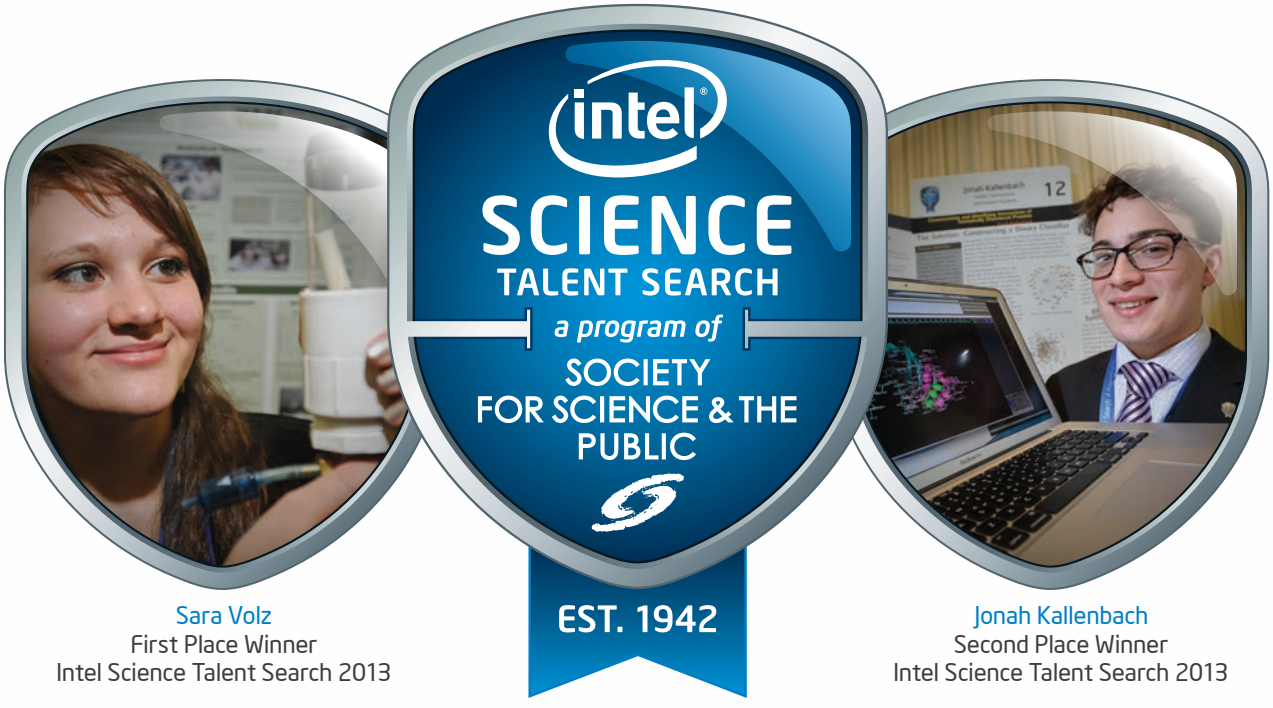
IT'S MIND ON MATTER

INTEL SCIENCE TALENT SEARCH 2014 FINALISTS



Sara Volz
First Place Winner
Intel Science Talent Search 2013

Jonah Kallenbach
Second Place Winner
Intel Science Talent Search 2013

2014 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 2014

March 6–12, 2014

The 40 finalists of the Intel Science Talent Search 2014, 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 15 young women and 25 young men come from 33 schools in 14 states. Finalists were selected from among 1,794 entrants representing 489 high schools in 45 states, the District of Columbia, and seven 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 2014 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 2014 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 11, 2014.

Each of the 300 students named a semifinalist in the Intel STS 2014 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 2014. 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 11, 2014, the date of the Intel Science Talent Search Awards Gala.

Alec Vadim Arshavsky
East Chapel Hill High School

North Carolina

Alec Vadim Arshavsky, 17, of **Chapel Hill**, developed an algorithm to automatically identify the precise three-dimensional structure of corneal transplant tissue for his Intel Science Talent Search **bioengineering** project. To ensure optimal vision when replacing diseased corneal tissue, a surgeon must know the precise 3D structure of the donor tissue. Currently, this analysis is performed manually using Spectral Domain Optical Coherence Tomography (SDOCT) and takes an expert approximately 1.5 hours. Alec's use of a novel iterative variation of graph theory and dynamic programming framework enabled him to develop an algorithm to characterize automatically low-quality corneal grafts with very high accuracy, saving both time and money. His algorithm is already being used in clinical research and Alec has presented his work at a premier ophthalmology conference. Fluent in Russian, Alec co-founded the Russian Club and the computer club at **East Chapel Hill High School**. He expresses himself artistically through the theatre as a designer, stage manager and actor. The son of Vadim and Nina Arshavsky, he has perfect SAT scores and hopes to explore nanotechnology's potential to maintain human health.

Kathy Camenzind
California High School

California

Kathy Camenzind, 17, of **San Ramon**, researched and built inexpensive optical tweezers using a low power laser and a generic microscope for her Intel Science Talent Search **physics** project. Optical tweezers use the momentum of laser light to trap microscopic particles in all three dimensions and hold them. The tweezers are particularly useful in biological applications such as cell manipulation, a key component in noninvasive manipulation. In commercial markets they can cost more than $20,000, but Kathy built her functional optical tweezers using equipment and materials she found in an undergraduate lab. She also designed an accelerating motorized microscope stage and a video analysis system that effectively measured the trap strength and efficiency. At **California High School**, Kathy is track captain, a four-year varsity runner, an officer of the Science Bowl team and first alto sax in the Jazz Ensemble. The daughter of Mark Camenzind and Dorothy Hassler, she earned perfect SAT scores and is an accomplished writer. For two summers, Kathy spent three weeks backpacking in the Sierras where she enjoyed unparalleled views of the Milky Way. She believes that, "we can advance technology and still preserve the beauty of nature."

