REGENERON

SCIENCE
TALENT SEARCH

A program of
SOCIETY FOR SCIENCE
& THE PUBLIC

Since 1942

REGENERON SCIENCE TALENT SEARCH

2017 FINALISTS

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The Regeneron Science Talent Search (Regeneron STS), a program of Society for Science & the Public, is the nation's most prestigious science and math competition for high school seniors. STS alumni have made extraordinary contributions to our society and are leaders in their fields. They hold more than 100 of the world's most distinguished science and math honors, including the Nobel Prize, National Medal of Science, Fields Medal, MacArthur Foundation Fellowship and Breakthrough Prize. Each year, roughly 300 Regeneron STS scholars and their schools are recognized, and from that select pool, 40 student finalists are invited to Washington, D.C., in March to participate in final judging, display their work to the public, meet with notable scientists and compete for awards, including the top award of $250,000.

REGENERON SCIENCE TALENT SEARCH 2017

MARCH 9–15, 2017

The 40 finalists of the Regeneron Science Talent Search 2017, a program of Society for Science & the Public, were selected based on the scientific rigor and world-changing potential of their research projects. These students have been awarded an all-expense paid trip to Washington, D.C., to attend the Regeneron Science Talent Institute, where they will compete for $1.8 million in awards.

The 15 young women and 25 young men come from 34 schools in 17 states. Finalists were selected from more than 1,700 entrants representing 527 high schools in 46 states, Puerto Rico and six overseas schools.

Unique among high school competitions in the U.S. and globally, the Regeneron Science Talent Search focuses on identifying the next generation of scientists and engineers who will provide critical leadership in solving some of the world's most pressing challenges while shaping the future of research and development for our nation and the world.

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 Regeneron STS. The Regeneron STS 2017 finalists, Regeneron 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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REGENERON 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 science competition for high school seniors. The Regeneron 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.

This year, Regeneron became only the third sponsor of the Science Talent Search, following previous sponsors Westinghouse and Intel. As part of its ten-year, $100 million commitment, Regeneron significantly increased awards to better reward the nation's brightest young scientists and encourage their continued pursuit of scientific innovation. In total, this year's finalists will receive over $1.8 million in awards provided by Regeneron, and overall, Regeneron will distribute $3.1 million in awards to the Regeneron Science Talent Search 2017 finalists, scholars and their schools.

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. Historically, the top 300 applications are identified from a pool of entrants from which 40 finalists are then selected from this prestigious group.

Since 1942, the STS has recognized 22,971 finalists and scholars who have received $20.2 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, National Medal of Science, Fields Medal, MacArthur Foundation Fellowship and Breakthrough Prize.

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, D.C., 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 Regeneron Science Talent Search in their senior year of high school.

Awards

Finalists will compete for more than $1.8 million in top awards – more than half of the Regeneron STS total annual award distribution of $3.1 million. The top ten awards range from $40,000 to $250,000 for the first place winner. Winners are selected by the judging committee and announced at a formal awards gala at the National Building Museum on March 14.

Each of the 300 students named a scholar in the Regeneron STS 2017 receives a $2,000 award for their outstanding science research, in addition to any amount that students may win as finalists. Each of their schools receives an award of $2,000 for each scholar named in the Regeneron STS 2017. The award is used to advance excellence in science, math, and/or engineering education at the recipient school.

Jessika Baral

Mission San Jose High School
California

Jessika Baral, 17, of **Fremont**, developed a rapid, cost-effective tool to predict the stage of small cell lung cancer (SCLC) for her Regeneron Science Talent Search **medicine and health** project. SCLC spreads quickly, and current methods to determine whether it has spread require complex machinery and expensive scans. Seeking an alternative, Jessika studied Nuclear Factor I/B (Nfib), a protein important to lung maturation, and found it was also crucial to the growth and spread of SCLC cells. She then wrote an app to analyze digital images of lung biopsies stained for Nfib. She trained her model to determine if the biopsy was cancerous and to predict whether it represented limited or extensive stage SCLC. Her tool is 95 percent accurate and can process scans within one minute. The daughter of Himanshu and Rashmita Baral, Jessika dedicated herself to cancer research after the death of her best friend in eighth grade. An accomplished pianist and composer who also performs and teaches classical Indian dance, Jessika attends **Mission San Jose High School**. She coauthored a paper published in *Cell* and has applied for patents for an eye-strengthening device and a cancer diagnostics application, OncoDetector.

Beau Taylor Bingham

Cascia Hall Preparatory School
Oklahoma

Beau Taylor Bingham, 17, of **Tulsa**, motivated by a family friend's life and death struggle with the "super-bug" methicillin-resistant *Staphylococcus aureus* (MRSA), evaluated algal extracts for their potential to treat antibiotic-resistant bacteria for his Regeneron Science Talent Search **medicine and health** project. Beau used extracts of the algae *C. crispus* and *L. digitata* for his study because they can be sustainably cultivated, are minimally toxic to native cells and have been identified as having antibacterial properties. He tested ten extracts against five commonly pathogenic bacteria, including two strains of MRSA. His extracts demonstrated previously unknown, antibacterial properties, both alone and synergistically with antibiotics, and were found to contain previously unidentified compounds that may be the basis of those properties. Beau must next research the effect of his extracts on human cells before they can be tested in a clinical setting. Beau is president of the scientific research team and the STEM club, and varsity team captain of the Academic Bowl at **Cascia Hall Preparatory School**. The son of Stephanie and Raymond Bingham, he answers calls on the hotline as a volunteer for Oklahomans for Equality.

Sambuddha Chattopadhyay

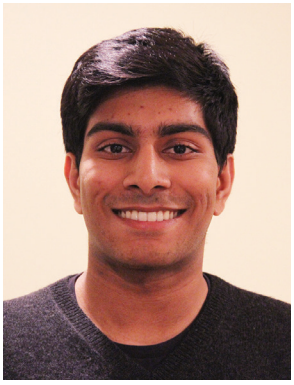
Montgomery Blair High School
Maryland

Sambuddha Chattopadhyay, 17, of **Olney**, examined a quantum symmetry with applications to dark energy for his Regeneron Science Talent Search project in **physics**. Theoretical investigations into the properties of dark energy are hindered by our limited understanding of quantum theory and ability to calculate the density of vacuum energy. Sambuddha investigated whether the application of Temperature reflection (T-reflection) symmetry could be used to study the vacuum energy of multiple quantum systems. He used analytic continuation to define T-reflection to avoid the divergences that typically occur in the equations of complex quantum mechanical systems when other methods are used. He hopes his work on T-reflective systems using this method can be used to further research in quantum field theory and ultimately increase our understanding of dark energy. Sambuddha is captain of the math, physics and Quizbowl teams at **Montgomery Blair High School** in Silver Spring, and also serves as a director of the math tournament. In his spare time, he volunteers at the Levine School of Music and has participated in the youth choir of the North American Bengali Conference. His parents are Manas and Gouri Chattopadhyay.

