurship to develop technologies that can positively impact the world. His childhood hero was James Bond because he admired the way that the agent was able to do the impossible through use of powerful devices.

As president of his high school’s Physics Club, Andrew is able to pursue his interest in STEM through a number of competitions. He likes physics because it helps to show the connections between different phenomena and forms the basis for most technologies. Andrew also founded the Emerald Ensemble, a volunteer band, and plays the trumpet and piano.



**NAME: ANJINI KARTHIK**

**SCHOOL: St. Francis High School, Mountain View, Calif.**

**YEAR: Senior**

**HOMETOWN: Sunnyvale, Calif.**

**PROJECT: Rapid and Selective Detection of Viruses Using Virus Imprinted Polymer Films**

**FIELD: Chemistry**

**MENTOR: Dr. Richard N. Zare, Marguerite Blake Wilbur Professor in Natural Science and Chair, Department of Chemistry, Stanford University**

*"I'm excited to see more interdisciplinary work being conducted in STEM and strongly believe that drawing on various areas of expertise can propel innovation."*

Anjini Karthik produced an inexpensive wipe that can detect viral infection rapidly, selectively and at the point of care. With her research, the world can control the spread of viral infections and minimize fatalities by diagnosing viral disease rapidly and easily. Anjini became interested in new virus diagnostic tools after reading about the 2014 Ebola outbreak in West Africa. She was surprised to find out that the current methods of detecting viral infection take upwards of three days to yield results, when results are required in minutes during an epidemic. Having previously studied cell imprinting, she was intrigued by the possibility of adapting the principles of this recently developed technique to virus detection.

Anjini aspires to design and develop products that better human health, either in industry or academia. She anticipates majoring in bioengineering or computer science with a minor in the humanities. Anjini has previously been a Google Science Fair Regional Finalist (Americas), received a National First Place Award in Chemistry in the Student Research Showcase hosted by Sigma Xi – one of the oldest scientific research societies – of which she is one of its youngest inductees.

Outside the lab, Anjini serves as President of her school's Environmental Club and is also the Founder and Lead of Inspire101, an initiative designed to engage and excite middle schoolers in STEM. She is also a trained Bharathanatyam (Indian classical) dancer. Recently, Anjini gave a TEDx talk about learning and celebrating educators.



**NAME: CLARENCE NAKANO**

**SCHOOL: Flintridge Preparatory School, La Canada, Calif.**

**YEAR: Senior**

**HOMETOWN: La Canada Flintridge, Calif.**

**PROJECT: Biological Electron-Transfer Dynamics in Multi-Heme Cytochrome Complexes**

**FIELD: Physics**

**MENTOR: Mr. John Romano, Mathematics and Physics Teacher, Flintridge Preparatory School; Professor Mohamed Y. El-Naggar, Department of Physics & Astronomy, University of Southern California**

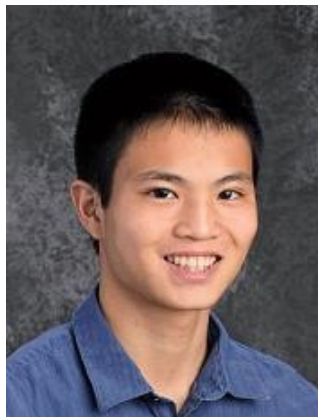
*"I love that the STEM fields are so fluid. There is essentially nothing in these fields that is one hundred percent set in stone, and as such, I love reading about, learning about, and especially participating in new developments across disciplines."*

Clarence used his integrated knowledge in biology, physics, chemistry, mathematics, computer science and entertainment technology to use bacteria capability as an energy producer to purify water. Wanting to make the earth a cleaner place, Clarence's project allows human society to live a sustainable life using bacterial power to produce fresh water from wastewater.

His current course load includes Advanced Placement (AP) Physics C, AP Statistics and Honors Multivariable Calculus, but it is history that is Clarence's favorite subject. He enjoys being able to compare and contrast events across the globe and over spans of time as well as connecting different events to form broader trends.