Eric S. Chen
Canyon Crest Academy

California

Eric S. Chen, 17, of **San Diego**, identified new drug candidates for the treatment of influenza for his Intel Science Talent Search **microbiology** project. His novel interdisciplinary approach combined computer modeling with structure-activity relationships (SAR) and biological validation to identify new, potent and structurally diverse endonuclease inhibitors. Endonuclease is essential for viral propagation, and inhibiting this enzyme would prevent the influenza virus from replicating. Eric's research may lead to a new class of anti-flu medicines that could protect against a flu pandemic while new vaccines are being developed. He says his use of supercomputers allowed him to work faster and more efficiently than conventional methods. Eric attends **Canyon Crest Academy** where he is founder and president of Club Intrigue, which promotes youth education in the sciences. Eric is also an epee fencer and co-president of the school fencing club. Fluent in Mandarin, he founded Senior Space to teach basic computer skills to elderly Chinese. The son of Longchuan Chen and Xiaohua Wu, he sees himself "going down one of two paths" — becoming a college professor or an entrepreneur developing innovative technologies.

Steven Chen
Westwood High School

Texas

Steven Chen, 17, of **Austin**, developed a model for studying the behavior of supercooled fluids, which remain liquid despite being cooled below their freezing points, as his **chemistry** project for the Intel Science Talent Search. When liquid is cooled quickly enough, it does not convert into a solid, but exists instead in an amorphous state as a metastable glass. Steven developed a mathematical description of the surface tension of idealized, spherical micro-droplets as they approach the freezing point and derived an equation that could be used to generalize such results to a broader class of droplets, including those with rough surfaces. The results of this study have many potential applications to aerosol behavior, atmospheric science and tissue preservation. At **Westwood High School**, Steven is President of the math circle, a member of the Mathcounts team that placed first in the 2009 national competition, and teaches math at an Austin Chinese education program. Steven holds the rank of Expert from the U.S. Chess Foundation and has twice been named a junior chess champion in his age group. He is a violinist and four year member of the Texas All-State Symphony Orchestra. Steven is the son of Zheng Chen and Chun Wang.

John Anthony Clarke
Regis High School

New York

John Anthony Clarke, 17, of **Syosset**, submitted an **earth and planetary science** project concerning X-ray emissions from Jupiter's magnetosphere to the Intel Science Talent Search. Jupiter, a gas giant, harnesses a magnetic field that has been called the solar system's largest natural particle accelerator. Utilizing a computer simulation, he demonstrated that NASA's NuSTAR (Nuclear Spectroscopic Telescope Array) in space should be capable of observing the complete X-ray spectrum generated by Jupiter's auroras. Since the electromagnetic spectrum of the planet's auroras has been measured only from the radio band to low-energy X-rays, this more comprehensive observation may provide significant insight into the nature of the planet's magnetosphere. John's interest in nature and astronomy has fueled his primary hobby – mountain biking to locations where clear night skies allow excellent views of the universe. At **Regis High School** in New York, John is a yearbook captions editor and an extemporaneous speaker for the speech and debate team. As co-president of the astronomy club, he conducts weekly celestial observations despite the "pesky light pollution rampant in New York City." He is the son of John and Josephine Clarke.

Aron Coraor
Huntington High School

New York

Aron Coraor, 17, of **Huntington**, investigated the effect of pressure and temperature on the formation of a mineral commonly found on the surface of the Moon for his Intel Science Talent Search **chemistry** project. Aron melted specific chemical compositions at high temperatures, slowly cooled them and then analyzed them using a specialized microscope. After he compared his results with those from earlier high-pressure experiments, it became clear that they could possibly explain why the mineral plagioclase exists in two different forms in the lunar highlands. His model suggests that one variety of the mineral formed under significant pressure deep within the lunar magma ocean and subsequently floated to the surface before the Moon solidified, while the other variety formed at shallower depths within the magma. This explanation is much less complex than the currently accepted model and is compatible with recent evaluations regarding the age of lunar rock samples. Aron is the son of John Coraor and Hanna Nekvasil, is a Science Bowl competitor at **Huntington High School**, and enjoys studying history in his spare time. He is also an enthusiast of whitewater kayaking and has won several first place awards in slalom races.

Soham Daga
Stuyvesant High School

New York

Soham Daga, 17, of **Forest Hills**, used data from Google Trends to enhance predictive models of mortgage delinquency for his Intel Science Talent Search **behavioral and social sciences** project. Motivated by the hardships caused by the foreclosures of a neighbor and a friend, Soham sought to improve existing models that use past mortgage delinquency and macroeconomic variables, such as the Consumer Confidence Index, to predict the likelihood of delinquency. Soham's models combined data from current predictive methods with data from Google Trends, which tracks the frequency of specific search terms over time, in order to provide insight into consumer behavior. His results indicated that adding Google Trends data improves predictability over current models, in that they may be used to more accurately identify emerging delinquency risks 6–18 months before an economic crisis. The son of Manoj and Pragya Daga, Soham attends **Stuyvesant High School** in New York City, where his extracurricular achievements included being the president of the digital photography club and captain of the policy debate team. Recipient of the Global Youth Leader and Congressional Gold Medal for Youth awards, Soham has volunteered in rural India and the United States serving underprivileged communities.

