THE FUTURE IS BRIGHT

Intel Science Talent Search 2015 Finalists

Intel STS 2014 Finalists
Intel Science Talent Search 2014 finalists visit the U.S. Capitol

Eric Chen
First Place Winner
Intel Science Talent Search 2014

2015 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 awards, including three top awards of $150,000.

Intel Science Talent Search 2015

March 5–11, 2015

The 40 finalists of the Intel Science Talent Search 2015, a program of Society for Science & the Public, represent 2.2 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 $1,012,500 in awards.

The 19 young women and 21 young men come from 36 schools in 18 states. Finalists were selected from among 1,844 entrants representing 460 high schools in 41 states, Puerto Rico, and five 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 2015 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

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 22,371 finalists and semifinalists who have received $17.9 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 17th 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

Starting in 2015, the Intel STS will offer three top awards of $150,000. Medals of Distinction will be provided for students who show exceptional scientific potential in three areas: Basic Research, Global Good, and Innovation. In addition, three second place awards of $75,000 and three third place awards of $35,000 will be given in these areas. Winners will be selected by the judging committee and announced at a black-tie gala on March 10, 2015.

Each of the 300 students named a semifinalist in the Intel STS 2015 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 2015. 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 10, 2015, the date of the Intel Science Talent Search Awards Gala.

Eswar Anandapadmanaban
Dr. Ronald E. McNair Academic High School

New Jersey

Eswar Anandapadmanaban, 17, of **Jersey City**, designed and built the ThereNIM, a new, affordable and non-invasive form of respiratory monitor for his Intel Science Talent Search **bioengineering** project. While watching a documentary on sleep research, Eswar was struck by the fact that patients were wearing bulky and expensive respiration monitors. Inspired, he created a touchless monitor based on the oscillator technology used in the Theremin musical instrument, famously used to create spooky sound effects in early science fiction movies. (The Moog Synthesizer is a Theremin.) Eswar's novel device uses two L-shaped antennae suspended above the patient to detect chest movement and transmits that activity to a computer display. The ThereNIM costs less than $50 to build, is easy to use and adaptable to both medical and home settings. Eswar believes the device will allow parents to effectively monitor a baby's breathing and help prevent sudden infant death syndrome (SIDS). The son of Anand Jagadeesan and Gomathi Raman, Eswar studies guitar and music theory and earned perfect SATs. He attends **Dr. Ronald E. McNair Academic High School** where he rose to corporal in the school's JROTC battalion.

Emily Lorin Ashkin
Providence Day School

North Carolina

Emily Lorin Ashkin, 17, of **Matthews**, studied the synergistic use of chemotherapy and immunotherapy to treat melanoma, a deadly skin cancer, for her Intel Science Talent Search **medicine and health** project. In adaptive cell transfer immunotherapy, tumor-infiltrating lymphocytes (TILs), white blood cells that identify and destroy tumor cells, are extracted, cultured and infused back to the patient. During processing, however, rapid changes in the tumor can render this treatment ineffective. Emily's novel solution was to use chemotherapy drugs to inhibit Topoisomerase I inside melanoma cells and cause them to exhibit death-marking molecules on their surface, thus facilitating recognition by TILs. She hopes her synergistic method will reach clinical trials in two to three years. Emily is captain of the academic team and the varsity Science Olympiad at **Providence Day School** in Charlotte and is a tournament-winning table tennis player. She advocates for adolescent health issues and has campaigned to raise awareness of domestic violence. The daughter of Audrey and Kenneth Ashkin, Emily has earned numerous science awards and has presented her research at the 2014 Beijing Youth Science Creation Competition.

Augustine George Chemparathy
Dougherty Valley High School

California

Augustine George Chemparathy, 17, of **San Ramon**, studied factors that induce microalgae to accumulate triacylglycerol (TAG) – a lipid precursor of algal biodiesel – for his Intel Science Talent Search **plant science** project. Algal biodiesel is a carbon-neutral alternative to fossil fuels, and a common method of increasing TAG production for biodiesel is to stress the algae by depriving it of nitrogen. Augustine tested the hypothesis that TAGs protect algae from the toxic buildup of electrons during photosynthesis in the absence of nitrogen. He identified four genetically modified strains of algae with high oil production and growth rates and then limited their ability to produce TAG. Augustine observed that electrons accumulate in the cells' photosynthetic apparatus, which supports his thesis. He also describes the photosynthetic efficiency of his various strains, which has implications for their use in industrial applications. Augustine is student head of speech and captain of Extemporaneous Speaking, as well as co-president of the National Science Bowl team at **Dougherty Valley High School**. An Eagle Scout, he has raised money for wells in West Africa and has explored science fiction writing at the Iowa Young Writers' Studio. The son of George and Mini Chemparathy, Augustine has perfect SAT scores.

Brandon Bicheng Cui
Hillcrest High School

Utah

Brandon Bicheng Cui, 17, of **Sandy**, sought to improve the construction of data transmission circuits for his Intel Science Talent Search **engineering** project. Conventional electronics are constrained to gigahertz (GHz) frequencies by the physical properties of electromagnetic waves and the dimensions of the devices that transmit them. Brandon designed a novel waveguide – a device that facilitates the transmission of high frequency waves with low power loss – that has the potential to transmit information at terahertz frequencies (1000 GHz) with a negative index of refraction. His waveguide design has applications in the development of faster optical circuits, a vital step in the advancement of high-speed communications and computing, and could even lead to the practical development of sub-diffraction-limited localization of light, such as cloaking fields. Brandon, the son of Muyi Cui and Liyuan Wang, competes on the varsity tennis team and serves as the vice president of the Future Business Leaders of America at **Hillcrest High School** in Midvale. Prior to beginning his two-year waveguide project, Brandon developed a method for using organic materials to remove metals from a mine's wastewater.