Clarence is a member of the National French Honor Society and spends time tutoring homeless children through an organization named 'Door of Hope Pasadena.' He is also the Founder and President of the Japanese Language and Culture Club. He has a second-degree black belt in Taekwondo and speaks English, French, Chinese and Japanese.

With an interest in concrete, if Clarence could speak with one person in history it would be the unnamed, unknown, ancient Roman inventor of concrete. Clarence would want to discuss the huge impact concrete has had throughout all of architecture as well as how concrete itself evolved as a medium from its original form.



**NAME:** ETHAN SHEN

**SCHOOL:** Cupertino High School, Cupertino, Calif.

**YEAR:** Senior

**HOMETOWN:** Cupertino, Calif.

**PROJECT:** Genetic Lineage Tracing of Axin2+ Cells Reveals a Stem/Progenitor Cell Population that Executes Skeletal Regeneration

**FIELD:** Biology

**MENTOR:** Ryan Ransom, MD/PhD candidate in Plastic and Reconstructive Surgery, Stanford University

*“To me, the most fulfilling aspect of advanced STEM courses is the level of understanding that is achieved in the field - not just the concepts, but the ‘why’ and ‘how’.”*

Ethan Shen discovered a new population of skeletal stem/progenitor cells with a remarkable regenerative capacity by tracing them through the bone healing process. These cells have the potential as therapeutics to not only treat degenerative bone diseases, like osteoporosis and osteoarthritis, but also as treatments for skeletal aging and cancer. His mentor, Ryan Ransom of Stanford University, inspired Ethan to pursue his research because of the ways in which he passionately spoke of stem cell biology. When Ethan’s grandfather was diagnosed with cancer in the foot, he realized that his work could not only save the lives of many patients, but also relieve the pain for their family members.

Ethan aspires to be a clinician scientist, and anticipates majoring in either biology, molecular biology and/or developmental biology in college. Ethan’s third grade teacher first piqued his interest in STEM subjects – she had a challenge folder labeled “6th Grade Math” for anyone who dared to try. Ethan served as a de facto mentor for an undergraduate student at California Polytechnic State University during his summer research program.

Outside the lab, Ethan is a four-year varsity basketball player – twice named team captain. He also got to play a game of ‘HORSE’ with current NBA player Aaron Gordon back when he was in high school. Since his sophomore year, Ethan has served as a Science Olympiad Team Captain. If Ethan could speak with anyone from history, he would ask Michael Jordan about his will to succeed in the face of adversity, an essential attitude in scientific research.

## TEAM COMPETITORS

**KENZ KALLAL**, Weston High School, Weston, Mass.

**FELIX WANG**, Roxbury Latin School, West Roxbury, Mass.

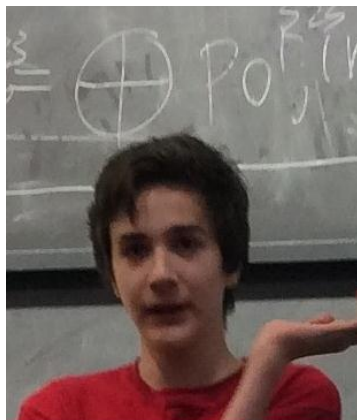
**MATTHEW LIPMAN**, Boston University Academy, Boston, Mass.

**PROJECT:** Equal Compositions of Rational Functions

**FIELD:** Mathematics

**MENTOR:** Professor Michael E. Zieve, University of Michigan; Thao Do, Graduate Student, the Massachusetts Institute of Technology

Kenz, Felix, and Matthew's project improves various mathematical theorems in differential equations and dynamical systems while also strengthening neural networks and improving computer graphics and economics. The research was done by resolving rational functions under certain constraints.



