REGENERON

SCIENCE TALENT SEARCH

A program of

SOCIETY FOR SCIENCE

Since 1942

REGENERON SCIENCE TALENT SEARCH

2022 FINALISTS

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The Regeneron Science Talent Search (Regeneron STS), a program of Society for Science, is the nation's oldest and most prestigious science and math competition for high school seniors. 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 Regeneron STS scholars and their schools are recognized. From that select pool of scholars, 40 student finalists are invited 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 2022

MARCH 10–16, 2022

The 40 finalists of the Regeneron Science Talent Search 2022, a program of Society for Science, were selected based on the scientific rigor and world-changing potential of their research projects. These students are invited to attend the Regeneron Science Talent Institute, where they will compete for $1.8 million in awards.

The 40 finalists come from 37 schools and one home school in 16 states. Finalists were selected from 1,805 entrants, representing 611 high schools in 5 states, Washington, D.C., Puerto Rico, and ten countries.

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 2022 finalists, Regeneron and Society for Science acknowledge with gratitude the guidance, expertise and patience of the experienced researchers who made many of these projects possible.

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HISTORY

The Science Talent Search (STS), a program of Society for Science 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.

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 2022 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 24,471 finalists and scholars who have received $31 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. A team of scientific evaluators and judges review applications and select 300 scholars and 40 finalists from the entrant pool.

The top 40 finalists participate in a finals week competition, typically held in Washington, D.C. Finalists meet leading scientists and distinguished national leaders, and visit institutions of historic and political importance. Finalists will display their research at to the public in a virtual forum on March 13, where they describe their work to the public. 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 on March 15.

Each of the 300 students named a scholar in the Regeneron STS 2022 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 2022. The award is used to advance excellence in science, math and/or engineering education at the recipient school.

2022 FINALISTS

Claire Andreasen She/Her/Hers

The Charter School of Wilmington
DELAWARE

Claire Andreasen, 18, of **Newark**, used computational physics to study the effects of strain on graphene for her Regeneron Science Talent Search **materials science** project. Graphene is a form of carbon that is one atom thick, and has exceptionally high tensile strength and electrical conductivity, which gives it many potential uses. Missing carbon atoms in the lattice structure of graphene has been found to be important. Using density functional theory results, Claire found that an imposed strain of 1.7% on graphene should alter the distribution of electrons near these defects, which in turn would change the magnetic properties of the graphene. Because this change is reversible, it could one day be used to make electronic devices, such as hard drives and transistors. This research has been published in the *Journal of Applied Physics*, with Claire as the first author. The daughter of Robin Andreasen and Milo Aukerman, Claire attends **The Charter School of Wilmington** where she is captain of the varsity girls cross country team, co-leader of the Envirothon competition and co-founder of an environmental activism club. In addition, Claire is the first chair French horn player in the Delaware Youth Symphony Orchestra.

Max Bee-Lindgren They/Them/Theirs

Decatur High School
GEORGIA

Max Bee-Lindgren, 18, of **Decatur**, significantly improved an important algorithm in quantum computing for their Regeneron Science Talent Search **physics** project. Quantum computers differ from traditional electronic computers by using quantum states and various aspects like superposition and entanglement to perform calculations instead of electronic logic gates. Quantum computers, though still in their infancy, can already perform some calculations faster than classical computers. Max significantly improved the quantum rodeo algorithm, which computed energy states but focused on just one quantum state. Max's modification involves isolating a superposition of two quantum states, which improves the algorithm's functionality, and makes it possible to calculate the probability of the system transitioning between these two states. Max, whose parents are Bert and Pamela Bee-Lindgren, began attending college the same time they started high school. At **Decatur High School**, they serve as the design and fabrication lead for their award-winning robotics team. Max also helped form a coding club and run the school's Fantasy Stork Club, a bird-based fantasy race that allows players to "draft" actual storks onto fantasy teams.