Valerie S. Ding
The Catlin Gabel School

Oregon

Valerie S. Ding, 18, of **Portland**, sought ways to optimize the design of quantum dot solar cells for her Intel Science Talent Search **engineering** project. Conventional solar cells are increasingly being used to meet our energy demands, yet these solar cells are inefficient because their material properties inherently limit the amount and spectra of light that can be converted to electricity. Quantum dots, which are nanoscale particles with semiconductor properties, have an advantage over traditional solar cell materials because they can be designed to overcome these limitations. In the course of her three-year project, Valerie independently developed an advanced algorithm that simulates the quantum mechanical properties of lead-sulfide quantum dot solar cells, and used her results to quantitatively define design parameters that dictate quantum dot solar cell efficiency. Her model predicts that quantum dot solar cells, optimized using her approach, may perform at double the efficiency of conventional solar cells. Valerie attends **The Catlin Gabel School** where she leads the math, Science Bowl and Science Olympiad teams. The daughter of Yaoguo Ding and Yiying Shao, Valerie is an award-winning piano soloist.

Ryan D'Mello
Benet Academy

Illinois

Ryan D'Mello, 17, of **Naperville**, studied the gaps between integer points on elliptic curves, for his Intel Science Talent Search **mathematics** project. Elliptic curves were integral to the celebrated proof of Fermat's Last Theorem. They also have practical applications to public key cryptography, enabling secure network transactions like online shopping and communication, and to the foundations of string theory. Ryan found a surprising lower bound on the gaps between Hall numbers – which are numbers whose cube is close to another number's square – a natural question that had not previously been addressed by number theory experts. Ryan attends **Benet Academy** in Lisle where he has competed throughout high school in varsity track and on the math team, which has finished in the top ten in the state of Illinois for the past three years. Ryan also has earned performance awards in piano. He is a member of the Model United Nations and studies politics and current events as a "side hobby." The son of Joe and Christabel D'Mello, Ryan plans a career combining math, computer science and economics.

Samuel Epstein
John F. Kennedy High School

New York

Samuel Epstein, 18, of **Bellmore**, used his Intel Science Talent Search **animal sciences** project to determine how manipulating digestive microbes and the genes of a cell-growth control pathway sensitive to nutrient levels might reduce caloric intake, which has been shown to correlate with increased lifespan in organisms ranging from yeast to mammals. Samuel measured the food consumption of fruit flies while controlling the presence of digestive microbes and activity in the pathway, known as "target of rapamycin" or TOR. His finding that fruit flies with high TOR signaling ate the most, regardless of microbial presence, may shed light on the potential for gene manipulation to slow the aging process, which Samuel believes is key to conquering age-related disease as a whole. A student at **John F. Kennedy High School**, Samuel is the science club president, co-founder of the Community Health and Research in Medicine Committee and founder of an organization called "Make an IMPACT!" to raise higher education scholarship funds for veterans. The son of Steven and Jill Epstein, Samuel plans to continue exploring the natural world while building a career as a professor or research scientist.

Nicole Eskow
Academy for the Advancement of Science and Technology

New Jersey

Nicole Eskow, 18, of **Emerson**, studied the effects of the drug valeryl salicylate, which is derived from aspirin, on the proliferation of chronic myelogenous leukemia (CML) induced by interleuken-4 (IL-4) for her three-year **medicine and health** Intel Science Talent Search project. IL-4 is a signaling protein, found at high levels in tumors, that activates other cellular proteins that control cell division. Previous studies showed that salicylates inhibit IL-4 activation in lymphoma, and Nicole theorized that they might prove equally effective in CML inhibition. She believes her study showed that valeryl salicylate does inhibit cell growth in IL-4 activated cells and elucidates several pathways through which it acts. She believes that valeryl salicylate could be a viable therapy for treating CML. Nicole attends the **Academy for the Advancement of Science and Technology** in Hackensack where she promotes STEM fields among younger students through the Bergen SciChallenge and chairs the Go4TheGoal Club that raises awareness of pediatric cancer. A varsity track and field athlete, Nicole competes in the triple jump, long jump, 100 meter dash and 200 meter dash. She is the daughter of Gina and Raymond Eskow.

Kalia D. Firester
Hunter College High School

New York

Kalia D. Firester, 17, of **New York**, investigated how a protein produced by nematodes, which are parasites highly destructive to crops worldwide, interacts with a plant's cells and defenses for her Intel Science Talent Search **plant science** project. Kalia grew gene constructs that express or degrade nematode secretions in *E. coli* bacteria to increase their numbers; she then transferred them into another bacterium for introduction into existing lines of tomato plants. By increasing knowledge of how these proteins interact with the plant's biochemistry, Kalia's work may contribute to the science of engineering natural immunity, rather than employing toxic agents, to repel a pest that causes global crop losses of roughly $100 billion annually. Kalia attends **Hunter College High School** where she is a teaching intern, was the editor of the school literary magazine and is a member of Young Playwrights, Inc. A recipient of numerous Scholastic Art & Writing Awards, Kalia also has interned at the Israeli national agricultural laboratory and the Lymphocyte Biology and Molecular Parasitology Lab at Rockefeller University. The daughter of Jonathan and Ruth Firester, Kalia plans a research career in health, clean water and/or agriculture.