**KENZ KALLAL**

**YEAR:** Junior

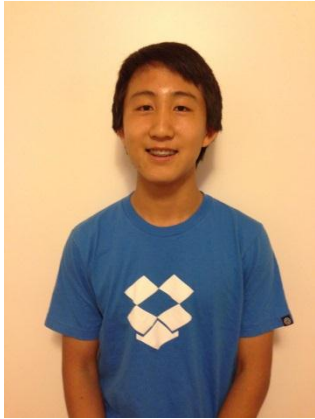
**HOMETOWN:** Weston, Mass.

*"Math is about discovering structure and beauty for yourself instead of following a recipe."*

Kenz first realized his love for math when he participated in the Program in Mathematics for Young Scientists (PROMYS) in 2014, where he stayed up all night completing problem sets.

Kenz aspires to become a mathematics researcher or professor. He is already taking advanced STEM classes at the Harvard University Extension School and he participates in the Weston High School Math Team. Kenz sees a deep beauty in the world of mathematics because it is so directly apparent or accessible in other subjects.

Kenz looks to his mentor on this project, Professor Michael E. Zieve of the University of Michigan, as his role model. Kenz believes STEM competitions similar to the Siemens Competition should be expanded to allow students the opportunity to compete in math and science and have more access to mentors and role models.



**FELIX WANG**  
**YEAR:** Junior  
**HOMETOWN:** Newton, Mass.

*“Flying kites when I was really young inspired me to learn more about physics, and got me very excited about STEM education.”*

Felix was excited and eager to participate in a long-term mathematics research project upon joining his Siemens Competition team. An aspiring mathematics professor, Felix is fascinated with the development of machine learning – in particular its applications in so many diverse fields of technology.

Throughout the project Felix had many times when he felt stuck and did not know how to continue with his work. The project truly tested his patience and determination, showcasing the importance of perseverance.

Outside of his studies, Felix is the captain of the junior varsity soccer team and enjoys playing tennis and the piano. He is also an active member of the debate team, speaks Chinese and frequently helps his classmates with STEM-related material covered in class.

If Felix could speak with one person in history it would be Archimedes, to ask him how he derived the area of a circle using basic understanding of calculus.



**MATTHEW LIPMAN**  
**YEAR:** Junior  
**HOMETOWN:** Lexington, Mass.

*“Math allows us to make remarkable statements that violate common sense.”*

Matthew’s love for math, science and technology is driven by the abstractness and general irrelevance of common sense of physical intuition. As a child he played many education games and was always



drawn to the STEM material. Matthew believes that, in order to have students become more excited about math and science, there needs to be low-level lectures on high-level material.

As an aspiring mathematician, Matthew has already started taking various math classes at Boston University. He particularly enjoys studying Galois Theory, thus, if Matthew could speak with anyone in history, it would be Galois to see how much more he would have been able to accomplish if he had more time.

Matthew enjoys playing tennis and is part of his school's math club. Emmy Noether, the German mathematician and namesake of Noether's Theorem, is Matthew's role model.

## TEAM COMPETITORS

**EVAN LAVERY, Oregon Episcopal School, Portland, Ore.**

**GRANT KRESGE, Wilsonville High School, Wilsonville, Ore.**

**PROJECT: Assessing the Photometry of GSC 03144-00595: a Radially Pulsating, Delta Scuti, Triple Mode Variable Star**

**FIELD: Physics**

**MENTOR: Dr. Bevin Daglen, Astronomy Teacher, Oregon Episcopal School; Mr. Peter Langley, Honors Biology Teacher, Oregon Episcopal School; Dr. Richard Watkins, Professor of Physics; Department Chair, Willamette University, Pine Mountain Observatory (PMO) Summer Research Workshop Professor**

Evan Lavery and Grant Kresge discovered the fifth Triple Mode Variable star ever, a star that has very little research surrounding it. The distance, size and luminosity of these stars can be calculated extremely accurately, and they have found a way to discover these stars in a much more efficient way, while also gaining accurate information about the universe.