Jonathan H. Chung

Hendrick Hudson High School
New York

Jonathan H. Chung, 17, of **Cortlandt Manor**, identified two intestinal metabolites that increase expression of the dopamine transporter (DAT) for his Regeneron Science Talent Search **cellular and molecular biology** project. Dopamine is a neurotransmitter and abnormal levels of DAT are observed in many mental conditions. To study this interaction, Jonathan genetically engineered a DAT variant in a mammalian cell line and exposed those cells to four substances produced by microorganisms in the human gut. Two were shown to increase expression of DAT and two reduced it. Jonathan believes that using probiotics to normalize the amount of bacteria that produce these DAT-increasing metabolites could help modulate neurotransmission of substances associated with autism, depression and other mental disorders. Jonathan attends **Hendrick Hudson High School** in Montrose where he is a Mathletes A-Team starter and co-captain of the varsity tennis team. He also is a volunteer tennis instructor for children with autism. An accomplished violinist, Jonathan is concertmaster of the school's string, symphony and pit orchestras. He is the son of Karen Kisook and William Chung.



Rohan Dalvi

Montgomery Blair High School
Maryland

Rohan Dalvi, 18, of **North Potomac**, entered the Regeneron Science Talent Search with a **chemistry** project that investigated the structures of biomolecules. Rohan's project improved on a new analytical technique called ion mobility-mass spectrometry (IMMS), which calculates the molecular sizes of biochemical samples by bringing them into the gas phase and measuring the time required for the gaseous ions to traverse an electric field. Rohan's improvements included pulsing the electric field and studying the molecules at atmospheric pressure instead of in a conventional vacuum. This minimized the unfolding of the biomolecules and preserved extremely weak bonds that would otherwise be lost, enabling him to more accurately calculate the true size of the dissolved biomolecules. His results indicate that his modified version of IMMS can be used to determine the characteristics of biomolecular structures and macromolecular assemblies. The son of Manish and Vrishali Dalvi, Rohan attends **Montgomery Blair High School** in Silver Spring where he plays varsity tennis and captains both the biology and debate teams. Rohan is a coauthor of a paper on this new technology published in *Analytical Chemistry*.

Indrani Das

Academy for Medical Science Technology
New Jersey

Indrani Das, 17, of **Oradell**, conducted a three-year *in vitro* study of a possible treatment for brain injury for her Regeneron Science Talent Search **medicine and health** project. Brain injuries, traumatic or chronic, lead to the death of neurons. A contributing factor is astrogliosis, a condition that occurs when neural support cells called astrocytes react to the injury by growing, dividing and reducing their uptake of glutamate. Too much glutamate is toxic to neurons. As the remediating agent, Indrani selected microRNA-124a delivered in exosomes, small vesicles that can transfer therapeutic agents to cells. She based her choice on existing research that shows microRNA-124a increased astrocyte glutamate uptake. Introducing it to the reactive astrocytes improved their function, restored their glutamate uptake and increased survival of the surrounding neurons. Indrani attends the **Academy for Medical Science Technology** in Hackensack, where she conducted her research. She is founder and captain of the biology team, captain of the science Olympiad team and plays trumpet in the school's brass ensemble. The daughter of Bidyut and Tanima Das, Indrani volunteers as a math tutor, an EMT and a research intern at Hackensack University Medical Center.

Vineet Edupuganti

Oregon Episcopal School
Oregon

Vineet Edupuganti, 17, of **Portland**, developed and modeled the behavior of a high-performing battery that would intentionally degrade over time for his Regeneron Science Talent Search **engineering** project. Vineet created a battery using a variety of inexpensive, biodegradable iron- and magnesium-based materials as electrodes. Discharge tests showed that employing a magnesium alloy, rather than pure magnesium as the negative terminal, extended battery life six-fold. He then modeled and accurately predicted the behavior of a battery using this electrode under various conditions. Potential applications for Vineet's work include degradable, dissolvable power sources for implanted medical devices or marine sensors deployed in toxic spills. A classical pianist, Vineet attends **Oregon Episcopal School** where he plays varsity tennis and leads the Intercultural Students Association. He also earned a Regional Gold Key for literary journalism for a chronicle of his experiences as bilingual coordinator for the Voz Worker Center, which connects disenfranchised workers with local employers. The son of Ranya and Sriram Edupuganti, Vineet recently formed his own company to further develop his biodegradable battery.

Steven Thomas Elliott

Magnolia Academy
Texas

Steven Thomas Elliott, 18, of **Parker**, submitted a Regeneron Science Talent Search project in **engineering** in which he developed a motor controller to improve maneuvering of a quadcopter drone. Although quadcopters have become a mainstream consumer product, their performance and flight stability continue to be affected by environmental factors, such as wind gusts or declining battery power. Instead of relying on the pilot or a central computer system to counteract these problems, Steven built and tested a controller with a feedback mechanism that interacts with a thrust sensor and the propeller's motor to immediately compensate for external forces affecting flight stability. His prototype showed significant flight improvements over traditional quadcopters, which he details as first author on papers published in two different peer-reviewed journals. He is currently seeking a patent for his design. Steven has served as treasurer of his student body at **Magnolia Academy**, his homeschool cooperative. The son of Beth and Bill Elliott, Steven competes in varsity cross country and classical piano, which he has studied for 11 years. He frequently volunteers to raise funds and in-kind donations for needy families in his community.