Atreyus Abdhish Bhavsar He/Him/His

The Blake School — Northrop Campus
MINNESOTA

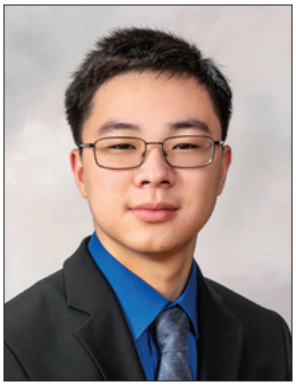
Atreyus Abdhish Bhavsar, 18, of **Medina**, studied the parameters and prevention of respiratory droplet spread in a school setting for his Regeneron Science Talent Search **behavioral and social sciences** project. Prompted by a desire early in the pandemic for a safe return to school, Atreyus replicated aspects of his school cafeteria in his basement lab and measured maximum droplet spread from a simulated cough. He attached mannequin heads to frames adjusted for standing and sitting heights and filled balloons with fluorescent paint diluted to mimic the viscosity of saliva. Using an air compressor regulated to the pressure of a laryngeal cough, he inflated the balloons within the mannequin heads until they burst, expelling paint through the mouth and nose. Atreyus measured droplet spread under a black light and repeated the trials using surgical masks and several barrier designs. His findings confirmed that masks mitigated respiratory droplet spread and revealed an optimal barrier design for use while unmasked. At **The Blake School — Northrop Campus**, Atreyus is a debater and US Squash Scholar Athlete. The son of Mary and Abdhish Bhavsar, he volunteers at a local wildlife center and cares for animals on the family farm.

Elijah Eshaun Burks He/Him/His

Caddo Parish Magnet High School
LOUISIANA

Elijah Eshaun Burks, 17, of **Shreveport**, applied his Regeneron Science Talent Search **animal sciences** project to measuring the effects on freshwater clams of rising acidity caused by higher concentrations of carbon dioxide (CO_2) in the atmosphere. Levels of calcium carbonate, a compound essential for clams to grow their shells, are directly impacted by the amount of CO_2 in the water. To simulate changing CO_2 conditions, Elijah built an apparatus to vary pH levels from alkaline to acidic in three tanks of *Corbicula fluminea* clams. After a week, he measured their body mass and respiration and found, as shown in saltwater studies, that the more acidic the water, the greater the negative effect on growth. Clams in acidic water lost mass and had increased respiration rate, while clams in alkaline water grew body mass while using less metabolic energy to build their shells. Elijah hopes to spur more study of freshwater acidification, which threatens natural resources and livelihoods alike. At **Caddo Parish Magnet High School**, Elijah is active in student government and was chosen as a student researcher in the SMART program. He also plays piano and is a six-time taekwondo champion. His parents are Broderick and Shawanda Burks.

2022 FINALISTS



Victor Cai He/Him/His

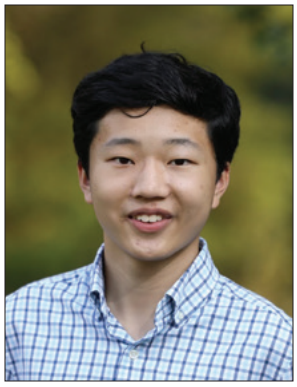
Parkland High School
PENNSYLVANIA

Victor Cai, 18, of **Orefield**, determined to create a digital guide dog to help his visually impaired karate teacher, designed a short-range, distance sensing radar for his Regeneron Science Talent Search **engineering** project. To keep the cost low, Victor adopted the little used multiple frequency continuous wave radar concept and built his system using "software defined radio," which allows him to control his radar with software instead of specialized hardware. Victor's radar transmits simultaneous signals at two different frequencies and then calculates distance by measuring the phase difference between them. Victor refined his radar by writing two algorithms to prevent imprecise readings caused by spectrum leakage and to correct erroneous phase measurements, allowing him to achieve 12 cm accuracy using only a few kHz of bandwidth compared to 1 GHz used by traditional radar. The son of Qian Huang and Yi Cai, Victor attends **Parkland High School** in Allentown, where he heads both the math league and the science fair club. A karate student for over 11 years, he is also an accomplished violist who has played in national and state level orchestras and founded Personal Musicians, Live! to provide virtual live music for seniors.