Noah Golowich
Lexington High School

Massachusetts

Noah Golowich, 17, of **Lexington**, focused his Intel Science Talent Search **mathematics** project on an area of Ramsey theory, a field based on finding patterns in large and complicated systems. He resolved a conjecture from 2005 and proved that an important linear equation in n variables is "n-1-regular," which means that if the integers are colored with n-1 colors, then the equation has a solution using integers of the same color, but there is no monochromatic solution when we use n colors. In his proof, Noah developed a new method that he showed can be generalized to answer other related questions. Noah attends **Lexington High School** where he captains the school's math team, plays jazz piano and helped the tennis team take home the 2014 state championships by remaining undefeated in all 11 of his singles matches. Noah earned a first place award in the individual project category at the 2014 Massachusetts State Science Fair. The son of Linda Zeger and Steven Golowich, Noah is a prolific author with four papers published in or submitted for publication in peer-reviewed journals. He has also performed chamber music for nursing home residents.

Charles Gulian
Ossining High School

New York

Charles Gulian, 17, of **Ossining**, developed a computer program to search and analyze the *Kepler* star survey dataset for white dwarf stars for his Intel Science Talent Search **space science** project. While white dwarf (WD) binary stars play an important role in our ability to understand astronomical events such as supernovae, there only have been about 100 WD binary systems identified to date. The search algorithm Charlie developed, which he has made available to the public, analyzed nearly 2,000 stars to identify the gravitational interactions characteristic of WD binary systems. His results may have identified a previously undiscovered WD binary system, although he is careful to note that additional research is necessary to confirm his findings. Charlie hopes his research contributes to our understanding of cosmological expansion. Charlie is vice president of the drama club at **Ossining High School** and has performed lead roles in multiple theater productions. He is also co-founder and vice president of a local math group. The son of Graham Young Gulian and Ann Gulian, he volunteers with a local ambulance service and participates in projects benefiting victims of Hurricane Katrina and Superstorm Sandy.

Anvita Gupta
BASIS Scottsdale

Arizona

Anvita Gupta, 17, of **Scottsdale**, submitted a **biochemistry** project to the Intel Science Talent Search that suggests new drug therapies for cancer, tuberculosis and Ebola. Anvita targeted intrinsically disordered proteins (IDPs), which make up 70 percent of all cancer proteins and are mutated in tuberculosis and Ebola. She used computer machine learning techniques, 3D visualization and biomimicry to systematically find drugs to inhibit the interactions of IDPs with other proteins. After the approach was proven successful in identifying approved drugs, such as the inhibitor of the cancer protein Thrombin, Anvita went on to identify drugs that could potentially be used to treat tuberculosis and Ebola. Preclinical trials on the potential tuberculosis drugs that she identified are already underway. Anvita is the first author of a paper published in a peer reviewed journal and two other papers that have been submitted for publication. The daughter of Aparna and Anup Gupta, Anvita attends **BASIS Scottsdale**. She is the chapter founder of a nonprofit group that connects villagers in India with microloans, and she directs an after-school program that teaches middle school girls programming skills to decrease the gender gap in STEM fields.

Brice Huang
West Windsor-Plainsboro High School North

New Jersey

Brice Huang, 17, of **Princeton Junction**, worked on an algebraic ring theory problem involving power ideals for his Intel Science Talent Search **mathematics project**. "Power ideals" are algebraic structures generated by powers of linear polynomials. Power ideals always have an associated series of dimensions, but there is no known method for efficiently computing these series for arbitrary power ideals. Brice computed the power ideal's dimension for a much larger class of ideals than had been formerly possible by associating a monomial ideal where the computations are clearer. Power ideals are used in many areas of mathematics, including algebraic geometry, approximation theory and mathematical modeling. A student at **West Windsor-Plainsboro High School North** in Plainsboro, Brice captains the math club and is principal cellist in the school's Philharmonic Symphony Orchestra. He earned perfect SATs, placed first in the Crescendo International Music Competition at Carnegie Hall and earned a place on the six-member United States team to the 2015 Romanian Master of Mathematics competition. Brice also earned a perfect score in the 2013 USA Junior Math Olympiad. The son of Kevin and Suzanne Huang, Brice plans to major in mathematics and eventually work in a research or technology start-up setting.

Andrew Jin
The Harker School

California

Andrew Jin, 17, of **San Jose**, submitted a **bioinformatics and genomics** project to the Intel Science Talent Search that studied natural selection using powerful machine learning algorithms to systematically identify adaptive mutations across the full human genome. For Andrew's project, the computer was "shown" 7.5 million simulated mutations with the goal of "teaching" it how to recognize adaptive ones in the genetic code. Then, when Andrew applied his new computational method to real-life DNA sequences, the system discovered more than 100 potential adaptive mutations that, he says, have never before been identified as instruments of natural selection. He believes that he has found candidates that play roles in crucial processes such as immune response, metabolism and brain development. One of his previous projects is published in a *Nature* paper listing Andrew as co-author. He is pursuing Eagle Scout status and in 2013 spent a week canoeing in the Canadian wilderness. At **The Harker School**, Andrew captains the high school debate squad and coaches the middle school program. The son of Shu Jin and Wen Cheng, Andrew loves the outdoors and is an accomplished classical pianist who has performed at Carnegie Hall.