**EVAN LAVERY**

**YEAR:** Senior

**HOMETOWN:** West Linn, Ore.

*"I think that STEM is the most important tool to solve world issues, such as global warming and hunger."*

Evan aspires to be a doctor, astronomer, professor and/or entrepreneur. He anticipates majoring in economics, medicine and/or astronomy in college. He has previously earned fourth place in physics and astronomy at the International Science and Engineering Fair as well as first place in physics and astronomy at the Intel Northwest Science Expo.



Evan's brother's past experience with an astronomy project inspired him to pursue his current research. His favorite subject is science (biology, physics, chemistry, astronomy, anatomy and physiology) because he believes that science is what has moved the world forward, and learning about how the universe works and what the world has done with this information to create new technologies is fascinating to Evan. He also appreciates how everything within the core science classes builds from one another.

Outside of the lab, Evan participates in Junior State of America. He also plays the guitar and enjoys basketball and lacrosse. If he could speak with anyone from history, Evan would ask Thomas Jefferson what he thinks of the current state of America and talk to him about different Supreme Court cases.



**GRANT KRESGE**

**YEAR:** Senior

**HOMETOWN:** Wilsonville, Ore.

*"I was inspired to pursue astronomy and physics because I have always been curious about space and its unknown boundaries."*

Grant aspires to be an engineer or practice medicine. His brother and father first piqued Grant's interest in math and science. Science fiction writing has also helped develop his excitement about the possibilities of the future. Grant's favorite courses are AP Biology and AP Calculus BC.

Grant believes that in order to encourage more students to pursue math and science, they must be shown that they can make a difference and are capable of incredible things. He also believes that the importance of understanding the applications of science in the real world are paramount.

Outside of the lab, Grant plays violin in the Metropolitan Youth Symphony, helps to remove invasive species from a local park, and participated in the Intel International Science and Engineering Fair. He also enjoys soccer, wrestling and lacrosse. If Grant could talk to anyone from history, it would be Galileo Galilei, because he symbolizes that even our closest held beliefs should be challenged.

## TEAM COMPETITORS

**EDWARD PARK**, Larchmont Charter School, Los Angeles, Calif.

**EMORY KIM**, Harvard-Westlake School, Studio City, Calif.

**GINA CHOI**, Harvard-Westlake School, Studio City, Calif.

**PROJECT:** A cost-effective chemiluminescent biosensor capable of early diagnosing cancer using a combination of magnetic beads and platinum nanoparticles

**FIELD:** Materials Science

**MENTOR:** Dr. Ji Hoon Lee, Luminescent MD

The team of Edward, Emory and Gina developed a kit capable of detecting Thyroid cancer at an early stage by using platinum nanoparticles and magnetic beads. This project works to advance the accuracy and effectiveness of cancer screening.



**EDWARD PARK**  
**YEAR:** Junior  
**HOMETOWN:** Los Angeles, Calif.

*“The aspect I like most about STEM is that it is never static, there is always a new way to look at a problem or a better way to solve a problem.”*

Watching videos of Bill Nye: The Science Guy is what first piqued Edward’s interest in STEM classes but he still views history as his favorite subject in school. Edward loves the sequence of events leading to an outcome, rather than just memorizing dates, names and wars. Seeing the advancement of technology and science unfold in his history books is true beauty for Edward.

Edward is the founder of a non-profit organization that sends relief aid to albino people being persecuted in Africa and he volunteers his time at the California Science Center in Los Angeles. Edward is currently undecided as to what his future profession will be, but he plans on applying to Stanford University and the Massachusetts Institute of Technology.

As a William Shakespeare fan, Edward would like to go back in time to speak with him mainly because so much of Shakespeare’s life is shrouded in a romanticized mystery. Edward looks to the fictional character the Count of Monte Cristo as a role model.



**EMORY KIM**  
**YEAR:** Sophomore  
**HOMETOWN:** Los Angeles, Calif.

*“STEM embodies all different concepts: language, English, history and even art. This union is so satisfying that every day I am inspired by this subject.”*

## SIEMENS | Foundation

From an early age Emory was experiencing the power of STEM education. Her elementary school brought in guest speakers who were all women in the STEM field. Emory recalls each speech giving her goose bumps because of the endless possibilities she felt were right in front of her. Women's rights activist Mary Wollstonecraft is a big inspiration to Emory. She would love to go back in time to speak with her and take in as much information as possible about standing up for one's rights.