Shaun Datta
Montgomery Blair High School

Maryland

Shaun Datta, 18, of **North Potomac**, used the mathematical framework of quantum chromodynamics (QCD) to improve understanding of nuclear interactions in his Intel Science Talent Search **physics** project. QCD is a theory that attempts to describe the nature of the "strong nuclear force," which is one of the four fundamental forces of physics. Shaun's research focused on saturated nuclear matter, a system in which attractive and repulsive forces balance and nucleons (protons and neutrons) touch, within the framework of QCD models. Shaun used computer models and rigorous QCD equations to simulate nuclear interactions. His research may contribute to a more accurate characterization of fundamental atomic particles and subsequently a better understanding of neutron stars. He plans to submit his research for publication. Shaun is a student at **Montgomery Blair High School** in Silver Spring where he is captain of the school's award-winning debate team and sings on Magnet Arts Nights and lunchtime open mics. Shaun is an avid user of online learning. The son of Subhasis and Soma Datta, he hopes to become a particle physicist and to someday work at CERN in Switzerland or an institute for advanced study.

Neil Davey
Montgomery Blair High School

Maryland

Neil Davey, 18, of **Gaithersburg**, created a blood-testing device that may be used to identify cancers for his Intel Science Talent Search project in **bioengineering.** Circulating tumor cells (CTCs) are malignant cells that seed metastatic disease through the circulatory system. Many cancers produce CTCs, but detecting a single mutant cell in a blood sample is a technical challenge. Neil's solution is to use a microfluidic device employing probes that he designed to label and then isolate cancerous cells. This approach to cancer detection could be applied to any cancer with a known gene mutation. Neil hopes to develop this project into a universal platform for rapid cancer screening. He has enjoyed previous bioengineering success, working on teams that produced vaccine candidates as well as automation projects for the pharmaceutical industry. Outside the lab, he has enjoyed playing the Tabla (Indian drums) since the age of six and plays varsity tennis at **Montgomery Blair High School** in Silver Spring. He is involved with multiple patent applications that relate to his many ventures including Ultrasafe Ultrasound and The Swap Hub LLC, both of which he co-founded. Neil's parents are Raju and Aparna Dave.

Benjamin Freed
Governor Thomas Johnson High School

Maryland

Benjamin Freed, 17, of **Frederick**, studied a key enzyme involved in the development of cancer for his Intel Science Talent Search project in **biochemistry**. Ben's love of chemistry and engineering inspired him to investigate the Ras family of proteins, which are responsible for controlling intracellular signals that promote and arrest cell growth. Improperly functioning Ras proteins are implicated in a variety of cancers, but detailed understanding of their function has eluded even experienced biologists. Ben synthesized variations of the Ras hypervariable region (HVR), a portion of the protein's peptide chain that varies among Ras family members, and showed that a particular HVR variant is bound to the functional region of inactivated Ras proteins. His studies also revealed the importance of dimerization, joining of two identical proteins, for Ras to function properly. Ben's work should provide insight into the functioning of Ras mediated cancers. First in his class of 321 at **Governor Thomas Johnson High School**, Ben is a varsity runner and swimmer. The son of Eric Freed and Janelle Cortner, he also is an elite triathlete who hopes to represent the USA at the 2014 Junior Pan American Triathlon championship.

Anubhav Guha
Horace Greeley High School

New York

Anubhav Guha, 17, of **Chappaqua**, submitted an Intel Science Talent Search **materials science project** investigating ways to improve fluorescence microscopy, an important tool for biological and medical research because it allows the study of cellular mechanisms and dynamics. Anubhav's work addressed a drawback of the technique – that the fluorescent dyes applied to cells are destroyed over time as they absorb light, a process called photobleaching. He designed and built a specialized internal reflection microscope that's capable of imaging the fluorescence of single molecules; then he showed that the addition of small quantities of rare earth oxide nanoparticles stops photobleaching by factors of three to five. The son of Supratik Guha and Monisha Ghosh, Anubhav attends **Horace Greeley High School** and enjoys participating in Math League and Mandelbrot competitions. An avid musician who has studied classical piano since age five, he has twice performed at Carnegie Hall and has toured with his jazz ensemble on the road to entertain audiences in more than 50 venues since 2010. Beginning in sixth grade, Anubhav has spent one Sunday every month volunteering in a local soup kitchen.

Yushi Homma
Carmel High School

Indiana

Yushi Homma, 18, of **Carmel,** studied the asymptotic behavior of correlation functions between real zeros of systems of random real polynomials as his **mathematics** project for the Intel Science Talent Search. Basing his studies on earlier work on the one-dimensional case, he found the asymptotic behavior for two points x and y, provided these two points lie on a coordinate axis, and he conjectures that this behavior holds in general. This research lies at the interface between probability theory and theoretical physics. Potential applications of this methodology are in computational physics where random objects are used to develop models of various phenomena. He is an author of a research paper published in *Discrete Mathematics and Theoretical Computer Science* (2012). At C**armel High School**, Yushi is principal horn player in both the symphony orchestra and wind symphony. He has won gold medals in three Indiana State Music Solo and Ensemble Competitions and also plays on the school chess team that won the Indiana State Championship in 2013. Yushi is the son of Michiharu and Emiko Homma, speaks Japanese fluently and hopes to pursue his passion for playing tournament golf.

Joyce Blossom Kang
Brentwood High School

Tennessee

Joyce Blossom Kang, 17, of **Brentwood**, created a prototype of a flexible, fast-charging, high-performance and low-cost supercapacitor for energy storage as her **engineering** project for the Intel Science Talent Search. Joyce chose conductive carbon fiber cloth as a substrate and created 3D electrodes on both surfaces by growing vertically aligned carbon nanotubes on the fabric, then electrodepositing manganese dioxide nanoparticles on the surface of the nanotubes. She created a capacitor by placing the carbon fiber electrodes, separated by an insulator, in a package with an organic electrolyte. Tests of her prototype capacitor demonstrated its ability to accommodate high energy density and its potential to scale for a variety of applications ranging from storing renewable energy to powering electric vehicles. First in her class at **Brentwood High School**, Joyce has perfect ACT scores. She also plays varsity tennis, is founder and captain of the school's Science Olympiad team and served in 2012-13 as national student vice president of the Mu Alpha Theta Math Honor Society. The daughter of Weng Kang and Cen Li, Joyce is an accomplished pianist who hopes to become a college professor and teach aspiring engineers and scientists.

