TOMORROW BEGINS TODAY

INTEL SCIENCE TALENT SEARCH 2013 FINALISTS

Andrey Sushko
Second Place Winner
Intel Science Talent Search 2012

Nithin Tumma
First Place Winner
Intel Science Talent Search 2012

Mimi Yen
Third Place Winner
Intel Science Talent Search 2012

2013 Finalists

The Intel Science Talent Search (Intel STS), a program of Society for Science & the Public, is the nation's most prestigious pre-college science competition. Alumni of STS have made extraordinary contributions to science and hold more than 100 of the world's most distinguished science and math honors, including the Nobel Prize and the National Medal of Science. Each year, 300 Intel STS semifinalists and their schools are recognized. From that select pool of semifinalists, 40 student finalists are invited to Washington, DC in March to participate in final judging, display their work to the public, meet with notable scientists, and compete for the top award of $100,000.

Intel Science Talent Search 2013

Intel Science Talent Institute 2013
March 7–13, 2013

The 40 finalists of the Intel Science Talent Search 2013, a program of Society for Science & the Public, represent 2.3 percent of entrants to this highly-selective and world-renowned scientific competition. These students have been awarded an all-expense paid trip to Washington, DC to attend the Intel Science Talent Institute, where they compete for $630,000 in awards.

The 19 young women and 21 young men come from 40 schools in 20 states. Finalists were selected from among 1,712 entries that were received from 42 states, the District of Columbia, Guam, and two U.S. overseas schools.

Many projects are the product of a research environment in which scientist mentors and teachers dedicate themselves to the intellectual development and technical training of students who participate in the Intel STS. Students are precluded from publicly acknowledging those mentors to avoid any potential for judging bias. Intel STS 2013 finalists, Intel and Society for Science & the Public acknowledge with gratitude the guidance, expertise and patience of the experienced researchers who made many of these projects possible.

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Intel Science Talent Search

Inquire. Innovate. Inspire.

History

The Science Talent Search (STS), a program of Society for Science & the Public since its launch in 1942, is the nation's oldest and most highly regarded pre-college science competition. The STS provides an incentive and a forum for U.S. high school seniors to complete an original research project and to be recognized by a national jury of accomplished professional scientists, mathematicians and engineers. The projects are a result of inquiry-based learning methods designed to nurture critical reasoning skills, experience research through the use of the scientific method, and demonstrate how math and science skills are crucial to making sense of today's technological world. Educators, scientists, engineers, and journalists throughout the U.S. have enthusiastically supported this annual program.

Since 1942, the STS has recognized 21,771 finalists and semifinalists who have received $16.3 million in awards as they launch their college careers. Many STS participants have gone on to distinguished careers; alumni of the STS include more than 100 recipients of the world's most distinguished science and math honors, including the Nobel Prize, the National Medal of Science, the MacArthur Foundation Fellowship and the Fields Medal.

In 1998, Intel Corporation was named the title sponsor of this storied competition. Intel reinvigorated the STS, significantly increasing the program's annual awards and visibility. Society for Science & the Public salutes Intel in this 15th year of sponsorship of the Intel Science Talent Search (Intel STS).

The Process

Students submit an extensive written report of their scientific research to demonstrate creativity and interest in science, as well as supporting documents from schools, advisors, and mentors.

While in Washington, DC, finalists meet leading scientists, visit places of historic and political importance, and meet with distinguished national leaders. Students display their research at the National Geographic Society where they describe their work to visitors. Many of those studying the exhibits are highly motivated younger students who aspire to enter the Intel Science Talent Search in their senior year of high school.

Awards

The top award for the Intel Science Talent Search 2013 is $100,000. The Second place finalist will receive $75,000; Third place is $50,000; Fourth place: $40,000; Fifth place: $30,000; Sixth–Seventh places: $25,000 each, and Eighth–Tenth places will each receive $20,000. The remaining 30 finalists will each receive $7,500. Winners will be selected by the judging committee and announced at a black-tie gala on March 12, 2013.

Each of the 300 students named a semifinalist in the Intel STS 2013 will receive a $1,000 award for their outstanding science research, in addition to any amount that students may win as finalists. Each of their schools will receive an award of $1,000 for each semifinalist named in the Intel STS 2013. The award is used to advance excellence in science, math, and/or engineering education at the recipient school.

*Finalist ages are listed as of March 12, 2013, the date of the Intel Science Talent Search Awards Gala.

Paulomi Bhattacharya
The Harker School

California

Paulomi Bhattacharya, 18, of **Cupertino,** submitted an Intel Science Talent Search **chemistry** project investigating structure-based drug design and used computational modeling to identify a new drug candidate for multiple myeloma, this country's second most common blood cancer. Paulomi studied p97, one of the cellular proteins that could potentially be targeted by myeloma drugs. She used an innovative method to explore the part of p97 she wished to target (called the N-domain) during natural changes in the protein's 3D shape, discovering a new binding site on the molecule. She then identified a compound with more binding affinity for the newly discovered N-domain cavity than any previously recorded. She believes that a structure-based approach can help speed the identification of the next generation of drugs. Paulomi attends **The Harker School** in San Jose where she is co-editor of the school's contributions to *The Triple Helix Online*. She is also co-captain of her club volleyball team. Paulomi's previous research includes projects on microbial fuel cells, radioactive emissions from granite, and nanoparticle synthesis. The winner of multiple awards in piano and science, Paulomi is the daughter of Partha and Sraboni Bhattacharya and speaks fluent Bengali.