Somya Khare
Lynbrook High School

California

Somya Khare, 18, of **Saratoga**, focused her Intel Science Talent Search **microbiology** project on mechanisms of cell growth and shape change to better understand how to bioengineer bacterial cells. Her research centered on the physiological changes in *E. coli* cells when the bacteria are subjected to stress using nutrient restriction. Somya developed code to collect and analyze time-lapse images of *E. coli* cell activity, focusing on cell growth rate and cell wall shape mediated by the protein MreB. Her results offer two novel insights: during the starvation response, growth rate reduction occurs before the *E. coli* changes from rod-shape to nearly spherical, and different cellular pathways control MreB and the proteins involved in division. She believes her research contributes knowledge needed for both cellular engineering and antibiotic design. Somya captains the varsity girls golf team at **Lynbrook High School** in San Jose where she started a mentorship program to assist students with science fair projects and now handles more than 100 science fair applications. The daughter of Manoj and Reena Khare, she served the community as a member of the Saratoga Youth Commission and is an accomplished Indian classical dancer.

Shashwat Kishore
Unionville High School

Pennsylvania

Shashwat Kishore, 18, of **West Chester**, focused his Intel Science Talent Search **mathematics** project on representation theory – a field that represents objects in abstract algebra as more easily interpreted arrays of numbers, called matrices. In particular, representations by unitary matrices are often the most useful. Shashwat studied an object of recent interest called a quantized quiver, in which a "quiver" is an orientation on a graph. Shashwat identified, for the first time, a family of unitary matrix representations for a quantized quiver. He also developed a new relationship between representation theory and topology. Shashwat attends **Unionville High School** in Kennett Square where he is a varsity letterman in cross-country, captain of the Academic team and a clarinetist in the school's symphonic band. He also earned a perfect score on the 2013 USA Jr. Math Olympiad. The son of Sheel and Suchismita Kishore, Shashwat has researched epidemiology, bioinformatics and abstract algebra since middle school. He plans to study both math and computer science in college and is convinced that "computational and AI approaches hold the keys to solving major problems in biology, economics and technology."

Rohith Kuditipudi
The Harker School

California

Rohith Kuditipudi, 18, of **Los Altos**, modeled DNA methylation – a chemical modification of DNA strands by which cells control gene expression – to investigate its role in the progression of fatty liver disease for his Intel Science Talent Search **bioinformatics and genomics** project. Inspired by new techniques enabling integrated analysis of gene expression and methylation data, Rohith conducted an analysis that revealed novel roles for methylation and identified several metabolic pathways that could be relevant to disease progression. His network-based approach to understanding these underlying mechanisms may contribute to future efforts to prevent or lower the risk of developing liver cancer. Rohith attends **The Harker School** in San Jose where he captained the freshman/sophomore basketball team and is an all-state Speech and Debate semi-finalist. He is an Eagle Scout, founder of an India Literacy Project youth group, member of the Los Altos Youth Commission and Bronze level recipient of the President's Volunteer Service Award. The son of Padma and Venkatram Kuditipudi, Rohith hopes to impart his love of science to curious students as a university professor.

Kriti Lall
Castilleja School

California

Kriti Lall, 17, of **Fremont**, developed a way to inexpensively remove arsenic from drinking water for her **environmental science** project for the Intel Science Talent Search. After observing the effects of arsenic poisoning in India, Kriti was inspired to develop a practical water treatment method. She learned about a gene that allows a bacterium that lives in very salty, alkaline water to oxidize arsenic, and was subsequently successful in extracting that gene and inserting it into another more common and safe bacterium that can live in fresh water. Once the arsenic is oxidized by the transformed bacteria, it can be easily removed. Kriti then created a water treatment prototype that combines sand filtration, arsenic oxidation by her new bacterial strain, and a stage in which the oxidized arsenic is removed using common iron sulfate. She says that her new system can be created for $8, less than one-twelfth the cost of existing devices. Kriti, the daughter of Vinish and Sonu Lall, attends **Castilleja School** in Palo Alto where she plays tennis, captains the speech and debate team, and co-leads the STEMx Club. She has perfect SATs and blogs for *Nature's* Scitable.

Jihyeon Lee
Amador Valley High School

California

Jihyeon Lee, 17, of **Pleasanton**, addressed problems encountered when using a mobile phone to take high dynamic range (HDR) photos for her Intel Science Talent Search **computer science** project. Many cameras create HDR images from a stack of several low dynamic range (LDR) images, but less-than-perfect alignment of the LDR images, caused by camera or subject movement, can cause blurring or ghosting. Working on her own, Jihyeon (Janel) created an application using her self-developed algorithms to completely capture a scene. At the outset of the project, her research suggested that the ultimate mobile device solution would to be too computationally complex to succeed. However, by using a heterogeneous model and parallel computing, she optimized her algorithm for the smartphone's limited power and computing resources. Janel founded the Key Club at **Amador Valley High School** and heads the first team for Science Olympiad. A violinist, Janel played in the California Youth Symphony for four years, and she performs at area hospices. Janel's parents are Yoon and Jake Lee, and she earned perfect SATs.