Jacy Fang

Academy for Medical Science Technology
New Jersey

Jacy Fang, 18, of **Ridgewood**, conducted research in stem cell immunotherapy for her Regeneron Science Talent Search **medicine and health** project. For patients with relapsed acute lymphoblastic leukemia (ALL), the five-year survival rate is only five to ten percent. Immunotherapy, such as chimeric antigen receptor (CAR) T cell therapy, in which T cells are genetically engineered to target tumors, could improve this prognosis. However, to prevent secondary relapse, Jacy's research sought to ensure long-term survival of the engineered T cells to continue to fight cancer. She focused on inducing T cells to become the self-renewing stem-like memory T cells (T_{SCM}) that retain this targeting ability. Her study tested growth promoting factors IL-7 and IFN-γ antibody on T cells grown with OP9 cells found in bone marrow and the results were dramatic. The T cells expanded 96-fold and included a population of robust T_{SCM}, demonstrating the reversal of differentiation in antigen-experienced T cells. The daughter of Jiwen Fang and Cuiwen Tan, Jacy attends the **Academy for Medical Science Technology** in Hackensack. She is a National Honor Society tutor, a counselor at a camp for gifted children and co-president of her school's cultural dance club.

Isabella Iris Greco

Bronx High School of Science
New York

Isabella Iris Greco, 17, of **New York City**, studied the effects of gender stereotypes on false memories in employment contexts for her Regeneron Science Talent Search **behavioral and social sciences** project. Isabella wondered if common employment-related gender stereotypes, e.g., "pilot/male; nurse/female," could alter memory and perceptions of others' occupations and accomplishments. She asked 136 online participants to read brief "biographies" describing typical male, typical female and neutral occupations in which the worker's gender was either consistent or inconsistent with stereotypes. Testing their recollections with true and false statements, Isabella found that participants recalled female-linked biographies less accurately than male-linked biographies, regardless of worker gender; and that false statements reducing achievements in "feminine" occupations were accepted more readily than untruths that increased them. Isabella's work may help to mitigate implicit bias affecting workplace compensation and advancement. Isabella attends **Bronx High School of Science** where she is a summa cum laude Latin scholar and creates digital animations of Latin roots for middle school students. She is the daughter of Joan Greco.

Natalia Hajlasz

Taylor Allderdice High School
Pennsylvania

Natalia Hajlasz, 16, of **Pittsburgh**, worked to improve the computational methods that are used to simulate chemical reactions for her Regeneron Science Talent Search project in **chemistry.** Researchers use models to make predictions about chemical processes that are difficult to observe in nature. These models can require impractical amounts of time to generate results and are prone to biases inherent to their methodology. Natalia addressed these deficiencies by identifying a weighted ensemble strategy to model the dissociation of water from Mg^{2+} ions, a common process in the biochemistry of living systems. Her estimation of the dissociation rate constant for Mg^{2+} in water suggests that using weighted ensemble strategies could improve chemical simulations. Her results also indicate that the mechanisms of dissociation might be different for smaller ions. A frequent mentor to her peers, Natalia attends **Pittsburgh Allderdice High School** where she captains the debate team. She is also founder and president of the school's STEMinism club, which promotes female involvement and interest in STEM fields. Natalia enjoys playing the piano and violin and performs as part of a quartet ensemble. Her parents are Piotr and Joanna Hajlasz.

Blake Hord

Dobbs Ferry High School
New York

Blake Hord, 17, of **Dobbs Ferry**, attempted to improve the theoretical models astronomers use to examine the formation of planets for his Regeneron Science Talent Search **space science** project. Observations of gravity, heat and light from sources such as the Hubble Space Telescope are used to infer the presence of so-called exoplanets. Astronomers create detailed astrophysical models to predict the observations one would make in the gas and dust clouds orbiting stars from which exoplanets form. Blake combined models of heat transfer and motion in these clouds to explain observations that contradict current models. His work provides evidence for the existence of a new exoplanet and his programming contributions significantly enhanced the array of usable modeling tools available. In 2016, Blake presented his work at the NASA Exoplanet Science Institute. He attends **Dobbs Ferry High School** where he is captain and founder of the men's volleyball team and a four-year member of Designation Imagination, a problem-solving team. As his Eagle Scout project, Blake worked with his school district to construct an educational walking trail on unused land. His parents are Kim and Jim Hord.

Krithika Iyer

Plano East Senior High School
Texas

Krithika Iyer, 18, of **Plano**, submitted a **computer science** project to the Regeneron Science Talent Search that enables electronic teaching devices to gauge the emotional state of the learner and adjust its responses to reduce student frustration. Krithika used photos or videos of people exhibiting emotions, and developed a set of algorithms to infer their emotional states from their facial expressions. She went on to integrate each user's acquisition of knowledge or skill with that data and use her algorithm to adjust the device's reply to be most appropriate. Her prototype of the system encourages the learner and reduces frustration when it is sensed. She believes her emotionally accountable prototype mimics the way effective teachers nurture students who are struggling to learn new material. Krithika is an experienced mentor and tutor in math, science and programming. She attends **Plano East Senior High School** and her parents are Mythili Sridhar and Sridhar Iyer. She is a nationally ranked tennis player and sportsmanship award winner who coaches tennis in her spare time. She says about her work, "It is about spreading human connection, the true catalyst for progress in our society."

Apoorv Khandelwal

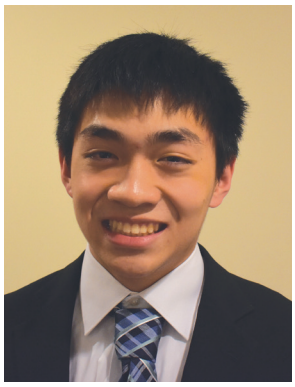
Tesla STEM High School
Washington

Apoorv Khandelwal, 17, of **Sammamish**, studied water desalination using atom-thin graphene membranes with nanoscale holes for his Regeneron Science Talent Search project in **materials science**. After visiting a region of India with very limited access to drinking water, Apoorv was inspired to investigate reverse osmosis as a way to derive clean water from seawater. Using supercomputer simulations of graphene filters, he determined an ideal structure for the highest theoretical filtration rates while still achieving adequate levels of clean water. He then fabricated single and double layer graphene membranes, sealed them, bombarded them with gallium ions to begin the creation of trillions of nanopores and then he tested desalination performance, which confirmed his computational results. Apoorv is president of the Future Business Leaders of America chapter at the **Tesla STEM High School** in Redmond, and has served as an engineer and programmer for VEX Robotics teams that won six tournaments from 2014 to 2016. Last year, he founded the school's competitive programming club, now with 80 members who compete in national problem-solving matches. Apoorv's parents are Vinay and Neelima Khandelwal.