Surya Narayanaraju Bhupatiraju
Lexington High School

Massachusetts

Surya Narayanaraju Bhupatiraju, 17, of **Lexington,** entered an Intel Science Talent Search project in **mathematics** that explored the computational complexity of the marginal satisfiability problem (MSP). An example of the MSP would be to determine whether, given summaries of data, it is possible to prove that the summaries correspond to actual data. Surya explored the MSP, identified several variations of the problem, and invented efficient algorithms for them. In particular, he developed an algorithm that permitted negative values, such as might occur with profits and losses, and a randomized algorithm that could be used to find approximately correct solutions to MSP problems. Surya's results may improve data compression techniques and summary tools used in data security. Surya attends **Lexington High School**, where he competes as part of the math and science bowl teams, as well as the Ultimate Frisbee team. He is also a member of the school's computer science league and volunteers as a tutor. The son of Venkata and Indira Bhupatiraju, he is fluent in his native language, Telugu, and has co-authored two published papers. His hobbies include running and breakdancing.

Adam Joseph Bowman
Montgomery Bell Academy

Tennessee

Adam Joseph Bowman, 17, of **Brentwood,** entered an **engineering** project in the Intel Science Talent Search focused on creating highly ionized gases known as plasmas. Plasma applications range from semiconductor manufacturing to nuclear physics. Typical plasma sources are large, complicated and expensive, making them impractical for small-scale research. Three years ago, Adam constructed a table-top-size coaxial plasma gun in the family garage. Building on that experience, Adam has developed relatively simple ways to create compact and inexpensive pulsed plasma devices and a novel fiber optic technique to study how the plasma moved as the device was discharged. Adam believes his low-cost experimental systems, along with his new diagnostic technique, could extend pulsed plasma research to low-budget institutions and even high school labs. At **Montgomery Bell Academy** in Nashville, Adam is president of the astronomy club and captain of the Science Olympiad team. He competes on the Quiz/Knowledge Bowl team and helped initiate a robotics club. The son of Joe and Lori Bowman, Adam has spent more than 300 hours as a volunteer at Vanderbilt University's Dyer Observatory.

Jennifer Chan
Academy for Medical Science Technology

New Jersey

Jennifer Chan, 18, of **Upper Saddle River**, submitted an Intel Science Talent Search project in **biochemistry** that investigated ways to increase the efficacy of the breast cancer drug tamoxifen. Jennifer examined the relationship between the expression of activation-induced cytidine deaminase (AID), a DNA-modifying enzyme that is upregulated in cancer cells, and the efficacy of tamoxifen. She found that at low doses, tamoxifen reduced AID levels only in cells possessing estrogen receptors, but at high doses, tamoxifen increased AID levels in cells with and without estrogen receptors. By inhibiting NFkB (a transcription factor that induces pro-survival signaling in cells) as part of a high-dose tamoxifen treatment, she was able to observe a reduction in cell growth and AID expression. Jennifer's pursuits in medical research were motivated by her personal experiences with cancer fatalities among her immediate family and close friends. She attends the **Academy for Medical Science Technology** in Hackensack, and has been a volunteer EMT with a local ambulance service for more than two years. She is also the recipient of a Meritorious Service award for providing emergency care at the scene of a severe car accident. Jennifer is the daughter of Dawn Liu.

Kevin Chen

Mission San Jose High School

California

Kevin Chen, 17, of **Fremont**, developed a low-cost (less than $100) ferroelectric analyzer from spare parts that is able to determine the electric characteristics of ferroelectric or dielectric materials for his Intel Science Talent Search **engineering** project. Ferroelectrics exhibit permanent polarization that varies in strength with an applied electric field. They have far reaching real-world applications in electronics and materials science, but until now, could only be researched with the help of multi-thousand dollar pieces of equipment. Kevin developed his analyzer — named ezyPEzy — using readily available components and wrote code for its operation in Python and C. More data needs to be gathered to fully calibrate the analyzer, but when it is complete, the software and instructions on how to build it will be released to the public. Kevin is a member of the math club and the engineering division of the Science Olympiad team at **Mission San Jose High School**. He's played violin with the California Youth Symphony Senior Orchestra and now participates as a member of his local Riceballs music ensemble. He also works as a tutor at the Olive Children Foundation and in his spare time, he enjoys juggling. Fluent in Chinese, he is the son of Chao-Peng Chen and Mei-Hsien Tsen.

Lillian Tiffany Chin

The Westminster Schools

Georgia

Lillian Tiffany Chin, 17, of **Decatur,** developed a computer model to test and understand cellular dynamics during wound healing for her Intel Science Talent Search **bioengineering** project. Lilly's model analyzes collective cell migration, a crucial part of biological processes including tissue repair and wound healing, and accounts for both the internal and external forces that act on a cell. When validated against *in vitro* wound healing experiments, her sophisticated model effectively simulated many cellular behaviors. She believes her model demonstrates how chemical and mechanical forces impact wound healing. Lilly's next goal is applying her model to study the loss of contact inhibition in metastatic cancer. Lilly attends **The Westminster Schools** in Atlanta where she serves as president of the Math and Science Olympiad teams, captain of two robotics teams, and vice president of her senior class. An avid violinist since the age of 4, Lilly enjoys spending time exploring local restaurants and collecting coins. She is the daughter of Lih-Shen Chin and Lian Li and recently co-authored a paper titled "Technology-Enhanced Conic Discoveries" that is scheduled for publication in an upcoming issue of *Mathematics Teacher*.

Katherine Cordwell
Manzano High School

New Mexico

Katherine Cordwell, 17, of **Albuquerque**, submitted a **mathematics** project to the Intel Science Talent Search concerning noncommutative algebra and representation theory, which have potential applications in quantum physics. A noncommutative structure is one for which the multiplication of two objects (A times B) does not necessarily equal the reverse (B times A). Representation theory involves replacing certain objects in mathematics (such as the algebra of polynomials) with other simpler algebraic objects that share similar characteristics. Katherine's research considered a series of algebraic objects, with each object having an infinite number of components. Katherine's goal was to characterize the structures of a defined set of quotients. She used computer software to recognize a pattern in these small examples and then proved that these patterns always arise. Katherine has studied the piano since the age of six and loves to read. A student at **Manzano High School,** she has remained active in the Saturday math seminar since middle school. The daughter of William and Rosemary Cordwell, Katherine has wanted to become a math professor since fifth grade and hopes to share her love of mathematics with future students.