Catherine J. Li
Lake Highland Preparatory School

Florida

Catherine J. Li, 18, of **Orlando**, applied a new fiber-based technique to synthesize drug-delivering microspheres for her Intel Science Talent Search project in **materials science**. Catherine sought a scalable solution for particle design that could be used to generate biodegradable, multifunctional particles in a variety of geometries. She applied a technique called In-Fiber Emulsification, originally intended to process optical materials at high temperatures, to develop drug-laden, polymeric particles at relatively low temperatures. She also developed a procedure to uniformly dope the particles with the selected drug in order to overcome incompatibility with currently available solvents. Her approach to particle fabrication has applications in cancer therapy and surgical recovery, potentially expediting the healing process while preventing infections. Catherine attends **Lake Highland Preparatory School** where she competes on varsity teams in both volleyball and track and field. An award-winning prose writer, she serves as the student body president of her high school. The daughter of Charlotte Xiaohong Chen and Guifang Li, Catherine has perfect SATs.

Ien Li
Jericho Senior High School

New York

Ien Li, 17, of **Westbury**, submitted a **behavioral and social sciences** project to the Intel Science Talent Search that investigates possible correlations between symptoms of major depressive disorder (MDD) and variations in neuroanatomy. Ien focused her research on specific depressive symptoms, such as anxiety and sleep disturbance, in order to identify whether the severity of those symptoms could be predicted by analyzing a patient's clinical data and MRI readings. She found that distinct changes in the brain correlate with specific depressive symptoms, and she showed a measurable relationship between an individual's brain and behaviors. Ien's research sheds light on the complexities of MDD and may inform new drug therapies. Ien attends **Jericho Senior High School** where she serves as editor-in-chief of the literary magazine and plays lead clarinet in the marching and symphonic bands. She also works as a technology aide to senior citizens at the Jericho Public Library and as a travel soccer referee. The daughter of Jen Ai Liu and Ching Sheng Li, Ien's prior research on brain asymmetry in Alzheimer's patients has been published in *The Journal of Experimental Secondary Science*.

Alexander Lin
Millburn High School

New Jersey

Alexander Lin, 17, of **Millburn**, conducted research in theoretical **computer science** for his Intel Science Talent Search project. The problem he studied asks how to sort objects into groups while adhering to restrictions preventing certain objects from being grouped together. This universal problem is relevant in fields such as biology, scheduling, business and entertainment, but is, in general, extremely difficult to answer quickly. For his research, Alexander used dotted interval graphs, a new method for representing graph theory problems in mathematics, and was able to develop an approximation algorithm that accepts a list of objects, groups and restrictions, and then quickly generates valid assignments to groups. He went on to write a second algorithm and associated proofs to convert any solutions for dotted interval graphs into a more understandable setting for application to the real world. At **Millburn High School**, Alexander is secretary of the science and technology club, which competes against other schools in multifunctional science challenges. The son of Kai-Ching and Patricia Lin, Alexander has been a clarinetist in the New Jersey Youth Symphony for four years and tutors Chinese students online.

Lily Liu
Texas Academy of Mathematics and Science

Texas

Lily Liu, 18, of **Plano**, used a computational approach to assess how best to break the carbon-oxygen bond in methoxyethane, a representative molecule of lignin, for her Intel Science Talent Search **chemistry** project. Lignins are common constituents of almost all land plants, so identifying an effective catalyst to selectively break them down could provide a new way to produce renewable energy and reduce the environmental and financial costs of materials currently generated from fossil fuels. Lily used computational chemistry methods to evaluate how using various transition metals as catalysts would affect the carbon-oxygen cleavage and identified rhodium and ruthenium as most likely to effectively catalyze this reaction. She also compared the performance of nine different computational approaches and determined the one that worked the best for this purpose. Lily attends the **Texas Academy of Mathematics and Science** in Denton where she is the Aspire Coordinator of the Research Organization. The daughter of Dong Peng Liu and Yu Hong Shao, Lily is a Taekwondo instructor, an accomplished violinist, and co-author of three papers that have been submitted for publication in peer-reviewed journals. She plans to pursue a doctorate in chemistry and become a research professor.

Yelena Mandelshtam
University High School

California

Yelena Mandelshtam, 17, of **Irvine**, studied the properties of totally positive matrices for her Intel Science Talent Search **mathematics** project. A matrix is a rectangular array of numbers or other mathematical objects, and a number called a determinant can be assigned to any square matrix. A matrix is totally positive if it has a positive determinant and if the determinants of the square matrices that might be formed by removing rows and columns – which are referred to as minors – are also positive. Yelena extended previous work on the arrangements of minors of totally positive matrices and introduced the novel concept of "multidimensional cubical distance." This novel approach has the potential to reveal even more relationships between matrix minors. A student at **University High School**, Yelena is co-president of the school's math club, teaches at the UCI Math Circle and at the Orange County Math Circle and has placed first or second nationally in the Math Kangaroo USA competition for three years. Yelena is active in community theater and teaches math, in Russian, to children at the nearby Russian School Karandash. She is first author of a paper published in the *Bulletin of Mathematical Biology*. Her parents are Svetlana Jitomirskaya and Vladimir Mandelshtam.

Scott Massa
Commack High School

New York

Scott Massa, 17, of **Commack**, investigated the relationship between impairment of intracellular signaling and the onset of neurological disorders for his Intel Science Talent Search **biochemistry** project. Previous research has indicated that protein production and neuronal signaling are altered in these neurological disorders due to changes in gene expression. To investigate the role of endocytosis (intake of molecules by a cell) in protein transport, Scott inhibited endocytosis of a key signaling protein in brain cells. He observed that inhibition resulted in decreased intraneuronal translocation of signaling proteins that has been associated with the onset of neurological disorders. His findings may inform the development of future medications to combat schizophrenia and Alzheimer's disease. Scott attends **Commack High School**, where he has participated in the school choir and competed on a travel baseball team. He also serves as president of the Science Olympiad team and captain of the Science Bowl team. The son of Karen and Roy Massa, Scott volunteers at a local hospital in the orthopedic and surgical critical care units and founded a local organization to raise donations for autism research.