Ethan Chiu He/Him/His

Syosset High School
NEW YORK

Ethan Anthony Chiu, 17, of **Jericho**, submitted a **medicine and health** project to the Regeneron Science Talent Search. While researching more economical cancer therapies, Ethan learned that the antibiotic doxycycline has been used to treat breast cancer. Believing it might work against other cancers, he found an opportunity to test the drug against the eye cancer uveal melanoma (UM). Ethan's study began with bioinformatics using single cell RNA sequencing to compare UM, normal human eye and eye organoid (lab grown) data to identify the differentially expressed genes implicated in the spread of UM. Once in the lab, Ethan used stem cells to grow normal eye organoid cultures and CRISPR-modified organoids with key genes knocked out. Then, he treated them with doxycycline and found that the drug's many tumor-inhibiting properties are also applicable to UM. The son of Tony Chiu and Soofang Wang, Ethan attends **Syosset High School**. Committed to social justice, he is founder and CEO of Next Generation Diplomacy, volunteers with the Red Cross in international humanitarian law and is on the youth advisory council for the UN Ocean Decade. Ethan also plays and tutors others on tenor saxophone.



Benjamin Choi He/Him/His

Potomac School
VIRGINIA

Benjamin Choi, 17, of **McLean**, designed and tested a low-cost way to control a prosthetic arm using mind control for his Regeneron Science Talent Search **bioengineering** project. Inspired by a news report he recalled from third grade, Ben wanted to advance the field of prosthetics by applying the power of artificial intelligence (AI) to the tasks. He placed tiny, non-invasive electrodes in a headband worn by human volunteers, to record "fuzzy residual electrical activity" and collect thousands of brainwave data points. With that data he trained his own complex AI-based algorithm to differentiate the wearer's thoughts from other electrical activity detected by the electrodes. In physical movement tests, his $300 bionic arm system compared favorably with alternative prosthetics that require brain surgery and can cost upwards of $450,000. Ben attends **Potomac School** where he plays varsity squash and is president of the student body, for whom he organized a year of activities to help students cope during the pandemic. A passionate violist and soloist from age six, he has won top honors in numerous international competitions. The son of Erin Cho and Brian Choi, Ben hopes to "use AI for good" in a future STEM career.

Neil Chowdhury He/Him/His

Phillips Exeter Academy
NEW HAMPSHIRE

Neil Chowdhury, 18, of **Bellevue**, Washington, submitted a **computational biology and bioinformatics** project to the Regeneron Science Talent Search. To fit inside a cell's nucleus, a long string of DNA wraps around proteins, called histones, to form chromatin, which further loops and coils to form a chromosome. One method of modulating this folding process is to chemically encode "marks" on the DNA string. Neil attempted to replicate chemical marking using molecular dynamics simulations of specific DNA polymers (large molecules). His computational project explored a modification of a specific histone implicated in colon cancer. Neil coded his simulation in Python, an open-source programming language, and data from the relevant colon cancer cell line. His work accurately reproduced recent experimental results and showed that the histone modification caused changes in compartmentalization and loop extrusion, two key processes regulating DNA organization in cells. Neil attends **Phillips Exeter Academy** in Exeter, New Hampshire, where he leads the Science Bowl team and co-leads the math, physics and chemistry clubs. The son of Rina and Shyamal Chowdhury, Neil is a birder who wants to have a birds-eye view of the world.

2022 FINALISTS

Andrew Kai Chu He/Him/His

The Nueva School
CALIFORNIA

Andrew Kai Chu, 18, of **Palo Alto**, studied possible ways to improve power grids for his Regeneron Science Talent Search **environmental science** project. As the world strives for more carbon neutral energy, power grids must adapt to the intermittency of renewable energy generation by employing technologies such as long duration energy storage. Andrew's modelling work indicates that in the future, both short and long duration storage could operate synergistically, instead of competitively. In fact, his model suggests that optimal incorporation of long duration storage technologies, such as hydrogen gas storage, could reduce the total amount of renewable energy infrastructure needed to achieve carbon neutrality by two-thirds and cut in half the overall cost of grid decarbonization. His clean energy research was the subject of a peer-reviewed paper, of which he was lead author, published last year. The son of Shelley Chu, Andrew captains the physics research club and leads the Fossil Fuel Divestment Team at **The Nueva School** in San Mateo, where he is co-president of the student council. Andrew is a passionate researcher and advocate for solutions in infectious disease.