Alexa Victoria Dantzler
Bishop O'Connell High School

Virginia

Alexa Victoria Dantzler, 18, of **Manassas,** submitted an Intel Science Talent Search project in **chemistry** that quantified chemical residues in dry cleaned fabrics. Lexy's research was inspired by articles about the toxic properties of perchloroethylene (PCE), a widely used dry cleaning chemical. She analyzed levels of PCE residue on polyester, wool, cotton and silk fabrics and discovered detectable PCE in all except silk. Her findings indicated that pressing fabrics resulted in reduced PCE levels and that PCE levels drop by half after seven days. She also found that levels of PCE varied in clothes laundered at 48 dry cleaning businesses in the Washington, DC area, suggesting that their individual methods may directly influence the amount of residue in the fabrics. She hopes this research will spur further investigation into the health risks of PCE exposure for the average citizen. Lexy performs in the orchestra and string quartet at **Bishop O'Connell High School** in Arlington, where she is the founder and president of the Medical Missionaries Club, and organized a trip for volunteers to work at a medical clinic in Haiti. The daughter of Willie and Anita Dantzler, she donates time at a local free clinic as an English/Spanish translator.

Kevin Garbe

Saratoga High School

California

Kevin Garbe, 17, of **Saratoga,** entered an Intel Science Talent search **mathematics** project on the dynamics of powers of polynomials over finite fields and properties of the fractals they generate. Fractals arise in a wide variety of contexts in mathematics, physics, and biology and have been applied in fields as diverse as cryptography, computer graphics and seismology. Kevin calculated the fractal dimension for polynomials of small degree over the two element field and proved upper bounds on the dimension in the general case. The son of Kurt and Emily Garbe, Kevin holds a second degree black belt in Tae Kwon Do and trains young students in the sport. Passionate about chess, Kevin has competed in more than 130 tournaments and has earned a Class A rating. He was a member of the **Saratoga High School** Chess team that won a record six consecutive championships. A self-acknowledged left-brain thinker, Kevin finds beauty and wonder in exploring the logic of the universe, including "the fractal patterns of the daisies on the field."

Lane Gunderman

The University of Chicago Laboratory High School

Illinois

Lane Gunderman, 18, of **Chicago,** used molecular dynamics simulations to explore the mechanics of energy transport in photosynthesis for the **chemistry** project he entered in the Intel Science Talent Search. He focused on the Fenna-Matthews-Olson complex (FMO), a pigment protein complex that transfers photons with near-perfect efficiency, and searched for possible explanations at the atomic level. His investigation centered on the resonance between the molecular components in FMO responsible for selective light absorption and their protein scaffolding. The results of his calculations show the specific, localized motions that had been hypothesized in 2007 but never before proved. Lane believes these motions are not great enough to be the dominant efficiency driver, but hopes his insights can contribute to future efforts in creating synthetic materials that can mimic FMO efficiency. At **The University of Chicago Laboratory High School**, Lane competes on the math and science teams, captains the Quiz Bowl team and is co-captain of the linguistics team. He enjoys building with Legos and K'Nex, acting, singing and dancing. A two-time Silver Medalist in the National Latin Exam, he is the son of Becki Martello.

Jacob Paul Smullin Johnson

Acton-Boxborough Regional High School

Massachusetts

Jacob Paul Smullin Johnson, 17, of **Boxborough,** entered an Intel Science Talent Search project in **bioinformatics and genomics** that identified genes that could be targeted in future breast cancer therapies. Jacob analyzed three tumor-suppressor genes in mice, demonstrating that the mouse model has many features that resemble aggressive human breast cancer. By combining bioinformatics techniques and experimental assays, he was able to identify several genes that potentially drive the development of this cancer. Jacob is a co-author on an article published in *PLOS Genetics*, as well as on four other future publications describing his work, including one paper on which he is the lead author. He is an Eagle Scout. At the **Acton-Boxborough Regional High School,** he is an elected student class leader and participates on the Science Team, which won the 2012 Massachusetts State Science Olympiad. Since 2009, when he started a program to provide long-lasting support to an orphanage in coastal Tanzania, Jacob's grant-writing efforts have secured 110 corporate-funded laptops for the institution. He also led the project to build and ship 20 solar-powered cookers, and he co-wrote a business plan describing a brick-making enterprise for the orphanage. His parents are Mark Johnson and Leslie Smullin Bourne.

Jonah Kallenbach

Germantown Academy

Pennsylvania

Jonah Kallenbach, 17, of **Ambler,** submitted an Intel Science Talent Search **bioinformatics and genomics** project that breaks new ground in predicting protein binding for drug therapy. Jonah solved an open problem first posed several years ago about segments in protein chains called "disordered regions" that have inconsistent three-dimensional structures. Jonah's research advanced methods for predicting interactions between disordered regions and their binding partners. He validated his results with proteins coded by the cancer-associated BRCA1 gene. His work may open a new paradigm of drug design in which disordered regions can be used as promising new drug targets, and has already attracted attention from a pharmaceutical company. Jonah attends **Germantown Academy** in Fort Washington, where he leads the computer science and ethics clubs, edits the school magazine and is a four-year varsity swimmer and water polo player. Jonah is the son of Charles Kallenbach (with whom he ran the Philadelphia half marathon) and Alison Rosenberg, and he cites his grandfather as the "first and last person" he talks to about matters of scientific importance.

Peter Kraft
Munster High School

Indiana

Peter Kraft, 17, of **Munster,** investigated the synthesis of novel coordination polymers for his Intel Science Talent Search project in **chemistry**. Coordination polymers are massive molecules with complex network structures that have applications in gas purification, LED lighting and the storage of hydrogen in fuel cells. Peter synthesized and characterized ten new polymers with a wide range of complexity and structural composition. His findings could increase the speed and efficacy of chemical reactions, or be used to improve methods of gas storage. Peter has already published a paper outlining some of this work in the journal *Acta Crystallographica,* and has submitted a second paper to the *Journal of Molecular Structure*. Peter is captain of the Lincoln-Douglas debate team at **Munster High School**, where he also competes on the JETS engineering team and in the Science Olympiad. He recently competed in the nationwide We the People civic competition with his peers; his team earned a spot as one of the top five in the nation. The son of Roger Kraft and Norma Elias, Peter credits his father with inspiring his scientific interests.