Outside of her love for STEM, Emory participates in ballet and is the founder of two clubs at school; Students Taking on Poverty and Save Every Albino Child. She also serves as editor of her school newspaper. Emory's favorite subject in school is math because there are always exact answers, no matter how complex or simple the question. She finds math quite beautiful that the complexity can be narrowed down into one precise answer.

With many interests, Emory has not decided what she would like her major to be in college. She has narrowed it down to biology, journalism, Latin or literature. Emory plans on applying to Columbia University and ultimately would like to become a dermatologist.



**GINA CHOI**

**YEAR:** Sophomore

**HOMETOWN:** Los Angeles, Calif.

*"I like how much math and science influence each other and can then be integrated into many real life circumstances."*

Around age 11, Gina began performing virtual dissections and watching live surgeries shown on video – first piquing her interest in the medical sciences. As an aspiring pediatrician, Gina has taken honors chemistry and biology as well as Advanced Placement computer science.

Gina plans to be pre-medical in college and wants to major in biochemistry. She has not yet applied to schools but wants to apply to Stanford University, Harvard University, the Massachusetts Institute of Technology, Yale University, Princeton University, the California Institute of Technology, the University of California at Berkeley and the University of Oxford.

Outside of classes, Gina participates in the Upper School Symphony, is a member of the Yearbook Club and is a volunteer for Cedars-Sinai. Gina also mentors other students in math, helping them prepare for standardized testing and even making videos to help students solve certain problems. She plays the viola and field hockey. Gina speaks English, Korean and Spanish and she looks to her mother as her role model.

## TEAM COMPETITORS

**TARA THAKURTA**, Castilleja School, Palo Alto, Calif.

**KATHRYN LI**, Palo Alto High School, Palo Alto, Calif.

**PROJECT: Imaging Human Glioblastoma Cell Migration in a Preclinical Model**

**FIELD: Biology**

**MENTOR: Edwin Chang, Ph.D, Research Associate, Multimodality Molecular Imaging Laboratory (MMIL) at Stanford University**

*“With our project, the world can come one step closer to understanding and treating brain cancer.”*

Tara Thakurta and Kathryn Li worked together to find a potential migration pattern for glioblastoma multiforme (GBM), a particularly malignant form of brain cancer. Their research can be used to determine drug therapies for stopping GBM migration. Kathryn’s grandmother passed away from GBM, so she wanted to do everything in her power to help others suffering from the disease.



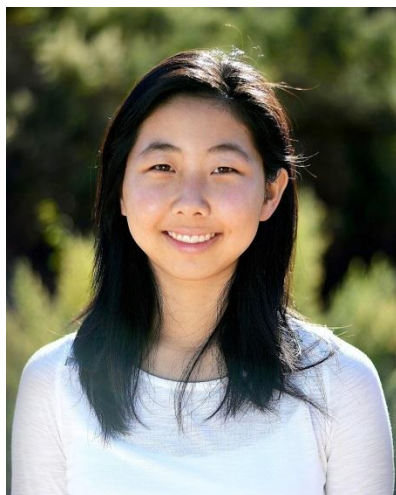
**TARA THAKURTA**

**YEAR:** Senior

**HOMETOWN:** Los Altos, Calif.

Tara hopes to be a researcher after she graduates from college. She grew up in a household that values STEM, as her mother is a molecular biologist at NASA. Seeing a space shuttle launch, and knowing that her mom’s experiments aided that success, inspired Tara to pursue STEM in her studies.

Tara is co-captain and pitcher of her high school softball team. She has been a varsity athlete all four years of high school. She also runs her school’s annual charity dance show, Arts with a Heart. She is a youth mentor for a fourth grade girl in East Palo Alto, helping out with the “Science Saturdays” program filled with projects and experiments for the mentees.