Angela Xiangyue Kong
Lynbrook High School

California

Angela Xiangyue Kong, 17, of **San Jose**, studied the role that a specific protein, Bcl11b, plays in controlling the development of mammary stem cells as her Intel Science Talent Search **biochemistry** project. Angela became interested in this disease when she learned that the mother of a close friend was being treated for breast cancer. Through her research, Angela was able to demonstrate that the protein, which plays an important role in the self-renewal of stem cells, repressed the proliferation of abnormal cells in normal mammary tissue. She determined that the Bcl11b protein does this by regulating the activity of the p21 protein, which is known to inhibit progression of the cell growth cycle. Her findings on the interaction of these two proteins provide insight into how normal cells transform into cancer cells and compromise the integrity of tissue boundaries, thus allowing cancer to spread. At **Lynbrook High School**, Angela is the co-president of Future Business Leaders of America and president of the multi-cultural dance club. She has also raised funds for an orphanage in Nepal and serves as the vice-chair of the San Jose Youth Advisory Council. Angela is the daughter of Charles Quan Kong and Nancy Xiaoyu Yang.

William Henry Kuszmaul
Lexington High School

Massachusetts

William Henry Kuszmaul, 17, of **Lexington**, developed a new approach to modular enumeration, i.e., finding the remainder of a polynomial f upon division by $x^n - 1$, as the **mathematics** project he submitted to the Intel Science Talent Search. Bill's approach uses cyclotomic polynomials, which are the irreducible factors of $x^n - 1$. In the process, he finds a new invariant associated to the n-th cyclotomic polynomial. Modular enumeration is applicable to a wide number of problems in computer science, bioinformatics and computational biology. Over the past three years, Bill has authored or co-authored four papers about his mathematical findings, including two that were published in peer-reviewed journals, and two for which he was the sole author. At **Lexington High School**, Bill is the only student studying ancient Greek. He has been practicing the martial art of Aikido for 13 years (he currently holds the rank of fifth kyu) and has been creating origami for almost as long. He also enjoys playing Frisbee in his spare time. Bill, the son of Dana Henry-Kuszmaul and Bradley Kuszmaul, says his favorite field of math is combinatorics and goes on to explain, "I love how math and computer programming are intertwined in my research."

Kevin Lee
University High School

California

Kevin Lee, 17, of **Irvine**, developed a computational model for heart arrhythmia as his **bioengineering** project for the Intel Science Talent Search. His model differs significantly from previous models in that the beating motion of the heart was incorporated into the calculations. Using the principles of fluid mechanics, he derived a series of equations that describe the shape of the heart as it beats. Kevin's model is computationally efficient and runs several orders of magnitude faster than prior models. His research may provide insight into the mechanisms responsible for arrhythmia, which could lead, in turn, to more efficient treatments for the disease. Kevin was inspired to pursue this research after experiencing his own arrhythmia during Taekwondo practice. He is a pianist in the jazz band at **University High School** where he founded the school's mathematics honor society chapter and competes on the Science Bowl team. Kevin, who earned perfect SAT scores, tutors students at the local elementary school and has organized math competitions for students across Orange County. The son of Tammie and Tae-Hwy Lee, Kevin plans to pursue studies in physics and bioengineering.

Charles Xin Liu
Henry M. Gunn High School

California

Charles Xin Liu, 17, of **Palo Alto**, submitted an Intel Science Talent Search **bioinformatics and genomics** project for which he built and analyzed a huge gene expression database seeking a new relationship between two autoimmune diseases, systemic sclerosis and systemic lupus erythematosus. The meta-analysis that Charles carried out using his database showed unexpected similarities in gene expression between these two debilitating diseases. His work raises the prospect that drugs prescribed for systemic sclerosis might now be used to treat lupus. This project led directly to follow-up research at the University of Texas and may result in new therapeutic applications for two FDA-approved drugs. In addition, Stanford researchers are now using his database for three new disease research studies. Charles is senior editor of the **Henry M. Gunn High School** student magazine, a member of the speech and debate club, president of the 30-member math team and a teacher for the middle school math club. An accomplished pianist, he loves to perform Romantic Era pieces as well as music from popular artists. The son of Yajun Liu and Shirley Hong Zeng, Charles earned perfect SAT scores and hopes to create a company to address real world needs.

Esha Maiti
California High School

California

Esha Maiti, 17, of **San Ramon**, developed a mathematical simulator that predicts the spread of cancer cells as her **mathematics** project for the Intel Science Talent Search. Esha was motivated to research metastatic cancer following her grandmother's death from misdiagnosis of breast cancer. She created a Monte Carlo-based algorithm that uses reverse engineering to predict the size and distribution of secondary tumors from data derived from the primary tumor's size, location, and growth rate. A unique feature of this method is that the rate of metastatic spread from the primary tumor into lymph nodes and vital organs as well as information about tumor vasculature can be incorporated as independent variables in the simulation to predict the distribution of the secondary tumors throughout the body. She hopes that this will allow patients with metastatic cancer to be treated more effectively. Her two years of independent work was published as a single author paper in 2012 in *Physical Review E*. She has subsequently worked to refine the simulation with real world clinical data. A student at **California High School**, Esha enjoys reading and watching football, as well as playing and teaching piano. Esha is the daughter of Amitesh and Baishali Maiti and intends to study applied and computational mathematics in college.