Nathaniel Paul Lee

Jericho High School
New York

Nathaniel Paul Lee, 17, of **Jericho**, entered the Regeneron Science Talent Search with a **physics** project investigating the use of a new low-cost ceramic for optical parametric oscillators (OPO) that could reduce their cost 20-fold. Current OPOs that modulate lasers for scientific purposes require a single crystal that is both toxic and costly to manufacture. Nate replaced the crystal with a new ceramic composed of crushed zinc selenide. In tests, his composites proved to be comparable to monolithic crystals in efficiency and spectral coverage, and he believes his composite is the first to show the viability of these cost-effective ceramics for use in nonlinear optics. His device is scheduled for clinical testing. Nate's research was motivated by his grandfather's medical crisis while abroad, caused by a disease he believes will someday be detectable early using an OPO diagnostic tool. An Eagle Scout, Nate is the son of Mimi Man and Paul Lee. He attends **Jericho High School** where he is a debater, student council president and varsity cross country runner. In his free time, Nate works as a developer with several startups, most recently on a tool to enhance communication among law enforcement agencies.



Dylan Li

Hunter College High School
New York

Dylan Li, 17, of **New York City**, identified distinctions between two forms of the fat-regulating protein PPARγ and designed a novel therapeutic strategy that exploits these differences to treat obesity and type II diabetes for his Regeneron Science Talent Search **medicine and health** project. An existing class of diabetes drugs increases insulin sensitivity by augmenting the activity of the fat-regulating protein PPARγ, but also causes side effects, including weight gain. By exploring functional distinctions between the two versions of PPARγ Dylan found that only PPARγ2 induces fat development and causes bone loss, while PPARγ1 reduces fat development and has no effect on bone density. He then designed a new compound that capitalizes on these differences by partially inhibiting PPARγ2 without affecting the activity of PPARγ1, an outcome that he confirmed experimentally. Dylan's work may lay the groundwork for the next generation of obesity and diabetes drugs. Dylan is on the varsity swim and cross country teams at **Hunter College High School** and is the lead or coauthor on two articles published in professional journals. He also participated in the Chinatown Youth Initiative and is an award-winning pianist who has performed at Carnegie Hall. His parents are Shouhong Xuan and Hailong Li.

Vrinda Madan

Lake Highland Preparatory School
Florida

Vrinda Madan, 17, of **Orlando**, examined potential anti-malarial drugs for her Regeneron Science Talent Search **cellular and molecular biology** project. Malaria threatens more than 3.2 billion people worldwide and causes about half a million deaths each year. Because *P. falciparum*, the parasite primarily responsible for malaria, quickly becomes resistant to treatment, new drugs must be found. For her research, Vrinda prioritized 24 anti-malarial compounds based on their apparent toxicity, the distinctiveness of their chemical structure and the timing of their action in the parasite's life-cycle. Vrinda's study yielded two potential drugs that are structurally unique, inexpensive, derived from natural products and have mechanisms of action unlike currently available drugs. Her findings could expand the arsenal of drugs available for use in combination therapies, which are the gold-standard of malarial treatment. Vrinda is president of the Chinese National Honor Society and co-founder of Project Be-YOU-tiful, an initiative to empower women, at **Lake Highland Preparatory School**. The daughter of Alka Arora and Atul Madan, she is co-captain of an Indian fusion dance team and captain of her Bharatanatyam group at Nritya Academy.

Prathik Naidu

Thomas Jefferson High School for Science and Technology
Virginia

Prathik Naidu, 18, of **Potomac Falls**, developed machine learning software to study 3D interactions of the cancer genome, which can help discover targetable pathways for next-generation therapies for his Regeneron Science Talent Search **computational biology and bioinformatics** project. Prathik's new computational tool, called DNALoopR, can "learn" as it rapidly predicts the 3D topology of the genome. In the process, it characterizes the abnormal disruption of known cancer-associated genes and suggests biological alterations that had not been previously identified. DNALoopR has higher resolution than existing methods, which enhances its sensitivity. The next step is experimental validation of his tool's predictions. At **Thomas Jefferson High School for Science and Technology** in Alexandria, Prathik presides over the bioinformatics society, biotechnology club and debate team. A prize-winning Latin scholar, he founded The Classics Project, an initiative that organizes reading groups for veterans focusing on the present day relevance of classical war texts, such as Homer's *Odyssey*. The son of Sujatha Golla and Babu Chakrapani, Prathik hopes to create new software that oncologists can use to diagnose and treat cancer patients.

Ethan Joseph Novek

Greenwich High School
Connecticut

Ethan Joseph Novek, 18, of **Greenwich**, developed and holds an issued utility patent for a new method of capturing carbon dioxide emissions for his Regeneron Science Talent Search **engineering** project. His novel carbon capture process desorbs high-purity CO_2 by adding an organic solvent to a CO_2-rich aqueous ammonia solution. He recovers the organic solvent with low temperature distillation. The remaining CO_2-lean solution is recirculated. Ethan's process requires 75 percent less energy than current CO_2 capture processes. Ethan believes his process is the first CO_2 capture process capable of being powered entirely by abundant low temperature waste heat. Ethan holds seven patents related to his research and is first author of a peer-reviewed paper describing this work in the ACS journal *Environmental Science & Technology Letters*. At **Greenwich High School**, Ethan was active in the DECA Business Club and cross country and track until he began working full time as researcher and CEO of the company he founded to commercialize this technology. Ethan's future plans are built around his passion to harness untapped energy sources and turn waste products into valuable commodities. His parents are Bonnie and Keith Novek.