**KATHRYN LI**

**YEAR:** Senior

**HOMETOWN:** Palo Alto, Calif.

Kathryn Li hopes to pursue STEM as a scientific researcher or a doctor. Her mother, a fellow woman in STEM, inspired Kathryn to pursue the field. She first became interested in science when she watched researchers extract DNA from strawberries and realized that a complex molecule could be visualized through simple means.

Kathryn has participated in her school's Science Olympiad competition and likes being challenged by her fellow teammates. She helps to run a science summer camp for middle schoolers, mentoring them in chemistry and forensic analysis.

## TEAM COMPETITORS

**DAVID ZHU, The Harker School, San Jose, Calif.**

**EVANI RADIYA-DIXIT, The Harker School, San Jose, Calif.**

**PROJECT: Automated Classification of Benign and Malignant Proliferative Breast Cancer Lesions**

**FIELD: Computer Science**

**MENTOR: Dr. Andrew Beck, Professor of Pathology, Beth Israel Deaconess Medical Center, Dana Farber Cancer Center; Mr. Chris Spenner, Physics teacher, The Harker School**

David and Evani developed a machine learning algorithm that can robustly diagnose a breast cancer tumor as either benign or malignant from a biopsy image. Their model can help improve breast cancer diagnosis accuracy, thereby reducing under- and over-treatment. The most challenging part of the project for them was designing the algorithm so it would obtain a high accuracy rate of cancer diagnosis and making sure they remained unbiased, so that their results could be replicated.



**DAVID ZHU**

**YEAR:** Junior

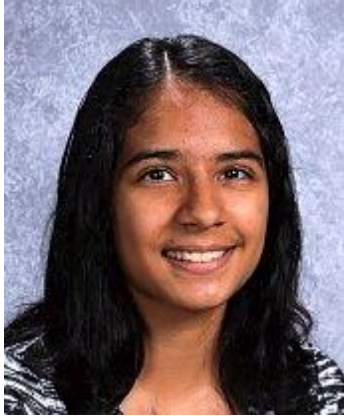
**HOMETOWN:** Saratoga, Calif.

*"STEM influences the daily lives of the common person quite significantly."*

David is an aspiring computer engineer, and he wants to use his skills to be able to help the world. David has seen breast cancer's impact up close and personal as he lost a close family friend to the battle. The survival rate for breast cancer patients has a lot to do with early detection, motivating David to develop a system that can detect breast cancer at an earlier stage.

David appreciates STEM education because he sees how it can influence the daily lives of individuals. He coaches the Middle School Science Bowl Team, and encourages his school to have more science experiment demonstrations opposed to traditional classroom exercises.

Outside of school David participates in tennis, basketball and dance. He also plays piano and percussion instruments. David looks to Steve Jobs as his role model and if he could speak to one person in history it would be Alan Turing. David would want to let Alan know that we are very close to passing the Turing Test.



**EVANI RADIYA-DIXIT**  
**YEAR:** Junior  
**HOMETOWN:** San Jose, Calif.

*"I encourage students to work on hands-on projects and to learn by experimentation."*

Evani has been deeply interested in technology and computer science, as she believes they can bring monumental improvements in human lives. She believes that STEM education can create unimaginable innovations and can accomplish what people thought was unsolvable only a few decades ago.

Evani is inspired by breakthroughs such as Google's low-orbiting satellites intended to beam Internet to the world's remote areas. She is excited to pursue multidisciplinary studies in engineering, medicine, and the humanities.

Outside of school, Evani participates in Future Problem Solving and volunteers at Sacred Heart, a community service organization. She enjoys running and playing tennis as well as writing and singing. Evani once had the opportunity to meet Sally Ride and hear her speak about the challenges and wonder she experienced during space travel. If Evani could meet one person in history, it would be Ardi, the 4.4 million year old human ancestor, to gain insight into the incredible human evolution.