Brooke Ann Dunefsky She/Her/Hers

Irvington High School
NEW YORK

Brooke Ann Dunefsky, 18, of **Irvington**, invented a biomedical device to speed the recovery of stroke patients with upper limb impairment for her Regeneron Science Talent Search **bioengineering** project. Brooke's invention applies the principles of neuroplasticity, which is the brain's ability to create new pathways when others are damaged, by providing specific, repetitive arm movement of variable intensity. To use her device, a patient grips a handle and turns it left and right to rotate their arm through a 180- degree arc in movements called pronation (palm down) and supination (palm up). To adjust resistance and intensity, Brooke's device uses magnetic eddy currents created by moving a neodymium magnet closer to or farther away from a metal flywheel. Her patented device is portable and, at under $100 to build, affordable to most. Brooke attends **Irvington High School** where she is co-founder and president of the debate team and a teaching assistant for engineering and architecture classes. The daughter of Allyse and Brian Dunefsky, Brooke created and hosts the podcast *Charity Talks*, on which she interviews leaders of local, national and global nonprofits and other inspirational people making an impact in the world.

Rohan Singh Ghotra He/Him/His

Syosset High School
NEW YORK

Rohan Singh Ghotra, 17, of **Woodbury**, focused his Regeneron Science Talent Search **computational biology and bioinformatics** project on investigating how computer models used to study DNA can be analyzed to obtain important information about gene expression. Artificial intelligence models are used to predict the biological effects of DNA sequences. Rohan identified several principles that could be used to improve these models while developing his own computational tool, dubbed GLIFAC, to robustly infer protein interactions across a wide spectrum of genomics models and DNA sequences. In tests with simulated DNA sequences, GLIFAC performed significantly better than current methods. Using tools such as GLIFAC to explain how mutations affect cellular machinery may open the way to treating illnesses with genetic origins, such as cancer and Parkinson's disease. Rohan attends **Syosset High School** where he presides over six robotics teams, including the award-winning Team Syosset Syborgs. Pre-COVID, he also volunteered weekly for a local hospital and a soup kitchen. The son of Tejinder and Satwinder Singh, Rohan is first author of two peer-reviewed workshop papers presented at international machine learning conferences.

Vivien He She/Her/Hers

Palos Verdes Peninsula High School
CALIFORNIA

Vivien He, 18, of **Rancho Palos Verdes**, invented a small, low-cost, seismometer to provide early warning of strong ground shaking during an earthquake for her Regeneron Science Talent Search **earth and planetary science** project. At the size of a Rubik's Cube, Vivien's low-cost, Wi-Fi accessible, in-home device, called the Qube, contains a processor, a geophone to sense ground motion, circuitry for signal processing and an alarm. Intended to detect the earliest vibrations, the Qube would give a few to several seconds of warning for people to seek shelter or go outside. Vivien programmed the Qube and wrote an empirical logarithmic formula to estimate local earthquake magnitude based on detected ground motion amplitude. During nine months of testing, the Qube detected earthquakes over magnitude (M) 3.0 around L.A., and nearby earthquakes of just M 2.3. At **Palos Verdes Peninsula High School** in Rolling Hills Estates, Vivien is a member of the varsity dance team and president of a political activism club. The daughter of Maggie and Andy He, she enjoys drawing and painting and plays violin, piano and guitar. Vivien also is founder and CEO of the environmental nonprofit Melior (Latin for "better") Earth.