Hannah Kerner Larson
South Eugene High School

Oregon

Hannah Kerner Larson, 18, of **Eugene**, submitted an Intel Science Talent Search **mathematics** project about fusion categories — a type of abstract mathematical structure that appears in many areas of math, theoretical physics and computer science. One way to approach these categories is to study related objects called fusion rings and determine which rings are associated with fusion categories. In the case with two self-dual elements, Hannah gave a complete classification of the rank four fusion rings that give rise to fusion categories. Hannah attends **South Eugene High School** and is the winner of multiple math honors. She is principal cellist of the Eugene-Springfield Youth Symphony, a member of the Top Chamber Ensemble at the University of Oregon, and received two summer cello scholarships to the Kinhaven Music School in Vermont. In addition, she has studied piano since second grade and now coaches and plays piano duets for fun. After college, she plans to teach and conduct research in mathematics. The daughter of Steven Larson and Winifred Kerner, Hannah organizes math competitions for her school and speaks Spanish with ease.

Stephen Adam Le Breton
Greenwich High School

Connecticut

Stephen Adam Le Breton, 17, of **Greenwich,** investigated a novel system to recoat teeth with artificial enamel, *in vivo,* for his Intel Science Talent Search project in **medicine and health**. Teeth cannot regenerate enamel, but researchers had shown that artificial enamel can be reformed by exposure to a solution of calcium, phosphorous and other chemicals for 24 hours. Unfortunately, this process takes too long to be practical, and the chemicals can be toxic. Stephen developed a mixture that would apply artificial enamel in one hour and tested it on tooth samples from which the natural enamel had been removed. He then used a polymer to time-release his reagents and applied it to the inside of a plastic retainer. Analysis of a tooth inserted into the retainer for one hour suggested that it was recoated with enamel. More research is needed, but Stephen believes his study could lead to a treatment for people whose natural enamel layer has eroded away. Stephen is a member of Greenwich crew's rowing team and the Greenwich Basketball Association. An Eagle Scout, he enjoys scuba diving and runs his own lifeguarding business. The son of Patrick and Linda Le Breton, Stephen attends **Greenwich High School** and hopes to become a military doctor.

Daniel Conor McQuaid
Ossining High School

New York

Daniel Conor McQuaid, 17, of **Ossining,** studied the degradation of KLF6, a protein that induces cell death (a process associated with the rapid proliferation of cancer cells) for his Intel Science Talent Search **biochemistry** project. Dan looked for and found specific sites on KLF6 targeted by the molecules that cause it to degrade. He also found that when these sites are not present, KLF6 does not degrade as quickly and cell growth stops. Now that these sites have been identified, researchers can focus on developing methods to specifically inhibit KLF6 degradation. Dan used lung adenocarcinoma cells for his research; however, KLF6 also functions as a tumor suppressor in prostate, colorectal, gastric and other cancers, which gives his work broad potential. Dan is co-editor-in-chief of the school newspaper and editor-in-chief of the literary magazine at **Ossining High School**, and he interned at *The Northern Westchester Examiner.* As passionate about soccer as he is about writing, Dan is center midfielder for a Westchester club team. He also serves as logistics coordinator for Relay for Life, which raises money for cancer research. The son of Michael and Gloria McQuaid, he is fluent in Italian and hopes to study oncology.

Pavan N. Mehrotra

Sierra Canyon School

California

Pavan N. Mehrotra, 18, of **Simi Valley,** submitted an **engineering** project to the Intel Science Talent Search that investigated a way to generate clean electrical power from biomass by merging two kinds of fuel cells. Pavan's design could be used to more effectively convert biomass directly into electricity. His patent pending conversion process combines a yeast microbial fuel cell (MFC) that runs on biomass, with a direct alcohol fuel cell (DAFC) that uses the alcohol generated by the yeast. Pavan had to overcome the challenge of yeast fermentation byproducts fouling the platinum catalyst. He succeeded by adding a semi-permeable membrane with sub-nanometer pores between the chambers, so yeast contaminants are stopped, while allowing alcohol to pass through. An avid researcher, he participated in plankton studies and squid and shark dissections two years ago at the Long Beach Marine Institute. Pavan attends **Sierra Canyon School** in Chatsworth, where he tutors students and is captain of the varsity soccer team. The son of Vivek and Sunita Mehrotra, Pavan volunteers at the Ronald Reagan Presidential Library and Walt Disney Archives and raised $2,500 for the National Multiple Sclerosis Society.

Naethan Sid Mundkur

duPont Manual High School

Kentucky

Naethan Sid Mundkur, 17, of **Louisville,** researched the enhanced thermal conductivity and heat transfer capabilities of nanofluids for the **materials science** project he submitted to the Intel Science Talent Search. Naethan created his nanofluid by suspending copper-oxide nanoparticles in a commercially available oil-based heat transfer fluid. He manipulated the concentrations and sizes of the nanoparticles and monitored aspects of the nanofluid that are not commonly observed. Naethan demonstrated that adding copper oxide increased the heat transfer capabilities by up to 30 percent, even at temperatures as high as 100 degrees Celsius. Furthermore, Naethan observed thermal enhancements in the nanofluid that had never been seen before, which suggest the potential for increased efficiency at temperatures commonly used in solar thermal energy development (about 390 degrees Celsius). Naethan attends **duPont Manual High School**, where he is co-captain and founder of the rocket club. He also serves on the youth advisory board and volunteers as a mentor at the Louisville Science Center. The son of Siddharth and Bandana Mundkur, Naethan hopes to become an entrepreneur in the nanotechnology field.