Emily Ann Peterson

Smithtown High School East
New York

Emily Ann Peterson, 17, of **St. James**, identified a new function for a protein that may impact wound healing and cancer treatment for her Regeneron Science Talent Search **cellular and molecular biology** project. Emily was intrigued to learn that squamous cell carcinoma (SCC) exploits healthy biological processes, such as wound repair, in order to spread malignant cells, yet suppresses the LRAT protein associated with wound healing. This prompted her to explore the protein's role in both cancer progression and skin regeneration. She created a population of SCC cell line with less LRAT suppression and ran numerous experiments to explore its effects on other proteins that control the stable growth of skin cells. A core finding, that LRAT-producing cells form thick, multilayered skin sheets as opposed to thin, easily fragmented sheets produced by cells lacking LRAT, sheds light on the mechanism of SCC spread. Her work may improve treatment for malignant skin changes and guide future wound healing studies. Emily competes on the math and varsity badminton teams at **Smithtown High School East** and is the founder of Boo Boo Bears, a charity supporting children at Stony Brook Hospital's Suffolk County Volunteer Firefighters Burn Center. She is the daughter of Stacy and Kevin Peterson.

Laura Catherine Pierson

The College Preparatory School
California

Laura Catherine Pierson, 17, of **Oakland**, used theoretical algebra to study the representation theory of mathematically symmetric groups for her Regeneron Science Talent Search **mathematics** project. One way to study such groups is to represent them with linear transformations that are easier to work with, while preserving the group's inherent structure. Laura's project dealt with such a representation; her challenge was to compute the signatures of multiplicity spaces in the Deligne category Rep(S_τ), where τ is a real number. Signatures in this context refer to the operations that characterize an algebraic structure. Previous research had developed ways to compute these signatures when τ is an integer, but Laura developed an algorithm that efficiently computes norm formulas and then combined these to produce signature formulas. The daughter of Cindy and Jerry Pierson, Laura skipped eighth grade to attend **The College Preparatory School**, where she is active in the theater as a performer and technician. She lectures, teaches and tutors math in a wide variety of settings and enjoys reading deep math and working on advanced topics. As a volunteer at Chabot Space and Science Center, Laura performs science demonstrations.

Evani Radiya-Dixit

The Harker School
California

Evani Radiya-Dixit, 18, of **San Jose**, developed an innovative approach to the analysis of cancer genetics for her **computational biology and bioinformatics** Regeneron Science Talent Search project. Evani examined the methylation patterns in large databases of DNA samples from healthy and cancer-stricken patients. Methylation is a natural process and one way that cells control gene transcription. Function-altering changes of methylation patterns occur in genes associated with cancer development. Evani developed a systematic approach to find these changes in lung, pancreatic and rectal adenocarcinomas, which together were responsible for 38 percent of U.S. cancer deaths in 2016. By searching the entire genome, not just the promoter regions of genes, she identified methylation abnormalities of genes responsible for signaling, structure and growth that were common in all three cancer types. This suggests that existing cancer drugs may be helpful in more than one cancer subtype and offers hints for targeting future cancer drugs. Evani's parents are Vibha Dixit and Ashvin Radiya. She attends **The Harker School** where she helps lead a 75-member club that brainstorms ingenious solutions to global challenges.

Arjun Srinivasan Ramani

West Lafayette Junior-Senior High School
Indiana

Arjun Srinivasan Ramani, 18, of **West Lafayette**, blended the mathematical field of graph theory with computer programming for his Regeneron Science Talent Search **computer science** project. A microbiologist studying protein interactions, a network engineer at a supercomputing center and a high school freshman using social media all face similar questions. Are their networks typical or unique? Do their networks have more cliques than would be expected, or fewer? Such questions can be difficult to answer, and are usually addressed by statistical comparisons to hundreds or thousands of random graphs, but generating such graphs can take a relatively long time. Arjun developed a novel algorithmic method that greatly reduced the computational time required to create the random graphs and graph sections. Arjun is the son of Sujatha and Karthik Ramani and attends **West Lafayette Junior-Senior High School**, where he is president of both the debate team and math club and plays varsity tennis. He plays the violin and volunteers in teen court and at the local science museum. Arjun is third author of a paper published in *European Journal of Physical Chemistry*.

David Boris Rekhtman

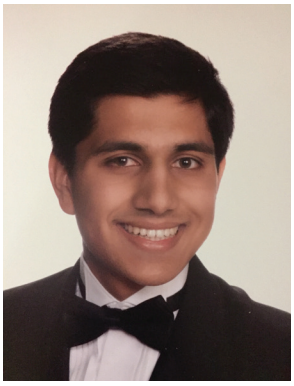
Walt Whitman High School
Maryland

David Boris Rekhtman, 18, of **Bethesda**, conducted research to determine if certain cancer treatments activated an immune response called immunogenic cell death (ICD) for his Regeneron Science Talent Search **medicine and health** project. David created *in vitro* simulations of two treatments – thermal ablative therapy, which uses high heat to destroy cancer cells, and near-infrared photo-immunotherapy, which uses a compound to kill cancer cells under infrared light. He found that both therapies result in the expression of damage-associated molecular patterns that can trigger localized ICD while stimulating the production of immune system cells that may target remote tumors found in metastatic cancer. David's next step is to develop a clinical assay to determine if a therapy has induced ICD. A leader in Sources of Strength, David has helped educate his peers at **Walt Whitman High School** on issues of depression and teen suicide. He works at Georgetown Cupcake and was a former rower, who as a sophomore set the victory pace for his team at the Maryland State Championship. The son of Boris Rekhtman and Luba Estrina, David is coauthor of a paper to be published in *Methods in Molecular Biology*.

Audrey Saltzman

Byram Hills High School
New York

Audrey Saltzman, 17, of **Pleasantville**, enhanced understanding of X-ray and UV emission from a neutron star for her Regeneron Science Talent Search project in **space science**. Audrey's long fascination with astronomy began as a child watching documentaries with her father. As her interest matured into scientific research, Audrey taught herself the necessary physics, calculus and computer skills to investigate low-mass X-ray binaries or "LMXBs." An LMXB is a two-star system in which one typical star orbits a second, incomprehensibly dense neutron star or black hole, which emits X-rays as it strips mass from its orbital partner. Audrey used data from NASA observations of an LMXB to identify the computational model that best estimated its neutron star's properties, as well as to demonstrate that its X-rays lose energy through interaction with matter pulled from its partner. Audrey, who compares doing research to "jumping into a novel, or my dreams," is a five-year Science Olympian and attends **Byram Hills High School** in Armonk. She is also a varsity debate team captain and jazz saxophonist. The daughter of Barbara and Jeffrey Saltzman, Audrey has also received the Girl Scout Gold Award for her gardening work at Audubon Greenwich.