2022 FINALISTS

Heloise Hoffmann She/Her/Hers

Community School of Naples
FLORIDA

Heloise Hoffmann, 18, of **Naples**, conducted the largest study ever done of sleep quality (SQ) and excessive daytime sleepiness (DS) in facioscapulohumeral muscular dystrophy (FSHD) patients for her Regeneron Science Talent Search **medicine and health** project. Diagnosed with FSHD at thirteen and determined to contribute to research, Heloise created a survey designed to better understand sleep by FSHD patients. Her four-part questionnaire included demographic information, medical history, such as pain and ambulation, the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale. Of the 2,000 patients surveyed, 690 responded. Her data analysis revealed that 66% of patients had poor SQ yet only 15% had excessive DS, suggesting that greater emphasis should be placed on improving quality of sleep in FSHD patients, including pain management. The daughter of Alex and Anne Hoffmann, she attends **Community School of Naples**. She is the lead editor of the *Journal for High School Scholarship* and president of the school's Science National Honor Society. A guitarist who sings pop-rock and opera, she plans a career in pediatric neurology "so that no other child must hear that their pain is due to their teenage imagination."

Theodore Tianqi Jiang He/Him/His

Palisades Charter High School
CALIFORNIA

Theodore Tianqi Jiang, 18, of **Santa Monica**, developed a machine learning model to predict whether a genetic variant causing an amino acid substitution causes disease for his Regeneron Science Talent Search **computational biology and bioinformatics** project. Theo developed MutFormer by modifying a machine learning method called a "transformer," which can be used for machine-based document generation and automating natural sounding translations between languages. After MutFormer was pre-trained on reference protein sequences and alternative protein sequences resulting from common genetic variants, it outperformed a variety of existing tools for predicting the ability to cause disease because it better understood the "language" of proteins. Theo attends **Palisades Charter High School** in Pacific Palisades, where he is involved in the leadership of the science fair and coding clubs and is principal oboist in the symphony orchestra. The son of Ruiwen Qin and Lin Jiang, Theo has also developed deep-learning software for MRI imaging in brain cancer treatment and led a team to develop software that mimics classical violin playing.

Daniel Larsen He/Him/His

Bloomington High School South
INDIANA

Daniel Larsen, 18, of **Bloomington**, showed the abundance of Carmichael numbers for his Regeneron Science Talent Search **mathematics** project. Along with being intellectually interesting, prime numbers are crucial for cryptography where large primes help keep communication secure. A tool useful in finding primes is called Fermat's little theorem, a test that all prime numbers pass. Carmichael numbers are those that pass this test yet are not actually prime, and so are sometimes called Fermat's pseudoprimes. Daniel answered an important question about the abundance of Carmichael numbers, showing that for any number, there is always a Carmichael number hidden between it and its double, if the number is large enough. Daniel hopes his work will lead to a better understanding of these intriguing numbers. Daniel is sole author on a paper published in *The Fibonacci Quarterly*. An award-winning violinist and pianist, he was orchestra concertmaster at **Bloomington High School South**. Daniel is also an avid crossword creator who, at age 13, became the youngest "puzzler" to be published by the *New York Times*, which has since printed 10 more of his puzzles. His parents are Michael Larsen and Ayelet Lindenstrauss Larsen.

Krystal S. Li She/Her/Hers

Coral Reef Senior High School
FLORIDA

Krystal Li, 17, of **Palmetto Bay**, applied her Regeneron Science Talent Search **plant sciences** project to exploring an alternative for traditional phosphorus fertilizers that threaten water quality, including in nearby Biscayne Bay. Fertilizer use causes phosphorus to become fixed by soils in a form inaccessible to plants. Krystal sought to identify strains of bacteria best able to dissolve fixed phosphorus to make this essential nutrient more naturally available to plants. She sampled bacteria from soils of native plants that grow well without phosphorus and grew it on solid and liquid media to determine their pH and phosphorus solubilizing abilities. After isolating dozens of solubilizing strains, she used gene sequencing to identify five types that both lowered pH levels of the soil samples and significantly increased water-soluble phosphorus. Her work may help reduce the need for inorganic phosphorus fertilizers that pollute local waters. At Miami's **Coral Reef Senior High School**, Krystal is the paper's editor-in-chief, layout editor of the literary and arts magazine and founding co-president of the Korean Culture Club. She also volunteers with Miami Homes for All, which addresses local housing instability. Her parents are Yuncong and Zhitong Li.