Vincent Jacob O'Leary
Wheeling Central Catholic High School

West Virginia

Vincent Jacob O'Leary, 17, of **Wheeling,** analyzed the behavior of two species of invasive crayfish for his Intel Science Talent Search **animal sciences** project. Compelled by the increasing threat of the invasive species *Orconectes rusticus* and *Orconectes virilis*, Vincent conducted a series of observational studies between 2009 and 2012 both in the field and in his home laboratory. His observations of *O. rusticus* suggest that the species is not excessively aggressive toward native crayfish until it has secured shelter, contradicting conventional assumptions. He also tracked the daily movements of *O. virilis* using radio transmitters and found that they preferred stagnant stream beds with ample silt. Vincent's unexpected findings suggest that maintaining healthy streams to eliminate the silt substrate would be effective at deterring the invasive crayfish. His research lays the groundwork for a proactive approach towards combating invasive species, a threat that results in damages of $120 billion per year in the United States. The son of Craig and Emma O'Leary, Vincent is an Eagle Scout and works at the Oglebay Good Zoo. He attends **Wheeling Central Catholic High School** and captains the swim team, in addition to acting in school plays.

Akshay Padmanabha
Houston High School

Tennessee

Akshay Padmanabha, 16, of **Collierville,** submitted a **bioengineering** project to the Intel Science Talent Search. People suffering from seizure disorders resistant to drugs or surgery can be treated with a vagus nerve stimulator (VNS), which delivers a constant, low-voltage signal to the brain. While it is an effective therapy, the side effects of continuous stimulation by a VNS include sleep apnea and an increased risk of heart disease. Akshay analyzed epileptic EEGs to develop an algorithm for detecting oncoming seizures and simulated the algorithm's use in a VNS-triggering system. His algorithm could be used to activate the VNS at the time of seizure onset, possibly avoiding the side effects of constant stimulation. He believes it could become the basis for embedded VNS-control software. Akshay plays the electric and jazz bassoon, is principal bassoonist of the **Houston High School** band in Germantown and started a bassoon quartet. He plays Ultimate Frisbee, is founder and captain of the Math Bowl team and is a leader of Horizons, which promotes interaction between special needs and general education students. The son of Poombady and Asha Padmanabha, Akshay can speak, read and write Kannada, his first language.

Jiayi Peng
Horace Greeley High School

New York

Jiayi Peng, 17, of **Chappaqua,** developed a computer model to study how the brain's information processing is optimized for her Intel Science Talent Search **physics and space science** project. She investigated short-term plasticity (structural changeability) and how this plasticity changes over time (metaplasticity), contributing to attaining and maintaining optimal brain functions (criticality). She found that short-term plasticity allows the system to attain criticality while long-term metaplasticity helps the system recover from perturbations. Working together, these two time scales of plasticity help the brain self-organize to a critical state. She is first author of a paper published in *Physica A* on this research. Jiayi believes her work could help others find cures for neuropathologies such as epilepsy and autism. Jiayi is co-president of the Science Olympiad team, editor of the school paper *Tribune*, a member of various math teams, and she competes on the varsity track team at **Horace Greeley High School**. She founded and is president of Kits4Kids which raises money to help children, especially girls in rural China, continue their education. A national award-winning pianist, Jiayi is the daughter of Gongwen Peng and Hong Deng.

Lilia Popova
Ann Arbor Huron High School

Michigan

Lilia Popova, 17, of **Ann Arbor,** examined the effects of magnetic fields on plant cell growth at the molecular level for the **plant science** project she submitted to the Intel Science Talent Search. In an earlier study, she had determined that weak magnets alter the degree and orientation of plant growth, and now she delved deeper. She studied two related plant species (*R. sativus* and *A. thaliana*) to explore the underlying environmental and genetic factors that can be altered by static magnetic fields (SMFs). She discovered that weak SMFs can influence plant nutrient and water absorption, as well as changes in gene expression, and described in detail how they affect plant growth. She believes her findings could have applications in biotechnology, sustainable agriculture and biofuel production. Lilia is president of the Key Club at **Ann Arbor Huron High School** and has logged more than 150 volunteer hours. She played field hockey for three years and captained the junior varsity team. Active in the choral program for four years, Lilia sings with both the A Capella and Chamber Choirs. Fluent in Bulgarian, her mother tongue, she is the daughter of Chavdar Popov and Antonia Popova.

Samantha Marie Scibelli
Burnt Hills-Ballston Lake High School

New York

Samantha Marie Scibelli, 17, of **Burnt Hills,** conducted a census of blue stars identified in the Sloan Digital Sky Survey (SDSS) to determine whether they were properly classified for her Intel Science Talent Search project in **physics and space science**. The astronomical survey, which has mapped over one-quarter of the sky, classifies more than 12,000 objects as blue stars based on their light spectra. Samantha examined the spectral data and identified 1,203 objects that she believed to be misclassified. Further investigation identified 626 of the objects as new. Samantha proposed 11 new categories for classifying these new stars, and hopes to submit her findings for inclusion in future releases of the SDSS. She has presented her research at two state conferences in addition to the 2013 American Astronomical Society conference. Samantha attends **Burnt Hills-Ballston Lake High School** where she serves as treasurer of the National Honor Society and math club, and also competes on the varsity field hockey team. She is a volunteer tutor for elementary school students and for high school Earth Science and Geometry students, and is the communications director for the school's Leadership Training Program. Her parents are Anthony and Julie Scibelli.