Rahul Siddharth Mehta

The University of Chicago Laboratory High School

Illinois

Rahul Siddharth Mehta, 18, of **Chicago**, studied a **computer science** problem regarding network flow for his Intel Science Talent Search project. Simply stated, the Maximum Flow Problem asks: "Given a network of nodes connected by links of certain capacity, what is the maximum amount of a single commodity that we can send from one node to another?" By combining techniques described in two papers published 24 years apart, Rahul developed an algorithm that addressed the problem by focusing on sparse networks. In this approach, he considered only medium-capacity links. His research may have practical applications in networking, scheduling and image processing algorithms. At the **University of Chicago Laboratory High School**, Rahul is a two-year captain of the varsity golf team and president of the Model UN team, which has ranked among the nation's top five for the past three years. Rahul plays classical guitar and participates in collegiate-level programming competitions at the University of Chicago. He is the son of Siddharth and Swati Mehta. For the last year, Rahul has worked for a local green energy startup as a software developer and even served briefly as the company's Interim Chief Technology Officer.

Joshua Abraham Meier

Academy for the Advancement of Science and Technology

New Jersey

Joshua Abraham Meier, 18, of **Teaneck**, studied the role of mitochondrial DNA (mtDNA) in the rapid aging of induced pluripotent stem cells (iPSCs) — which are derived from adult donors — for his Intel Science Talent Search **medicine and health** project. The rapid aging of iPSCs limits their utility in regenerative medicine. Joshua noted that the mtDNA of iPSCs contained the same defects as aged donor cells, suggesting a reason for the rapid aging. He identified a gene that prevented these defects from forming and slowed the aging of iPSCs *in vitro*. He was then able to eliminate that gene to induce mtDNA defects in cancer cells while leaving normal cells unaffected. He believes that this could offer a novel approach to cancer therapy. Joshua attends the **Academy for the Advancement of Science and Technology** in Hackensack where he leads Provita Pharmaceuticals, a virtual biotechnology company run by students, and is on the debate team. He founded Rescue the Voice, a non-profit that uses debate strategies to give voice to abused youth. A pianist from age four, he plays with a local chamber ensemble. Joshua is the son of Ronny and Elizabeth Meier and aspires to manage a biotech company specializing in iPSCs.

Anne Merrill
Greenwich High School

Connecticut

Anne Merrill, 17, of **Old Greenwich**, submitted an **environmental science** project to the Intel Science Talent Search that explored natural, non-chemical methods for suppressing soil-borne diseases. Anne's research focused on how biochars, a charcoal-like material created by burning organic waste materials to sequester carbon, can be integrated into topsoil by earthworm bioturbation (the burrowing and digestion of soil). Anne found that tomato plants she grew in soils amended with biochars and earthworms were 20 percent larger and less susceptible to damage from soil-born fungi and bacteria. Her results suggest that combining the natural methods of earthworm bioturbation with biochars in soil may help reduce carbon emissions, prevent the spread of plant-borne *E. coli* and increase agricultural yields. The daughter of George and Janice Merrill, Anne attends **Greenwich High School** where she is president of the art club and an editor and contributor to the literary magazine. She has exhibited her nature-inspired art in several shows and placed first in the Princeton University Playwriting Competition. Anne plans to pursue a career in environmental science research.

Lisa P. Michaels
Plano West Senior High School

Texas

Lisa P. Michaels, 18, of **Plano**, used fruit flies grown in her home lab incubator to show how increased levels of an antioxidant, glutathione, could slow the progression of Alzheimer's-related neuron damage for her Intel Science Talent Search project in **medicine and health**. Senile dementia is most commonly associated with Alzheimer's disease, which is itself related to the accumulation of toxic metabolic products that harm the brain's neurons. Lisa, inspired by her grandfather's early dementia, crossbred one strain of fly that had been engineered to develop Alzheimer's with another that produced high levels of glutathione. Compared to their Alzheimer's progenitors, the offspring demonstrated longer life spans, less neuron damage and increased activity in the enzymes that protect cells from oxidative stress. She believes that her research may lead to additional assays for Alzheimer's-related damage and has a patent pending for her new strain of fly. Lisa's results are the culmination of work she began in the eighth grade. Lisa is a decorated Girl Scout who is fluent in three languages. She attends **Plano West Senior High School** and enjoys mixed martial arts and tennis. Lisa's parents are Max and Shobha Michaels.

Sreyas Misra
The Harker School

California

Sreyas Misra, 17, of **Cupertino**, designed a low-cost imaging technique for the **bioengineering** project he submitted to the Intel Science Talent Search. Non-invasive positron emission tomography (PET) scanners have revolutionized medical imaging science, but the cost and size of the detector array and other equipment makes them inaccessible to many hospitals. Sreyas was able to design a PET detector that relied on the less-studied technique of Compton collimation as a means of performing localized scanning. He used a Monte Carlo computer simulation to optimize the design of his new detector, reducing it to the size of a hand-held tablet. This novel design, if successfully implemented in hardware, would dramatically reduce the size of the apparatus and cost associated with typical PET methodology. Sreyas plays varsity water polo and captains the debate team at **The Harker School** in San Jose. He won a gold medal on the National Latin Exam and is conversant in Bengali. His hobbies include reading and chess. The son of Satrajit and Sharmila Misra, Sreyas says "medicine is my passion" and plans to study biomedical engineering and medicine in preparation for a career as a physician.