2022 FINALISTS

Victoria Li She/Her/Hers

Hunter College High School
NEW YORK

Victoria Robin Li, 17, of **New York**, designed a program to better understand gene editing outcomes of CRISPR-Cas9 for her Regeneron Science Talent Search **computational biology and bioinformatics** project. CRISPR-Cas9 is an important biological discovery that has given scientists a tool for easily editing the genome of living organisms. However, existing prediction methods are heavily dependent on manual engineering to further develop disease treatments. Using tools from machine learning, Victoria developed an algorithm that outperformed existing prediction tools to determine gene editing outcomes directly from target DNA sequences of CRISPR-Cas9 and requires minimal manual tuning. Victoria also identified how known natural genetic variations from, for example, racial and ethnic differences, can affect editing outcomes in an effort to make gene editing treatments more consistent, effective and equitable. The daughter of Ming Li and Xiuyan Wang, Victoria attends **Hunter College High School** where she heads the Science Olympiad team and founded Hunter Data Analytics for Change so fellow students could apply their data science skills for good. She has also raised funds for I-HELP Liberia.

Steven D. Liu He/Him/His

Shady Side Academy
PENNSYLVANIA

Steven D. Liu, 18, of **Pittsburgh**, designed a new process for making biodiesel fuel from algae for his Regeneron Science Talent Search **chemistry** project. Making biodiesel from algae is more resource-efficient than making it from conventional materials such as corn, but no one has been able to produce an algae-based biodiesel fuel that can compete with commercial diesel. While previous efforts had focused on improving process efficiency and reducing waste, Steven instead tried to optimize overall cost effectiveness by modifying the harvesting, dewatering, fat extraction and oil-to-biodiesel conversion steps. This wasted more of the algae, but Steven added an anaerobic digester to convert this waste into methane, which would be converted to electricity on site. Modeling suggests that Steven's process could produce biodiesel at 10% less than the price of regular diesel when federal subsidies are considered. The son of Tiana Zhang and W. Vincent Liu, Steven leads the **Shady Side Academy's** math club, astrophysics club, puzzle club, and environmental club, and he serves as the editor-in-chief of the school's newspaper. *The Bulldog Bugle*. He is also a varsity rower and volunteers at the Carnegie Science Center.

Roberto Antonio Lopez He/Him/His

Brentwood High School
NEW YORK

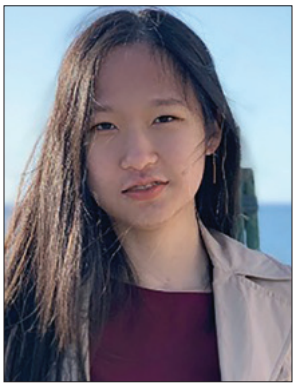
Roberto Antonio Lopez, 17, of **Bayshore**, studied the effect of dead and decaying invasive plant matter on native salt marsh vegetation for his Regeneron Science Talent Search **environmental science** project. The dead plant matter (known as wrack) largely consisted of leaves from the common reed, an invasive plant species that infests marshes worldwide. Roberto established research plots in the salt marsh of a local state park in order to evaluate how the wrack from the invasive plant affects native salt marsh vegetation. He analyzed the sediment and its microbes, while also using aerial images from a drone for a more comprehensive view of marsh health and density of native plants in various plots. His work demonstrated how the wrack inhibited native plant growth and interfered with the ability of the marsh to process nitrate and store carbon dioxide, thereby limiting its capacity to help mitigate global warming. The son of Cheryl Dagostino, Roberto attends **Brentwood High School** where he is captain of the swim team. He also leads the research club, which won $15,000 worth of Samsung technology for his school by replanting native species in a local park, and recently founded a local chapter of Students for Climate Action.