Manan Ajay Shah

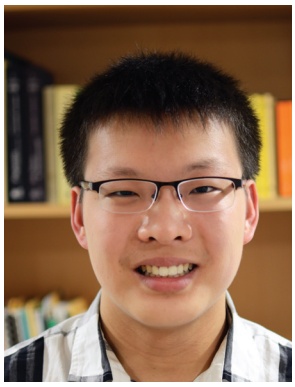
The Harker School
California

Manan Ajay Shah, 17, of **Los Altos**, developed an automated method to grade the severity of breast cancer tumors for his Regeneron Science Talent Search **computational biology and bioinformatics** project. The current method pathologists use to classify tumors is inefficient, expensive and subjective, which can lead to diagnostic disagreement. To speed the process and improve accuracy, Manan used image-oriented machine learning to create an analytical computer model that, in two seconds, uses multiple biologically relevant deep learning classifiers to characterize the severity of breast tumor growth and spread. His approach achieved pathologist-level performance and identified more than 200 unique biomarkers that may improve the accuracy of tumor assessments. He believes his cost-effective model can be applied to a wide range of cancers. Manan attends **The Harker School** in San Jose where he is team captain of the U.S. Invitational Young Physicists Tournament and an international delegate to the Critical Issues Forum for Nuclear Nonproliferation. The son of Ajay and Mona Shah, he authored a paper on computational epidemiology published in the *Journal of Machine Learning Research*.

Arjun Subramaniam

The Harker School
California

Arjun Subramaniam, 17, of **Cupertino**, submitted a Regeneron Science Talent Search project in **computational biology and bioinformatics** that investigated a new computational approach for antibody therapeutics. Arjun was inspired by the idea of a medicinal "magic bullet" that could use an engineered antibody to deliver a payload of drugs directly to a pathogen. His approach combined computational design with a deep learning model to analyze an antibody's structure and predict mutations that would increase its affinity and potency for targeting a specific pathogen. Results from his model suggest increased predictive accuracy of antibody binding affinity. He compared his method against current antibody-based treatments for HIV to further demonstrate real-world applications for his model and inform future treatments. The son of Deepa Gopalakrishnan and Srikanth Subramaniam, he is an accomplished Carnatic vocalist with over 12-years' experience and has performed in concerts and on television for audiences in India and the United States. Arjun is a student at **The Harker School** in San Jose and plans to earn a Ph.D. in computer science in preparation for an entrepreneurial career in Silicon Valley.



Alec Sun

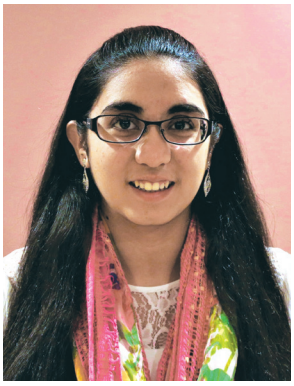
Phillips Exeter Academy
New Hampshire

Alec Sun, 18, of **Lexington, Massachusetts,** worked in the field of representation theory for his Regeneron Science Talent Search **mathematics** project. Alec's research project addressed questions about the combinatorics of multipartitions that arise from crystal operators and wall-crossing bijections. These questions are, in turn, related to the representation theory of rational Cherednik algebras and their interactions with certain natural operators. Alec was able to prove that a certain family of irreducible representations of rational Cherednik algebras are infinite-dimensional. This resolves the final case in a conjecture about the normalizer orbits of finite-dimensional representations associated with Coxeter groups, and may someday lead to useful results in quantum physics. Alec attends **Phillips Exeter Academy** in New Hampshire where he leads the physics club, heads the math club's problem committee and organized a hackathon event for New England high schoolers. The son of Bingjin He, Alec worked as a math competition instructor at A-Star Winter Math Camp. An avid pianist, he has taught piano to children and performed at Weill Recital Hall at Carnegie Hall.

Jessica C. Tian

Del Norte High School
California

Jessica C. Tian, 17, of **San Diego**, developed an easy, eco-friendly method to virtually eliminate bacterial growth on cellulose, the world's most abundant organic polymer, for her Regeneron Science Talent Search **chemistry** project. The unique structure and properties of cellulose, found in food, textiles, cosmetics, paper goods and countless other aspects of daily life, make it especially prone to the growth of microorganisms. To address the problem, Jessica used a simple solution and dip-coating process to modify the surface of cellulose fibers with titanium dioxide and silver nanoparticles, a combination that worked synergistically to inhibit more than 99 percent of *E. coli* bacteria. Her fabrication technique requires neither UV irradiation nor extremely high temperatures, making it more economical and easier to scale than commonly used methods. Her process may one day be used to create inexpensive antibacterial products of particular benefit to the developing world. Jessica attends **Del Norte High School** where she is a tutor for local junior high students, a writing and chemistry tutor and vice president of Science Alliance. She is the founder and head coach of the junior high math club of the neighboring Maranatha Christian School and is the daughter of Bei Chen and Runfeng Tian.



Archana Verma

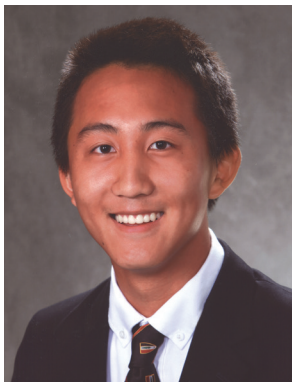
Jericho High School
New York

Archana Verma, 17, of **Jericho**, studied the energy dynamics of dyes similar to those used in dye-sensitized solar cells for her Regeneron Science Talent Search **chemistry** project. If more efficient dyes can be found, they could someday be integrated into windows capable of generating solar energy. Archana investigated how dyes absorb and transfer energy to electrons by comparing their molecular symmetries and spin-orbit coupling interactions. She used numerous analytical techniques to detect femtosecond (one quadrillionth of a second) changes in the dyes' electron energy when exposed to light and observed new mechanisms that reduce their energy transfer efficiency. She then generated more accurate electron orbital diagrams for the inorganic compounds she studied, to show that molecular symmetry and spin-orbit coupling are important determinants of how those mechanisms affect a dye's energetic properties. She believes her technique can be extended to more complex organometallic dyes to identify those with ideal characteristics for solar energy generation. The daughter of Alka and Rakesh Verma, Archana attends **Jericho High School** where she leads the Science Bowl and Quiz Bowl teams, and plays varsity badminton. She is also an accomplished Bollywood dancer.