Jennifer McCleary
Arnold O. Beckman High School

California

Jennifer McCleary, 17, of **Irvine**, focused her Intel Science Talent Search **chemistry** project on how the electronic bandgap of certain metal oxides correlates to their ability to use solar energy and catalyze the splitting of water into hydrogen and oxygen. If this reaction can be optimized, it could become a promising alternative to current methods of hydrogen production that use non-renewable sources, such as natural gas. After determining the bandgaps of various metal oxides, Jennifer tested the ability of each to produce electric current when exposed to light – a function that directly relates to the ability to produce hydrogen. Her results characterize the optimal bandgaps for producing the largest electric current, which may help advance the field of clean energy development. Jennifer attends **Arnold O. Beckman High School** where she plays piano and cello and is a member of the varsity cross-country team. Jennifer also ranked among the top 50 in the U.S. National Chemistry Olympiad. The daughter of Ying and James McCleary, Jennifer hopes to become a chemical engineer focused on solar energy applications.

Anya Michaelsen
Lake Braddock Secondary School

Virginia

Anya Michaelsen, 17, of **Fairfax**, investigated variables that contribute to scoring success when performing a fencing "flick" for her Intel Science Talent Search **physics** project. A flick is an advanced maneuver in foil fencing that involves moving the blade backward and then rapidly forward forming a whip-like arc, allowing the tip of the blade to circumvent an opponent's defenses. Using a high-speed video camera Anya tracked the movements of two nationally ranked female fencers as each performed a flick, and analyzed their movements to determine variables that predict scoring success. Her statistical analysis indicates that the most important factors of a successful flick are the fencers' use of their fingers and the distance of their hands from the target. An avid fencer since middle school, Anya has captained several teams and regularly competes in local and national competitions. She hopes her findings guide future coaching practices and provide insight into new methods for analyzing and improving fencing techniques. Anya attends **Lake Braddock Secondary School** in Burke, where she has tutored for the math department and the Aristotle Circle. Her parents are Veronica Michaelsen and Corey Cleland.

Dhaivat Nitin Pandya
Appleton North High School

Wisconsin

Dhaivat Nitin Pandya, 17, of **Appleton**, submitted a **computer science** project to the Intel Science Talent Search investigating ways to increase available bandwidth for large networks, including the Internet. He studied linear network coding, which is a technique that instructs network nodes to assemble information packets into groups (instead of merely passing along individual packets), and then sends each group to its destination where it is disassembled. This workflow can reduce packet loss and improve both network security and speed. Dhaivat developed algorithms that determine the best way to combine these network packets. He went on to assess the potential cost savings (up to 35 percent) of linear network coding and developed an algorithm for a cluster-based approach that may allow such coding to be used for large applications, including cellular networks and data storage. At **Appleton North High School**, Dhaivat is head of the ThetaX Robotics Club where he oversees robotic engineering. The son of Nitin and Shailaja Pandya, Dhaivat co-founded and hopes to expand on a global scale the International Campaign against Blindness, a nonprofit group that provides free surgeries and prescription glasses in developing nations.

Reesab Pathak
Camas High School

Washington

Reesab Pathak, 16, of **Camas**, who was motivated by the prevalence of HIV in his ancestral home of Nepal, conducted a two-year research project to clarify the mechanism of a new HIV vaccine for his Intel Science Talent search project in **medicine and health**. Using a vaccine targeting the Simian Immunodeficiency Virus (SIV), which causes AIDS in Rhesus macaques, Reesab demonstrated that the MHC-E protein is responsible for activating a subset of cytotoxic T cells. T cells are a vital component of the immune response that detect infectious material presented on the MHC proteins of infected cells. This finding is potentially important because MHC-E is very similar in humans and macaques, making it more likely that a vaccine developed using this property of the immune response could effectively induce HIV immunity. Moreover, MHC-E-mediated immunity had not been demonstrated before for SIV or HIV vaccines. Reesab is president of the student government and secretary of the Science Olympiad at **Camas High School**. A pianist and composer, he is a Vox Novus Composition award winner. The son of Bima and Roopa Pathak, Reesab has earned many awards and is co-author of a paper published in the *Journal of Immunology*.

Max Pine
Pelham Memorial High School

New York

Max Pine, 17, of **Pelham**, conducted the first-ever study of the effect of climate over time on multi-species bird irruptions – or non-seasonal migrations – for his Intel Science Talent Search **animal sciences** project. Intrigued in 2012 by one of the largest irruptions of seed-eating birds on record, Max examined the potential impact of climate driving ocean-atmosphere cycles on bird irruptions, irruption synchrony and bird abundance for eight species. He performed an integrated analysis of 51 years of Audubon Society Christmas Bird Counts, “citizen science” bird density measures and North Atlantic and El Niño southern climate indices. Results revealed correlations between climate and irruption in four species, climate and synchrony in ten pairs of species, and warmer climate indices with bird abundance. These findings may help to guide conservation policy and projections in the face of global climate change. Max attends **Pelham Memorial High School** where he is active in the Model United Nations, plays violin and competes as a Science Olympiad regional champion. A member of the New York State Young Birders Club, Max is the son of Richard Pine and Cheryl Agris. He plans to study ecology with the goals of teaching and conducting university research.