Christopher Vincenzo Luisi He/Him/His

John F. Kennedy High School
NEW YORK

Christopher Vincenzo Luisi, 17, of **Bellmore** used his Regeneron Science Talent Search **animal sciences** project to gauge the effect of dietary restrictions on the lifespan, metabolic rate and athleticism of fruit flies. This species is ideal for research as its systems are very similar to humans in terms of fat metabolism and disease-causing genes. Chris based his model system on two strains of “obese” flies, each with either upregulated or downregulated growth factors caused by specific mutations affecting weight and longevity. Two groups of each strain received either a normal or high carbohydrate, low protein diet. Subsequently, he used an inexpensive self-built tool to measure their metabolism and recorded population trends. Results showed that both strains on restricted diets had significantly increased metabolic rates, athleticism and lifespan as compared to flies on normal diets. His work may have meaningful public health inferences for managing obesity. At **John F. Kennedy High School**, Chris is lead student ambassador, captain of the varsity track/cross country team and founding member of a “community cupboard” that supplies local families in need. The son of Giuseppe Luisi and Flora Amitrano, he is also a certified open water scuba diver.

2022 FINALISTS



Amber Luo She/Her/Hers

Ward Melville High School
NEW YORK

Amber Kaixin Luo, 18, of **Stony Brook**, created a computational tool to reveal how ribosomes move along a cell's mRNA transcript to produce proteins for her Regeneron Science Talent Search **computational biology and bioinformatics** project. Her new approach, called RiboBayes, couples a powerful algorithm and statistical techniques to reveal vital information about ribosome pause sites. These critical regions where ribosomes pause to regulate and determine next steps in the gene expression are not yet well identified. Current algorithms are unable to efficiently and accurately locate these key pause sites from ribosome sequencing data on a large scale. By finding these crucial determinants of ribosome movement and having the ability to evaluate key components of protein synthesis, RiboBayes opens the door to discovering how changes in ribosome movement can directly influence any disease of interest, such as cancers and Alzheimer's. Amber attends **Ward Melville High School** in East Setauket, where she heads the math team and Science Olympiad. She also founded a nonprofit group that offers free virtual STEM courses to students and ran a two-week summer workshop for student-researchers. Her parents are Weiqin Lu and Yongde Luo.

Yash Narayan He/Him/His

The Nueva School
CALIFORNIA

Yash Narayan, 17, of **San Carlos**, developed an easy-to-use mobile app that guides users on whether an item is recyclable, compostable or trash for his Regeneron Science Talent Search **environmental science** project. Yash began to develop the app, which he named DeepWaste, in 2018. It relies on images of waste items, such as a paper cup or banana peel, that Yash captured at various angles and lighting, and paired with their correct recycling classification. By 2021, Yash had sufficiently refined the app to evaluate its performance. He asked 73 people to classify photos of various waste items on their own and found them to be correct in about 63% of cases, as compared to the app, which classified the same items with 92% accuracy. He also solicited reviews, which were generally quite positive, from individuals who had tried the app. Yash has patented DeepWaste, which can now be downloaded onto Apple devices. He is currently testing tablets with the app installed at Stanford University, Williams College and **The Nueva School**, which Yash attends in San Mateo. The son of Ritu and Amit Narayan, Yash is also founder and executive director of SchoolHacks, a global student-led hackathon.