Raja Selvakumar
Milton High School

Georgia

Raja Selvakumar, 17, of **Alpharetta,** developed a fuel cell that uses gastric microbes in stomach acid to produce electricity for his Intel Science Talent Search **biochemistry** project. He created his Gastro Microbial Fuel Cell (GMFC) as a power source for self-assembling remotely operated surgical nanobots that may someday be swallowed by patients to treat digestive diseases. Nanobot implementation has been impeded by the limitations of current battery technology. In a two-year effort, Raja created a GMFC that captures electricity from digestive bacteria he obtained from yogurt. He has managed to shrink his device — which he plans to patent — to the size of a gummy bear, while demonstrating its continuous operation for more than two months in the acidic conditions of the stomach. A black belt martial artist, Raja is co-president of the robotics club and founder and president of the chess club at **Milton High School**. He is currently working on his Eagle Scout service project. His work with youth includes math workshops, judging math contests, mock spelling bees and science bee preparation. The son of Selvakumar Shanmuganathan and Devi Selvakumar, Raja is fluent in Tamil and Spanish. He hopes to be an international entrepreneur.

Naomi Chetan Shah
Sunset High School

Oregon

Naomi Chetan Shah, 17, of **Portland,** focused on the impact of indoor air quality on the lung health of asthmatic patients for her Intel Science Talent Search **environmental science** project. Prompted by respiratory disorders in her own family, she spent two years on a project that included collecting more than four million indoor air quality and lung function measurements of healthy and asthmatic volunteers at home and at work. She also developed a mathematical model and interactive software application to quantify the impact of harmful pollutants. To mitigate their effects, she invented a novel, cost-effective biofilter prototype that can metabolically break down volatile organic compounds before they enter the indoor air supply and hopes to patent the software model and her biofilter. Naomi has been recognized by *Popular Science* as one of the top ten high school inventors of 2012. She has already presented this work at numerous conferences; other honors include a Best of Category award in the Intel ISEF. Naomi lettered in swimming at **Sunset High School**, and is fluent in Spanish and Gujurati (her mother tongue). She enjoys playing piano, singing and filmmaking. She is the daughter of Chetan and Sonal Shah.

Meghan Marjorie Shea
Unionville High School

Pennsylvania

Meghan Marjorie Shea, 18, of **West Chester,** developed a water filtration method using crushed seeds of the *Moringa oleifera* plant for her **environmental science** Intel Science Talent Search project. Previous researchers had developed relatively complicated ways to use these seeds to purify water; Meghan found that a filter containing powdered, non-shelled seeds was more cost effective, reducing *E. coli* bacteria in the water by as much as 99 percent. More research is required to improve and further test the filter's effectiveness and to establish how often they should be changed, but Meghan hopes that the Moringa tree, which is widely grown in tropical and subtropical areas for food, will become a source of both income and clean household water in impoverished areas. Meghan attends **Unionville High School** in Kennett Square, where she is co-editor-in-chief of the student-run newspaper and captain of the school's drumline. Meghan also helps run after-school programs for local elementary school children, introducing them to science concepts and helping them with their homework. Meghan is the daughter of Peter and Kathleen Shea and hopes to pursue a career "bettering the lives of others" in environmental science or biology.

Kensen Shi
A&M Consolidated High School

Texas

Kensen Shi, 17, of **College Station,** submitted to the Intel Science Talent Search a **computer science** project designed to identify collision-free paths for robots trying to maneuver safely among obstacles. A widely used method to solve such motion planning problems is the Probabilistic Roadmap Method (PRM). However, PRMs can be inefficient in certain real-world environments, a problem addressed by Kensen's novel extension to the PRM algorithm he dubbed the Lazy Toggle PRM. Kensen then analyzed the efficiency of this PRM and concluded that it is more efficient than other methods — performing best in the most difficult and complex scenarios, where it generated solutions two to four times faster than the most promising of the other methods. Motion planning problems have numerous applications in robotics, animation and video game design. Kensen attends **A&M Consolidated High School**, where he is president of the math club, captain of the Science Bowl team, a member of the Aggie Swim Club and school recycling director. The son of Wenjie Shi and Zhe Wang, Kensen attended piano camp last summer and has placed in many musical competitions. In his spare time, he enjoys solving Rubik's cubes.

Jamie Lee Solimano
Stuyvesant High School

New York

Jamie Lee Solimano, 17, of **New York,** used advanced microscopy techniques to study the distribution of proteins that send intracellular signals for her **microbiology** Intel Science Talent Search project. Most cells of vertebrate mammals have a primary cilium: a hair-like microtubule organelle that projects from the cell surface and contains structural and signaling proteins. If the function of these proteins is impaired, organisms are at risk for birth defects and an array of devastating diseases. Jamie treated her cell lines with lithium and then studied the arrangement and movement of primary cilia proteins using a high-resolution laser microscope. She captured, for the first time, images that clearly show an important signaling molecule (ACIII) lining the structure. She also observed that the arrangement of molecules attaching the primary cilia to the cell changed drastically when exposed to lithium. Her results may expand basic knowledge of how cells function and could aid understanding of the mechanisms of human disease. Jamie has performed at Open Mic events at **Stuyvesant High School**, where she also participates in a weekly writing workshop and contributes regularly to the literary magazine. Her mother is Eun Lee.

Mayuri Sridhar
Kings Park High School

New York

Mayuri Sridhar, 17, of **Kings Park,** submitted a **biochemistry** project to the Intel Science Talent Search with a computer model exploring the mechanism by which mutations of protein p53 lead to a loss of its cancer suppressing function. Her work indicates that the mutation of a single amino acid causes p53 to fold into a different stable conformation that is not conducive to DNA binding. She also proposed a three-dimensional structure for the mutant version of p53. Her research may lead to better methods for diagnosing cancer through computational simulation. The daughter of Sridhar Vijayaraghavan and Gayathri Sridhar, Mayuri is a senior at **Kings Park High School** where she is captain of the math team, active in the French and National Honor Societies, and is a multiple award winner. Mayuri spent two summers taking classes in the art of problem solving and has played the flute for the past six years. She can speak both Tamil and French fluently, and she placed in the top ten in the National French Exam. She believes that "computer modeling is the future of drug discovery" and hopes to study math, computer science and biochemistry in college.