Stefan Wan

Alexander W. Dreyfoos, Jr. School of the Arts
Florida

Stefan Wan, 17, of **Wellington**, developed a new composite material to remove phosphate from wastewater and storm runoff before they are discharged into the natural environment, and recycle the material for soil enrichment for his Regeneron Science Talent Search **engineering** project. After seeing phosphate-driven damage in the Everglades, Stefan integrated biochar, a charcoal-like powder, with layered double hydroxides (LDH) to adsorb damaging phosphate from polluted waters. By testing variations of the materials in several combinations, he found that biochar layered between a composite of aluminum and magnesium hydroxide achieved over 95 percent phosphate saturation within one hour. He then showed how the phosphate-laden material could be recycled as a cost-effective slow-release fertilizer for farm soil. A paper about his work appears in the *Journal of Industrial and Engineering Chemistry*. Stefan majors in piano performance at the **Alexander W. Dreyfoos, Jr. School of the Arts** in West Palm Beach, where he heads the academic team and science honors society. The son of Jianchang Cai and Yongshan Wan, Stefan tutors students in math ranging from algebra to calculus, and even teaches science and piano on request.



Felix Wang

The Roxbury Latin School
Massachusetts

Felix Wang, 18, of **Newton**, used algebraic geometry and his analytic results to solve a long-standing theoretical math problem for his Regeneron Science Talent Search **mathematics** project. Since the time of Archimedes, scholars have been interested in finding solutions to polynomial and rational equations. Felix found a new approach to solving combinatorial questions that can be applied to various mathematical fields, including complex analysis, dynamical systems and number theory. Prior to Felix's work, problems in these fields could be solved for polynomials, but not for the broader area of rational functions. His approach made it possible to extend the earlier work on polynomial functions to rational functions, and he proved its usefulness by using it to answer a theoretical math question that had remained unsolved since being posed in 1973. He also made progress on numerous other established problems. Felix, the son of Huajun Wang and Cindia Liu, attends **The Roxbury Latin School** in West Roxbury, where he is vice president of the science club, associate editor of the school's newspaper and plays on the varsity soccer team. He has worked as a summer intern for a startup company in San Jose and enjoys playing the piano.

Jackson Barker Weaver

Dr. Ronald E. McNair Academic High School
New Jersey

Jackson Barker Weaver, 17, of **Jersey City**, studied the use of electricity to increase the kinetic energy of molecules for his Regeneron Science Talent Search project in **biochemistry**. He began his work by asking if electrical energy would affect molecular reaction rates in the same way as thermal energy. Generally, as energy is added to a reaction, the motion of the reactant molecules and speed of enzyme catalysis increase, resulting in more rapid product formation. To explore his hypothesis, Jackson extracted peroxidase from turnips and used it to catalyze breakdown of hydrogen peroxide into water and oxygen, while varying the voltage across the reaction chamber using a circuit he designed. He concluded that an increase in voltage does lead to higher catalytic rates in enzymes, and he believes his work may eventually promote the use of small electrical currents as a medical therapy. Jackson attends **Dr. Ronald E. McNair Academic High School** where he is captain of the varsity soccer team, member of the Model UN and president of the Epsilon math club. The son of Carol Losos and Judson Weaver, Jackson researched microfluidics at the Governor's School of Engineering and Technology summer program.

Julian Wellman

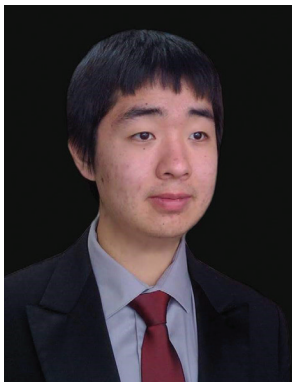
Greenhills School
Michigan

Julian Wellman, 18, of **Ann Arbor**, contributed to the math field of combinatorics for his Regeneron Science Talent Search **mathematics** project. Suppose you have a supply of balls, each of which is one of three colors. If you were asked to arrange them in a line while avoiding any immediate repetitions or repetitive alternations of two colors, then what would be the maximum number of balls you could line up? Now imagine that you have more colors, or the "no alternating" rule only applies to a subsequence of six or eight balls. This is the Davenport-Schinzel sequence problem that Julian worked on. After making an insightful connection between Latin squares (think Sudoku!) and his problem, Julian was able to make progress by studying how well you could do if you had many colors to work with and were allowed to have longer and longer alternating subsequences. Julian attends **Greenhills School**, where he captains the chess team and the National Science Bowl Team. The son of Michael Wellman and Erika Homann, Julian was a member of Michigan's Regional Math League team, which placed eighth nationally last year, and enjoys the physical and mathematical challenge of juggling.

Derek Woo

Greenwich High School
Connecticut

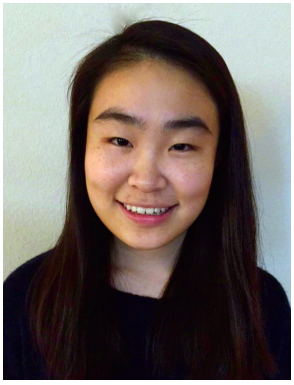
Derek Woo, 17, of **Greenwich**, explored a possible explanation of colony collapse disorder, which is devastating honeybee populations worldwide, for his Regeneron Science Talent Search **environmental science** project. Working in his high school's horticulture lab, Derek first demonstrated that imidacloprid pesticide migrated from the soil into and through his experimental plants, and was excreted as water droplets at the tips of their leaves at levels nearly four times greater than he had administered to the soil. At these levels, the pesticide would be lethal to bees, which preferentially drink such water because it normally contains nutrients. He then showed that adding ten percent biochar to the soil reduced pesticide concentrations in the droplets on the leaf surface by 90 percent, a level that should be safe for bees. Derek is varsity crew team co-captain who competed in Youth Nationals and attends **Greenwich High School**, where he also plays clarinet in the wind ensemble and has been accepted into Connecticut's Regional and All State bands. The son of Charles Woo and Ryeo-Jin Kang, Derek volunteers at a local nursing home and works part-time at Bricks-4-Kidz, teaching children the basics of robotics and engineering.