Viola Mocz
Mililani High School

Hawaii

Viola Mocz, 17, of **Mililani**, devised a model for studying angular momentum and energy flow of elementary particles for her **physics** project submitted to the Intel Science Talent Search. Physicists use quantum theory to study the interior path of the particle-wave and explain the fundamental properties and internal energy flow of elementary particles. Viola's model uses wave-particle nature to confine the particle within ring- or doughnut-shaped space and tracks the particle movement to determine its mass. Her results suggest that subatomic matter can be described by regular structural patterns and may reveal a relationship among spin, angular momentum, internal rotation energy and path. These observations indicate the possibility of organizing subatomic matter into a Periodic System of elementary particles. Viola is first in her class of 625 students at **Mililani High School**. She is a published poet, enjoys playing the viola in Hawaii's top youth symphony and is fluent in Hungarian. She is the daughter of Gabor and Eva Mocz. At Intel International Science and Engineering Fair 2012, Viola's work won her the chance to travel to CERN in Switzerland, tour the facility and meet with researchers there. She credits this opportunity as directly informing her current project.

Natalie Ng
Monta Vista High School

California

Natalie Ng, 18, of **Cupertino**, developed a diagnostic tool for her Intel Science Talent Search **medicine and health** project that may predict the spread (metastasis) of breast cancer cells to other parts of the body more accurately. Currently, many more breast cancer patients than necessary receive chemotherapy and endure its harsh side effects in a broadband effort to prevent metastasis. To bring more precision to breast cancer treatment, Natalie developed a novel statistical approach to the hunt for biomarkers of disease-free progression in small RNAs, which play a role in regulating the appearance of characteristics attributed to particular genes. Her prediction models may one day be used to guide long-term strategies for treatment of breast cancer patients. Natalie attends **Monta Vista High School** where she leads a research club and the varsity girls' golf team. She has competed nationally as a violin soloist, founded a local organization to raise funds for Parkinson's research and attended a genomics conference at Cold Spring Harbor Laboratory to present research she developed as an Ingenuity Systems intern. The daughter of Cho Ng and Lydia So, Natalie hopes to become a medical geneticist engaged in cutting-edge genomics research.

Emily Pang
Dougherty Valley High School

California

Emily Pang, 17, of **San Ramon**, discovered a potential method of controlling cancerous growth by manipulating levels of specific immune system proteins for her Intel Science Talent Search **medicine and health** project. Emily's interest in medical advancements led her to combine oncology and immunology, investigating the progression and immune evasion of cancers. Delving deeper, she uncovered the importance of the C1q protein complex and its gC1qR and cC1qR receptors in the regulation of cancer cell survival. For this project, she identified that manipulating the expression of these two proteins could respectively suppress or proliferate tumor progression. Verification of the receptors' opposing functions illuminates their role and may lead to development of new cancer therapies. An award-winning pianist, Emily leads the **Dougherty Valley High School** debate team and presides over Science Alliance, a program designed to foster children's science skills. The daughter of James and Rita Pang, Emily plans to indulge her yearning to understand and explain the world's complexities through a career in biomedical research.

Jiho Park
University High School

California

Jiho Park, 17, of **Irvine**, developed a computational model for the structure of a key enzyme associated with breast cancer for his Intel Science Talent Search **biochemistry** project. The crystal structure of the enzyme aromatase was only determined a few years ago, which enabled researchers to develop drugs that inhibit aromatase activity. Jiho, however, realized that the observed structure was only a "snapshot" and that a more complete image was necessary. Over three years, Jiho completed computational studies of the 3D structure of the enzyme and identified previously unknown locations on the enzyme that could be vulnerable to targeted attack by a new generation of aromatase inhibitors. This could lead to the development of more effective breast cancer therapy. Jiho is first author of a paper describing this work that has been published in the *Journal of Chemical Information and Modeling*. At **University High School**, Jiho is captain of the Science Bowl team that finished fourth in the 2013 national competition. A self-described "news junkie," he pours over newspapers and news-related websites on a daily basis. Jiho is the son of Euiyoung Park and Mibong Chung. He plans to pursue studies in biochemistry or molecular biology.

Ivan Spassimirov Paskov
Edgemont High School

New York

Ivan Spassimirov Paskov, 18, of **Scarsdale**, developed a computational model to more accurately predict cancer patients' responses to drugs based on the genetic makeup of their disease for his Intel Science Talent Search **bioinformatics and genomics** project. Ivan's desire to pursue cancer research began in fifth grade after his mother was diagnosed with the disease. By high school, the evolution of large genomic databases and high performance computer technology able to identify patterns in massive amounts of data enabled Ivan to design a computational tool that better predicts the effectiveness of drugs based on the cancer's genetic profile. By leveraging the relationships between cancer drugs, his approach improves on prior models that predict drug efficacy and also can account for their side effects. This may lead to treatment tailored to the genetic makeup of a patient's tumor. Fluent in Bulgarian, Ivan connected his grandparents' village in Bulgaria to the internet. He pioneered digital note taking at **Edgemont High School** where he plays alto saxophone, runs track, and presides over the robotics and technology clubs. Ivan is the son of Spassimir Paskov and Todorka Paskova and looks forward to a career in computational cancer research.

Brianna Pereira

Academy for Medical Science Technology

New Jersey

Brianna Pereira, 17, of **Fort Lee**, studied the efficacy of treating metastatic non-small cell lung cancer (NSCLC) with the off-label use of the drug AMD3100 for her **medicine and health** project for the Intel Science Talent Search. AMD3100 was originally synthesized to treat HIV by blocking entry of the virus into cells through the CXCR4 receptor. In her three-year study, Brianna found that using AMD3100 to block this receptor on lung cancer cells inhibited the intracellular signaling that activates the malignant cells' ability to migrate, adhere to distant sites and establish new blood supplies. She believes her results suggest that researchers should consider regulating cell crosstalk when developing new anticancer therapies. Brianna attends the **Academy for Medical Science Technology** in Hackensack where her research was conducted. She is a member of the Science Olympiad team and Health Occupations Students of America. She volunteers at Englewood Hospital and Medical Center and has participated in a program with its vascular department to learn surgical procedures. The daughter of Ashley and Sunita Pereira, she loves to draw and paint. Brianna hopes to become a surgical oncologist.