Saranesh Prembabu
Dougherty Valley High School

California

Saranesh Prembabu, 17, of **San Ramon**, studied the electrical and magnetic properties of nanocrystal superlattices by manipulating their composition for his Intel Science Talent Search **materials science** project. Interface effects arising from intrinsic asymmetry between the layers of lead titanate and strontium ruthenate used in the lattices confer an inherent polarization that can be harnessed for a variety of electrical and computing applications. Saranesh (Saran) characterized precisely how these properties vary as a function of layer thickness and strontium ruthenate composition. Saran's results demonstrate that superlattices can be engineered to respond predictably and that their electrical properties can be manipulated reproducibly and hint at new methods to efficiently store data with magnetic fields. Saran is the president of the Science Bowl Club, math club and physics club at **Dougherty Valley High School**. A scout since third grade, he recently earned his Eagle Scout award with a project that provided personal hygiene supplies for hundreds of local homeless people. The son of Bhavani and Thiruvelan Prembabu, Saran plays the piano and enjoys teaching himself foreign languages, recently Russian.

Anika Raghuvanshi
Jesuit High School

Oregon

Anika Raghuvanshi, 17, of **Beaverton**, studied logic design and synthesis for the memristor – an electrical circuit element that offers space and power benefits over the transistor currently used in computer chips – for her Intel Science Talent Search **engineering** project. Logic tools used for modern circuit architectures are incompatible with memristors (short for memory resistors), so they must be created anew. Anika designed and implemented new logic synthesis methods for memristor-based binary circuits, and tested their performance based on cost, space and time. To represent the unique characteristics of memristor circuit design, she invented a notation system that is now being adopted by other researchers. To date, Anika has presented three research papers at international conferences, including two in Japan and Germany. The daughter of Arvind Kumar and Geetanjali Krishna, Anika began building complex robots, including humanoids and hexapods, while still in grade school. She is also a community activist who has raised thousands of dollars for education efforts in rural India. Anika attends **Jesuit High School** in Portland, where she plays varsity sports year-round and is a seasoned gold medal triathlete at the state level.

Emily Jane Spencer
Hathaway Brown School

Ohio

Emily Jane Spencer, 18, of **Moreland Hills**, developed a novel polymer that demonstrates both shape-memory and self-repair for her Intel Science Talent Search **materials science** project. A uniform polymer capable of this feat is the result of Emily's four-year effort. Current stimuli-responsive polymers achieve shape-memory or self-repair through the integration of separate materials, each with only one of these properties. Emily hypothesized that both could be achieved in a single cross-linked polymer with light-sensitive disulfide bonds. She carefully tuned her polymer's composition to achieve the desired properties, and then demonstrated its ability to recover shape when heated and repair itself in ultraviolet light. Emily believes that her creation could be applied as a coating to vehicles to simplify repair of scratches and surface damage. The daughter of Elizabeth and Ethan Spencer, she was co-author on an American Chemical Society publication and presented her work at the 2015 American Association for the Advancement of Science meeting. Emily attends **Hathaway Brown School** in Shaker Heights where she is captain of the debate team, competes on the varsity soccer team and is founder and president of the stock market club.

Tiffany Sun
Roslyn High School

New York

Tiffany Sun, 17, of **Roslyn**, put a unique spin on a study of the classic moral dilemma known as the Trolley Problem for her Intel Science Talent Search **behavioral and social sciences** project. The trolley problem requires a subject to decide between saving one person or five people from certain death with a flip of a lever. To explore how attractiveness, socioeconomic status and disability might affect that decision, Tiffany randomly assigned subjects one of six descriptions of the single person at risk: attractive woman, plain woman, woman in business suit, woman in waitress uniform, woman in wheelchair and woman standing. She found that subjects more frequently acted to sacrifice one plain, disabled or low-income woman than one attractive, able-bodied or wealthier woman. Tiffany believes her findings suggest a tendency to devalue the lives of plain, poor and disabled people. Tiffany participates in model government, the math team and Youth Against Cancer at **Roslyn High School** in Roslyn Heights, where she also has run varsity track. The daughter of Danielle and Ivan Sun, Tiffany coauthored a paper published in *Whitman Journal of Psychology* about the perceptions of stay-at-home parents re-entering the work force.

Tanay Tandon
Cupertino High School

California

Tanay Tandon, 18, of **Cupertino**, developed a low-cost system that could be used in remote areas for fast and portable blood diagnostics and parasite detection for his Intel Science Talent Search **computer science** project. Parasitical diseases can be fatal and affect hundreds of millions of people in undeveloped areas – many cases go undiagnosed until the patient is very ill. Tanay's solution was to make a powerful, low-cost microscope lens attachment for a smartphone camera that would enable rural medics to photograph a patient's blood sample, send the image to a computer equipped with statistics-based vision software that has been "trained" to analyze the images, and quickly view pathology results on the phone. In tests, Tanay's system identified parasites almost as accurately as a human technician. His research was inspired by his grandfather, a pathologist, who diagnosed blood disorders among remote villagers. The son of Neeraj and Mona Tandon, Tanay attends **Cupertino High School**. He has studied Hindustani Classical Music since sixth grade and enjoys singing at cultural events and playing tennis. Tanay also founded a startup company that recently received its seed-round of funding.