Jack Ryan Takahashi
Lynbrook High School

California

Jack Ryan Takahashi, 17, of **Saratoga,** identified a previously unknown signaling relationship that may be the cause of pulmonary hypertension for his **medicine and health** Intel Science Talent Search submission. Pulmonary hypertension is characterized by abnormal growth of cells in the blood vessels of the lungs. Previous studies had indicated that impairment of the body's natural response to cellular growth factors contributed to the anomalous cell changes, so Jack explored the role of the signaling molecules that regulated this process. Jack showed that one such molecule, beta-catenin, was present at abnormally high levels in the dysfunctional cells, and that it plays a major role in the aberrant regulatory pathway. He believes that additional studies of beta-catenin and its interaction with other cellular growth signals could lead to development of new drug therapies for this very serious disease. Jack is a skilled musician (he plays the alto sax, flute and piano) and a composer, who has written a flute concerto for a full symphony orchestra. He is also an award-winning photographer and president of the photography club at **Lynbrook High School** in San Jose. His parents are John and Barbara Takahashi.

Chris Traver

Croton-Harmon High School

New York

Chris Traver, 18, of **Croton-on-Hudson,** tracked noise levels in his community with the help of citizen science volunteers for his **behavioral and social science** submission to the Intel Science Talent Search. Chris's early fascination with smartphones inspired him to investigate how cellular devices could be used to collect noise data. His volunteers collected noise samples from their surroundings using an app called WideNoise. By overlaying the study results on the local geography, Chris created visualizations that he hopes will enable policymakers to better manage community noise levels. Chris believes his results also show how qualitative perceptions are an important aspect of noise pollution. For example, he noticed that a softer but unpleasant sound is more likely to cause distress than a louder, more tolerable sound. He notes that after participating in the study, many volunteers became more aware of noise pollution. Son of Todd and Carol Traver, Chris attends **Croton-Harmon High School** where he is president of the stage crew. He is founder and manager of a digital media business, has been co-captain of his travel club soccer team, and volunteers with Guiding Eyes for the Blind and the Westchester Coalition for the Hungry and Homeless.

Raghav Tripathi

Westview High School

Oregon

Raghav Tripathi, 17, of **Portland,** sought drug targets that could yield new pain relievers for the **biochemistry** project he entered in the Intel Science Talent Search. He focused on a fatty acid naturally produced in the body, known as anandamide (AEA), which, at elevated levels, has pain-killing effects similar to cannabinoids, but without many of their side effects. AEA is transported to degradation, however, by fatty acid binding proteins (FABPs), a process Raghav worked to inhibit. Using computational analysis, he virtually screened over a million molecules for binding affinity to FABP, identified the one with the greatest affinity, and from that synthesized an optimized compound with even more FABP inhibition. He believes his work may contribute to the next generation of innovative analgesic medications. At **Westview High School**, Raghav plays varsity tennis, captains the speech and debate team and plays clarinet (first chair) in the concert band. He also plays with the Portland Youth Philharmonic, and is an Eagle Scout with a black belt in Tae-Kwon-Do. He is a Best of Category Intel International Science and Engineering Fair award winner and his research has been published in several peer-reviewed journals. Raghav is the son of Sharad and Sunita Tripathi.

Sahana Vasudevan
Gnyanam Academy Homeschool

California

Sahana Vasudevan, 16, of **Palo Alto,** entered an Intel Science Talent Search project in **mathematics** that proves a new, generalized way to minimize carries. Carries are important in arithmetic; for example 7 + 6 = 3 with a carry of 1. In computing, the carry is usually handled by a "carry bit," so reducing carries decreases computational load. With the usual choice of digits, one is forced to carry about half the time, but previous work had shown that in odd prime bases, digits could be chosen so that the probability of a carry is reduced to 25 percent and that no further reduction is possible. Sahana generalized this result to mathematical structures called "groups" and proved that, in this general case, the set of digits must satisfy a certain necessary condition for the probability of a carry to be less than 25 percent. Sahana is fluent in Tamil, her first language, and is an award-winning Carnatic (South Indian Classical) vocalist and violinist, having honed her singing talents since she was four and played violin since age seven. Last summer, she performed on a Carnatic music concert tour in India. Sahana is a student at **Gnyanam Academy** (Homeschool) and is the daughter of Jayaraman Vasudevan and Vanaja Narayanaswamy.

Sara Volz
Cheyenne Mountain High School

Colorado

Sara Volz, 17, of **Colorado Springs,** investigated artificial selection for its potential to increase algae oil yields, which is essential for algae to become an economically feasible source of biofuel for her Intel Science Talent Search **plant science** project. In her home lab under her loft bed, Sara grew algae in a medium containing the herbicide sethoxydim to kill algae cells with low levels of acetyl-CoA carboxylase (ACCase), an enzyme crucial to lipid synthesis. Her analysis of the remaining artificially selected algae cells revealed significant increases in lipid accumulation, and she believes that if these algae cells can be sustained, artificial selection could be used to increase microalgae oil yields and make algae biofuel viable. Since her first science fair project as a kindergartener, Sara has earned numerous honors in science competitions at home and abroad. She attends **Cheyenne Mountain High School** where she is field captain of the Science Olympiad team, captain of the Science Bowl team and debate captain of the speech and debate team. A performer since the age of 6, Sara loves musical theater and improvisation and has sung and acted in many plays. The daughter of David and Pattye Volz, her long-term goal is to understand the universe.

Joy Yiran Wang
Parkland High School

Pennsylvania

Joy Yiran Wang, 17, of **Orefield,** experimented with polyoxometalates (POMs) for her Intel Science Talent Search **chemistry** project. POMs are unusual compounds that can function as both surfactants (fluids that help substances mix together) and catalysts. Joy investigated whether this would make POMs effective in crude oil refinement, where breaking down organic sulfur compounds is challenging. Adding a POM allows hydrogen peroxide to mix with and attack the sulfur compound; Joy found that she could enhance the POM's effectiveness by raising the pH because that increased the surface area of the globules. She also unexpectedly found that at a pH below 5 the nature of the globules changed, which caused the organic sulfur to continue to break down rapidly, regardless of subsequent pH changes. Joy is second author of a paper on this work, which has already been published in *Chemistry – A European Journal*. Joy heads the science fair club and co-captains the debate team at **Parkland High School** in Allentown, where she also plays varsity tennis. She is a member of the Student Senate, a violinist and chemistry tutor. Joy is the daughter of Xiaoyi He and Yadong Wang and is fluent in conversational Chinese.