Thabit Pulak

Richardson High School

Texas

Thabit Pulak, 18, of **Richardson**, developed an affordable filter to remove arsenic from drinking water and a test for measuring dissolved arsenic for his Intel Science Talent Search **environmental science** project. After personally witnessing the widespread effects of arsenic water contamination in Bangladesh, Thabit "felt an obligation to do something." He learned that commercial testing and filtering methods were too expensive, so Thabit worked at home to design an inexpensive filter and a simple sensor that could be made using basic household materials. To remove the arsenic, he added iron nanoparticles—which he made from rust, home-made soap and vinegar—to a self-made version of a sand filter. He then used the iron nanoparticles to create paper test strips that villagers could make and use to measure dissolved arsenic. Thabit first tested his inventions in the U.S. using grape juice, which contains trace amounts of arsenic, and later in rural Bangladesh, using contaminated drinking water. Thabit is senior class president, a champion speller and skilled debater at **Richardson High School**. Thabit is the son of Mohammad and Chowdhury Pulak and hopes to become a physician-scientist, applying nanotechnology for affordable treatments to complex diseases such as cancer.

Zarin Ibnat Rahman
Brookings High School

South Dakota

Zarin Ibnat Rahman, 17, of **Brookings**, studied the effects of electronic screen exposure on adolescent sleep patterns, stress and academic performance for her Intel Science Talent Search **behavioral and social sciences** project. Zarin chose her topic after attributing changes in her own sleep habits and next day mental alertness to prolonged computer use the night before. For this project, Zarin designed a questionnaire to divide subjects into normal and sleep-deprived groups who then completed cognitive, memory and attention tasks simulating classroom activities. Heart rate and blood pressure also were recorded. Zarin's findings indicate that increased screen time may shape poor sleep patterns, resulting in daytime fatigue, greater stress, altered mood and reduced cognition and memory. Because the maturing brain is especially vulnerable to stressors, Zarin believes her research may flag excessive electronic activity among adolescents as a public health concern. Fluent in Spanish, Bengali and Arabic, Zarin is senior yearbook editor and an award-winning orator at **Brookings High School**. The daughter of Shafiqur and Moursheda Rahman, Zarin is a 2013 Sanford Research PROMISE scholar planning a career in pediatric neurology.

Ajay Saini
Acton-Boxborough Regional High School

Massachusetts

Ajay Saini, 17, of **Acton**, developed a model to simulate the dynamics of social interaction for his Intel Science Talent Search project in **behavioral and social sciences**. Existing social network models track either the changes in opinions or changes in social connections over time, but they are limited in their ability to simulate the dynamic evolution of social networks in the real world. Ajay created a model that assessed the strength of social connections and quantified how one individual valued opinions from other individuals within a network. He then established parameters for his model to simulate and predict changes over time, such as the tendency to follow opinions of closely associated individuals versus those from a more distant set of connections. Ajay's model may offer new methods for anticipating the changes in social dynamics over time and may provide insight into real-life scenarios like targeted marketing and ways to prevent the spread of panic. Ajay attends **Acton-Boxborough Regional High School** and is the son of Basant and Punita Saini. He has been a practitioner of Taekwondo since 2004 (he holds a third Dan black belt) and competed in the World Class Division at the 2013 USA Taekwondo National Championships.

Sara Sakowitz
The Brearley School

New York

Sara Sakowitz, 17, of **New York**, motivated by the pervasiveness of cancer in her family, studied a protein inhibitor as a potential treatment for breast cancer for the **biochemistry** project she submitted to the Intel Science Talent Search. The EZH2 protein turns off normal tumor suppressor genes, and its activation is associated with the likelihood of metastasis in breast cancer patients. Sara selected a commercially available inhibitor that had been shown in other studies to be effective against lymphoma cell lines. She observed decreased rates of tumor cell migration, invasion and proliferation and she believes EZH2 protein inhibition could be a new therapeutic option for metastatic breast cancer. At **The Brearley School**, Sara writes about women in engineering and science for the student paper and founded an organization called Build Her Future that supports robotics and engineering programs for underprivileged girls. She is an avid oboist and guitarist and was recently cast in a new improvisational comedy web series. The daughter of Mervin and Nera Sakowitz, Sara designed a nanotubule water filtration system for storm drains, which she hopes to patent. Sara aspires to "unravel the hidden mechanisms of the biological universe."

David Seong
Lexington High School

Massachusetts

David Seong, 18, of **Lexington**, investigated ways to reduce symptoms of Huntington's, a fatal brain disease caused by genetic mutation, through manipulation of RNA molecules for his Intel Science Talent Search **biochemistry** project. Huntington's symptoms are known to ease with reduced mutant protein levels, which microRNAs are capable of regulating. Excited by the possibility of utilizing an organism's own "machinery" and natural abilities to produce results that synthetic drugs cannot, David identified six molecules as prime candidates for preventing the production of mutant proteins responsible for the symptoms of Huntington's. He also investigated the synergistic effects of various microRNA combinations. As human genome sequencing progresses, David's research may contribute to developing personalized treatment for genetic diseases. Fluent in Korean, David plays cello and competitive tennis. He is a **Lexington High School** student and a summer intern at Massachusetts General Hospital. David is the son of Jaekyung Park and Ihnsik Seong, who introduced him to the "subtle beauty" of cell biology at age four. David hopes to become a physician or pursue biological research.