Steven Michael Wang
The Harker School

California

Steven Michael Wang, 17, of **Los Altos Hills**, developed a computational model to distinguish true drivers of colon cancer from irrelevant genes, and demonstrated the applicability of a 3D cell culture system, called an "organoid," as a validation medium for his Intel Science Talent Search **bioinformatics and genomics** project. Motivated by his late father's colon cancer diagnosis to better understand the disease, Steven first merged numerous bioinformatics techniques into a robust analytical workflow to predict and prioritize potential cancer causing genes, finding numerous novel candidates in the process. He then selected two well-known cancer genes from his bioinformatically generated list for induction into colon organoids, where substantial expansion confirmed them as colorectal cancer drivers. His multidimensional approach may contribute to more precise and patient-specific cancer diagnosis and treatment. A student at **The Harker School** in San Jose, Steven captains the speech and debate team, enjoys participating in annual dance productions, and serves as the founder and president of the nonprofit "Science Pursuits" to assist under-served students with STEM research. He is the son of Lisa and Steven S. Wang and plans to become a physician or college professor engaged in leading-edge cancer research.

Michael Winer
Montgomery Blair High School

Maryland

Michael Winer, 18, of **North Bethesda**, studied how phonons interact with electrons for his Intel Science Talent Search **physics** project. Phonons are fundamental units of sound, just as photons are units of light. Michael treated the phonons as system perturbations, which allowed him to derive a mathematical expression for a one-dimensional system representing a disordered system's energy and behavior. This enabled him to show that electrons, when bombarded by sound waves, absorb and emit phonons, which is analogous to how light photons interact with matter. He also developed the means to calculate the probabilities of such events. This work could have practical applications if it can be generalized to more complex atomic structures in which phonons interact with electrons, such as inside superconductors. Michael, the son of Emily Hofmann and Kenneth Winer, won a silver medal at the 2014 International Physics Olympiad, where he was the highest scoring U.S. student on the theoretical exam. Michael attends **Montgomery Blair High School** in Silver Spring, where he captains the physics and Science Bowl teams and competes on the math team. Michael plans a career in theoretical physics.

Jesse Zhang
Fairview High School

Colorado

Jesse Zhang, 17, of **Broomfield**, researched heat energy brought into the Arctic by the ocean's North Atlantic Current (NAC) that may be the trigger for Sudden Stratospheric Warming (SSW) for his **earth and planetary science** project for the Intel Science Talent Search. SSW is a large-scale atmospheric anomaly that occurs as part of a more general phenomenon known as Polar Vortex Weakening (PVW). Using 28 years of available observational data, Jesse correlated increases in the near-sea-surface temperatures in both the NAC and the North Atlantic subpolar region with well-defined SSWs and PVWs. Moreover, by correlating the ocean current conditions with PVW, he believes his findings can improve the accuracy of models used to forecast weather at the Earth's surface and in the upper atmosphere. The son of Yimin and Xiaoli Zhang, Jesse earned perfect SAT scores and is first author of two published journal articles about lunar tides. At **Fairview High School** in Boulder, Jesse is an avid basketball player and founder of the Physics Bowl club as well as an extracurricular math class for advanced middle school students — two of whom subsequently won the top awards in Colorado's MATHCOUNTS contest.

Yizhen Zhang
Richard Montgomery High School

Maryland

Yizhen Zhang, 17, of **North Potomac**, submitted an Intel Science Talent Search project in **animal sciences** that studied the structure, connections and signal modulation of retinal cells sensitive to blue light called S-cones. Blue light sensitivity is important for color vision as well as regulating basic brain functions. Using high-resolution images she gathered from a new type of scanning electron microscopy, Yizhen was able to identify the extremely rare S-cones based on light microscopy images that she had previously observed. She then built 3D reconstructions of the cells and their neuronal interconnections. Her research observations, which lend support to other recent hypotheses of S-cone function and clearly describe the anatomy of the blue-light pathway, may inform future treatments for colorblindness. At **Richard Montgomery High School** in Rockville, Yizhen is a vice president of the Red Cross chapter and member of the debate team. She also serves as editor-in-chief of a newspaper, which she co-founded in 2009 at the Potomac Chinese School. The daughter of Jun Zhang and Kui Sun, Yizhen has served as bilingual master of ceremonies in three Chinese-American events in the Washington, DC metro area. She enjoys playing flute and piccolo in multiple musical ensembles including the Potomac Valley Youth Orchestra.

Crystal Zheng
Jericho Senior High School

New York

Crystal Zheng, 17, of **Jericho**, studied the neuroscience behind some fear-related mental illnesses for her Intel Science Talent Search **biochemistry** project. Roughly 20 to 30 percent of the human population has a certain nucleotide mutation of the Brain-Derived Neurotrophic Factor (BDNF) gene that increases susceptibility to various fear-based disorders by impairing fear extinction circuitry. Crystal described the mutation's underlying molecular mechanism, including its effect on the shape of neurons, and believes she found a novel molecular pathway in mutation-induced hippocampal neuronal remodeling. Her work may result in more effective treatments for a range of mental illnesses, such as anxiety conditions and post-traumatic stress disorder. The daughter of Lihong Mao and Jianing Zheng, Crystal hopes to earn an MD/PhD in preparation for a career in neurology and research. She attends **Jericho Senior High School**, where she is a varsity athlete, captains the girls' swimming and diving teams and manages those same varsity teams for boys. Crystal is active in the Asian Culture Club, Stitching for Care Club and Piano for Patients, an organization whose members entertain residents of a nearby assisted-living facility.

Intel Science Talent Search 2015
Finalists by State

Intel Science Talent Search 2015
Finalists by Last Name

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