Brittany Wenger
Out-of-Door Academy

Florida

Brittany Wenger, 18, of **Sarasota,** created a neural network to aid in the diagnosis of breast cancer using data from biopsy samples for her Intel Science Talent Search **computer science** project.
Fine needle aspirates (FNAs) are the least invasive form of biopsy but they can also be inconclusive. Brittany designed and implemented her own artificial neural network to analyze these samples. She trained her system using images of 681 FNA biopsies from masses classified as either malignant or benign. By weighting her training algorithm to identify false-negative results (as identified by experts), she achieved 99.1 percent sensitivity to malignancy, which is a significant improvement over existing commercial analysis software. Brittany used her algorithms, which she hopes to patent, to develop a web-based system that permits rapid analysis of FNAs. Brittany attends **Out-of-Door Academy** where she founded a science fair club and is a member of the Future Problem Solving team. She is on the varsity track team and plays both varsity and club soccer. The daughter of Jeff and Cami Wenger, Brittany hopes to combine her dual passions for research and medicine by becoming a pediatric oncologist.

Catherine Wong
Morristown High School

New Jersey

Catherine Wong, 17, of **Morristown,** submitted an Intel Science Talent Search project in **bioengineering** that presented two novel prototypes for wireless, mobile phone-based telemedicine devices. Inspired by the museum exhibition *Design for the Other 90%,* Catherine taught herself how to work with microprocessors and develop phone software in order to build a Bluetooth-enabled stethoscope prototype. The device produced acoustic performance comparable to traditional stethoscopes and wirelessly transmitted heart and lung sounds to a mobile phone. She then developed an EKG prototype that produces digitized electrocardiograph results for transmission to mobile devices. She currently has two patents pending for her prototypes, each of which costs less than $250 to produce, and she has published the first phase of her research in a peer-reviewed journal. Catherine attends **Morristown High School** and is the daughter of James and Margaret Wong. She co-founded Kids Teach Kids, a local tutoring program, and is the owner and manager of Better Than Wikinotes, an online academic notes database. She hopes to develop an entire suite of wireless telemedicine devices for use in developing countries.

Samuel Zbarsky
Montgomery Blair High School

Maryland

Samuel Zbarsky, 17, of **Rockville,** submitted a **mathematics** project to the Intel Science Talent Search that has implications for the study of geometry and has potential applications in the construction of efficient computer networks. Sam addressed the following conjecture: Suppose we want to connect points in Euclidean high-dimensional space so that each point is connected to no more than three other points. The claim is that the ratio of the total path length to the sum of distances from the starting point is at most 1.5. A 1994 proof had shown that this ratio could be no more than 1.666, and another mathematician had subsequently reduced this to 1.63. Sam's results improved on this even further, proving that it was between 1.447 and 1.561. At **Montgomery Blair High School** in Silver Spring, Sam is captain of the math team and participates in computer club, science bowl and the It's Academic team. He is fluent in Russian and has won honors at numerous competitions including the International Linguistics Olympiad, USA Math Olympiad, USA Physics Olympiad and the Harvard-MIT math tournament. Sam is the son of Alexander and Margaret Zbarsky, and he credits his father as being the most influential person in the development of his scientific career.

Kelly Zhang
The College Preparatory School

California

Kelly Zhang, 17, of **Orinda,** submitted a **bioengineering** project to the Intel Science Talent Search in which she developed a method for selectively staining cancer cells with fluorescent dyes to help surgeons visualize tumor margins. Kelly adapted nanotechnology concepts used in drug delivery techniques to develop a nano-scale imaging agent, taken up by cells, that is derived from a combination of albumin, a water-soluble protein, and fluorescent dye. She incubated a variety of cell lines with her stain, observing that tumor cells were more luminous than healthy cells. Kelly believes her study will contribute to the improvement of cancer imaging techniques for surgeons resecting tumors. At **The College Preparatory School** in Oakland, she is editor-in-chief of the yearbook and student council treasurer. She competes in debate, varsity cross country and varsity swimming. She is a pianist, violinist and self-taught guitarist, a youth group leader and a volunteer at rescue missions. Kelly has created a biotech video website to bring lab experiences to high school students who haven't yet had that exposure. She reads, writes and speaks Mandarin Chinese and is the daughter of Dongxiao Zhang and Yang Sun.

Michael Zhang
Smithtown High School East

New York

Michael Zhang, 18, of **Saint James,** investigated how visual behavior reflects the self-perception of human subjects playing one of four distinctive roles — thief, security guard, cleaning person or tourist — for his Intel Science Talent Search project in **behavioral and social science**. After roles were assigned, his participants viewed sequences of randomly selected scenes from hotel rooms, beaches, airport terminals and checkout counters while their eye movements were recorded in real time by an eye-tracking system. Through statistical analysis, Michael observed that his subjects demonstrated different visual behaviors, depending on their roles, particularly the security guard and the thief. He believes that there is substantial information contained in eye movements, which could have implications for airport security and marketing techniques. At **Smithtown High School East**, Michael participates in the Quiz Bowl, Science Olympiads and varsity swimming. He is president of the math team, a peer tutor and violinist in the school orchestra. He also played first violin with the New York All-State String Orchestra. The son of Yueli Zhang and Yanzhen Liu, Michael speaks fluent Chinese and teaches Chinese Chess.

Intel Science Talent Search 2013

Finalists and Research Project Titles

Intel Science Talent Search 2013

Finalists by State

Intel Science Talent Search 2013

Finalists by Last Name

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