Vishnu Shankar
Monta Vista High School

California

Vishnu Shankar, 17, of **Cupertino**, calculated the 3D structure of a human prostanoid receptor for his Intel Science Talent Search **biochemistry** project. Binding of a ligand (a molecule or ion) to its corresponding receptor controls many processes in human cells. Prostanoid receptors control processes mediated by prostaglandin and have been implicated in the progression of cardiovascular disease. Vishnu spent two years calculating the structure of the receptor in the presence of its ligand using a variety of computational methods. His results accurately predicted the structure of the receptor's ligand binding site. At **Monta Vista High School**, Vishnu has lead mock trial teams and heads the varsity debate teams. Considered a "serious kid" as a youngster, he has "discovered laughter" and likes to perform stand-up comedy. Vishnu learned Chinese as a third language and participated in the International Mandarin Speaking Competition in China. Inspired by his grandmother, he also volunteers in his spare time at the Parkinson's Institute as a way of "contributing to her cause." Vishnu is the son of Sadasivan and Bharathi Shankar. He plans to pursue studies in medicine and hopes to become a neurosurgeon.

Jessica Shi
Montgomery Blair High School

Maryland

Jessica Shi, 17, of **Rockville**, submitted a **mathematics** project to the Intel Science Talent Search that addressed an old combinatorics problem concerning the number of graphs with *n* vertices which can occur as the intersections of various geometric objects. Previous work estimated the number of solutions that were possible for the intersections formed by lines. Jessica obtained upper and lower limits for a wider class of graphs than previously known, including ones formed by segments of parabolas. She also linked her estimates to the number of variables required to define these segments. She believes that her research may pave a way to completely characterize the structure of these intersection graphs. At **Montgomery Blair High School** in Silver Spring, Jessica is co-captain of both the math and physics clubs, co-president of the Green Club and technical director of the online newspaper. She also enjoys teaching English and mathematics to Chinese-American immigrants and in 2012, received an Outstanding Tutor Award for her work. Jessica is the daughter of Huanqiang Shi and Xiaoli Zhao and credits her friends with helping her find research errors just by listening as she reads a paper out loud "on the grassy fields of Bunker Hill."

Kaitlyn Shin
Jericho Senior High School

New York

Kaitlyn Shin, 17, of **Jericho**, sought to identify whether emissions from primordial black hole (PBH) clusters can be detected for her Intel Science Talent Search **space science** project. Kaitlyn investigated whether photons from clusters of PBHs could be detected by the Nuclear Spectroscopic Telescope Array (NuSTAR), NASA's space-based X-ray telescope. Her research also evaluated whether emissions of positrons (the antimatter equivalent of electrons) from PBH clusters could resolve a galactic mystery: We know from detected "annihilation radiation" that electrons and positrons are colliding, but where are the positrons coming from? Kaitlyn found that NuSTAR cannot effectively detect photon emissions from PBH clusters, and that PBH clusters may have contributed positrons, though at extremely low levels, to the annihilation radiation. Kaitlyn's results may aid our understanding of the early universe. The daughter of Thomas Shin and Sehrie Lee, Kaitlyn attends **Jericho Senior High School** where she captains the varsity badminton team. She studies classical violin, serves as concertmistress of the Long Island Youth Orchestra and played with the New York All-State Symphonic Orchestra.

Anand Srinivasan
Roswell High School

Georgia

Anand Srinivasan, 17, of **Roswell**, studied genomic structure prediction for his Intel Science Talent Search **computer science** project. Coding regions of the genome in eukaryotes (cells of higher organisms) are interrupted by noncoding regions, but distinguishing between the two can be difficult for scientists. Anand developed a neural-network-based computer model that he called RNNScan, which "learns" patterns in DNA in order to predict the boundaries of these genomic regions. Anand's RNNScan algorithm was able to find nearly twice as many gene boundaries as GENSCAN, a widely used prediction tool. He believes his work will aid in disease screening and even genome-tailored pharmaceuticals. Anand is a class officer at **Roswell High School** and helped coordinate movable molecular biology labs for fifth graders, popularly known as Science on a Cart. His hobbies include building model sailplanes, playing first violin in a local chamber orchestra and tutoring students at Sweet Apple Elementary before the school day begins. The son of Srinivasan Ramaswamy and Vasantha Srinivasan, Anand hopes to specialize in artificial intelligence and machine learning and says he can think of no better way for him to be useful to society than as a scientist.

Parth Thakker

North Carolina School of Science and Mathematics

North Carolina

Parth Thakker, 17, of **Charlotte**, developed an inexpensive solar cell component that is compatible with human health for his Intel Science Talent Search project in **materials science**. Parth repurposed drug delivery quantum dots—a class of extremely small nanocrystals—to act as photosensitizers. Quantum dot sensitized solar cells (QDSSCs) are important due to their low production costs and theoretically high performance limits; however, currently available QDSSCs contain toxic cadmium and lead. By using nontoxic medical imaging quantum dots, Parth produced biocompatible QDSSCs and then worked to improve their energy conversion efficiency. His efforts may hasten advances in the field of embedded assistive electronics. Parth attends the **North Carolina School of Science and Mathematics** in Durham where he is student body president, co-captain of the Science Olympiad team and senior chemistry editor of his school's research journal. He is also a former Civil Air Patrol staff sergeant and two-time recipient of the Presidential Volunteer Service Award. The son of Chetan and Babita Thakker, Parth scored perfectly on his SATs and ACTs and hopes to combine research and entrepreneurship in the field of chemical engineering.

Intel Science Talent Search 2014

Finalists and Research Project Titles

Intel Science Talent Search 2014
Finalists by State

Intel Science Talent Search 2014

Finalists by Last Name

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