Byron Lee Xu

William P. Clements High School
Texas

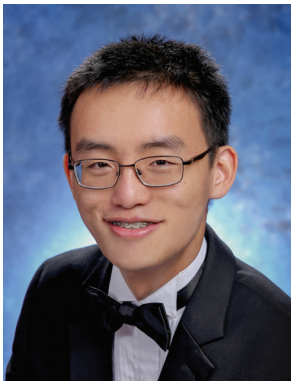
Byron Lee Xu, 17, of **Sugar Land**, developed a new method of measuring ocean temperature for his **earth and planetary science** Regeneron Science Talent Search project. Current techniques rely on satellites, which only measure temperatures near the ocean's surface, or probes that descend vertically into the ocean, which lack horizontal detail. Byron bridged this gap by analyzing seismic data to determine changes in sound wave velocities and then used this information to calculate water temperatures at a higher level of horizontal detail. Byron believes that using his approach to analyze seismic data gathered over the past 50 years will reveal how ocean currents and temperatures have shifted over time, potentially leading to more accurate climate change models. The son of Jessie Li and Jim Xu, Byron was inspired to study seismic oceanography in 2013 after observing a sonar image of the ocean floor during a lobster boat tour. An avid violinist, he has performed in his school's orchestra and in the All-Region Orchestra for the past four years. He regularly volunteers as a coach of his former middle school's Mathcounts team and as a science tutor at his school, **William P. Clements High School**.



Amber Zoe Yang

Trinity Preparatory School
Florida

Amber Zoe Yang, 17, of **Windermere**, created a novel machine learning system to track and prevent collisions with orbiting space debris for her Regeneron Science Talent Search **space science** project. Amber's concern about space debris hazards was sparked by the 2013 collision of a Russian satellite with debris from an abandoned Chinese satellite. An estimated 500,000 debris objects are now believed to exist in low Earth orbit. Currently, tracking changes in their orbits requires using software to make manual adjustments in their trajectories. As a more efficient alternative to predicting those trajectories, Amber developed two artificial neural networks (ANNs) capable of applying Kepler's laws of planetary motion to orbiting space debris. Tested with simulated and real debris data, the ANN system was able to catalogue and predict orbital changes to within 100 meters. Amber's work may be a step toward safer space travel amid rising populations of space debris. At **Trinity Preparatory School** in Winter Park, Amber is editor-in-chief of the school paper and Science Olympiad team leader. She is classically trained on piano and violin and blogs on plant chemistry for Nature Publishing Group's *Scitables*. Her parents are Chia-Ying Teng and Lifarn Yang.



Michael Yang

Charlotte Latin School
North Carolina

Michael Yang, 18, of **Matthews**, entered the Regeneron Science Talent Search with a **computational biology and bioinformatics** project that models how collective behaviors in nature, such as the decentralized collaboration of foraging ants, may evolve in response to environmental change. Inspired by the biological cell, Michael based his model on the environmentally dependent, thus constantly changing, interactions among intracellular proteins. His model simulates how individuals sharing certain relationships may act in concert with their cohorts in a group or network. If network motifs can be identified as tending to arise under certain environmental conditions, Michael's model may offer a new representation of how collective behaviors reorganize in response to change. His work also demonstrates how models of these networks can be used in computing applications. The son of Andy Yang and Yan Sun, Michael attends the **Charlotte Latin School** where he leads the math club and publishes poetry in the school's literary magazine. Michael enjoys charcoal portraiture and figure drawing, as well as oil painting.

Aaron Joseph Yeiser

Perkiomen Valley High School
Pennsylvania

Aaron Joseph Yeiser, 18, of **Schwenksville**, developed a new numerical method for solving partial differential equations on complicated geometries for his Regeneron Science Talent Search **mathematics** project and demonstrated its applicability to the challenging field of computational fluid dynamics. Partial differential equations are ubiquitous in math, engineering and science, and are typically solved numerically by dividing the problem area into small units of various shapes and then compiling the values for each unit. Some of the most challenging problems in modern numerical partial differential equations occur when one needs an extremely fine mesh size, as these lead to inefficient simulations. Aaron developed a new algorithm that is more efficient in these cases, as it can use a mesh with a few very skinny elements, rather than larger numbers of regularly shaped elements. Aaron, the son of Ruth and Charles Yeiser, has co-authored a computer science paper published online in *IEEE Xplore.* He attends **Perkiomen Valley High School** in Collegeville, where he competes on the Science Olympiad and track teams. He is also on Lehigh Valley's elite math team. During the summers, he works as a sailing instructor.

Mary Zhu

Nashua High School South
New Hampshire

Mary Zhu, 18, of **Nashua**, created a linear programming model to project the environmental and economic impact of enforcing the carbon tax proposed during the Paris Agreement's negotiation by the U.S. Senate's 2015 Climate Protection and Justice Act for her Regeneron Science Talent Search behavioral and social sciences project. Using free/home software, Mary focused solely on the global agricultural market that accounts for about one-third of the world's carbon emissions. She examined three scenarios: no country enacts the tax; enacted only by developed countries; or enacted by all countries. A comparative analysis of the scenarios' trade-offs and projections of their impacts capture the carbon tax controversy, in that enforcement reduces carbon emissions, but depresses trade and production, causing price increases. The model's versatility, allowing different parameters to be set for different goals, makes it a potentially powerful tool for exploring environmental and economic policy. At **Nashua High School South**, Mary leads the Economic Quiz Bowl team and both the National Math and Social Studies Honor Societies. The daughter of Shushuai Zhu and Ying Yang, Mary founded a non-profit bakery to benefit World Vision International's Child Sponsorship Program.

REGENERON SCIENCE TALENT SEARCH 2017 | Finalists by State

REGENERON SCIENCE TALENT SEARCH 2017 | Finalists by Last Name

REGENERON SCIENCE TALENT SEARCH 2017 | Finalists by Category

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Society for Science & the Public is a 501(c)(3) nonprofit membership organization, dedicated to the achievement of young researchers in independent research and to the public engagement in science. Established in 1921, its vision is to promote the understanding and appreciation of science and the vital role it plays in human advancement. Through its acclaimed education competitions, including the Regeneron Science Talent Search, the Intel International Science and Engineering Fair, and the Broadcom MASTERS, and its award-winning publications, *Science News* and *Science News for Students*, the Society is committed to inform educate and inspire.

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