Nyasha Nyoni She/Her/Hers

Ossining High School
NEW YORK

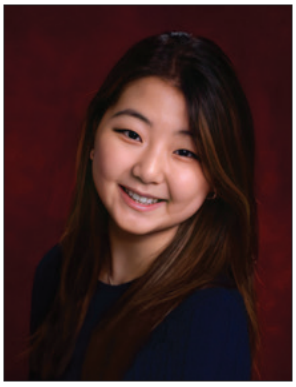
Nyasha Nyoni, 17, of **Ossining**, used her Regeneron Science Talent Search **behavioral and social sciences** project to investigate the public health impact on adolescents of online food and drink endorsements. Over two years, Nyasha analyzed the engagement rate, or number of "likes," and posting frequency of the most popular celebrity and relatable "micro-celebrity" influencers on Instagram, a platform on which nearly 40% of users are between ages 13 and 24. She also surveyed local high school students to assess their recognition of and engagement with these personalities. Using the Nutrient Profile Index (NPI), she assigned a nutritional value for each endorsed product. Nyasha's results showed that Instagram influencers endorsed the most products overall, as well as more unhealthy, low-scoring NPI foods, snacks and drinks than the items promoted by celebrities. She hopes her study will spark regulation of social media marketing to underage consumers. At **Ossining High School**, Nyasha is an award-winning multi-sport athlete and senior captain of the varsity soccer team. She is also a youth group leader in her church, a performer in community theater and a prolific baker of decadent treats. Her parents are Vanessa Jones-Nyoni and Farai Nyoni.

Amara Orth She/Her/Hers

Lewis Central High School
IOWA

Amara Orth, 18, of **Glenwood**, developed a method to identify vibroacoustic patterns of honeybees, which reflect the health of the hive, to predict hive collapse and help protect her family's bee farm for her Regeneron Science Talent Search **computational biology and bioinformatics** project. Working at home and in the family barn, Amara measured the sounds and vibrations from the bees in 25 hives from August to November 2021, and then analyzed the data using a mathematical model she developed. Her system predicted bee colony health with 92% accuracy. She hopes this will provide beekeepers with an early warning for hive collapse and give them time to intervene. She plans to expand the sound library and make her system available to other Iowans. Amara also founded a nonprofit organization that informs and connects beekeepers throughout the state. An avid soccer player, Amara attends **Lewis Central High School** in Council Bluffs, where she plays on the varsity and club teams. In 2019, she used scholarship funds received from the Broadcom MASTERS competition to attend a bee conservation program in a Costa Rican cloud forest. A future climate scientist, she is the daughter of Carol Fassbinder Orth and Brian Orth.

2022 FINALISTS



Hannah Park She/Her/Hers

Tenafly High School
NEW JERSEY

Hannah Park, 17, of **Tenafly**, submitted a **cellular and molecular biology** project to the Regeneron Science Talent Search. Down Syndrome (DS) is associated with impaired immune function, a leading cause of childhood mortality. Hannah's three-year study focused on the gene *Tmem131*, which is altered in DS. Hannah studied the role it plays in the development of the thymus, which produces infection-fighting T-cells. She examined thymus tissues from normal mice and DS mouse models with the *Tmem131* gene knocked out (KO). She observed that the thymus in KO mice experienced changes in thymic epithelial cell differentiation, was 25% smaller, and had 75% fewer T-cells than those in mice with the gene. Her findings could help improve early life medical treatment for children with DS. Hannah attends **Tenafly High School** where she is president of the Science Olympiad and Chamber Music Club, and competes on the girls' varsity swim team. An award-winning violinist, she has performed with several leading youth orchestras and was featured on NPR's "From the Top," yet still finds time to advocate for DS research funding. Hannah is the daughter of Sooyeon Kim and Junghyun Park.

Rishab Parthasarathy He/Him/His

The Harker School
CALIFORNIA

Rishab Parthasarathy, 16, of **San Jose**, investigated a new way to mark cancer progression using genomics and artificial intelligence (AI) for his Regeneron Science Talent Search **computational biology and bioinformatics** project. By adapting an AI technique often used to predict the next word in a sentence, Rishab created a "dictionary" of known tumor mutations and treated each mutation as a "word" in the genome. He used "grammatical" genetic rules to train his algorithm on the order in which mutations are expected to occur, identifying the future progression of mutations in various cancer types. Finally, he scoured drug databases to discover the best available treatments for the predicted mutations based on the genomic progression patterns. Proper treatment, he believes, "could halt the domino effect of cancer progression, like metastasis, from ever happening." At **The Harker School**, Rishab heads the Programming and Public Health Clubs and plays second violin. He is also co-founder and organizer of the Online Physics Olympiad, a multinational nonprofit with participants from 60 countries. He developed its online platform and grading algorithm. Rishab is the son of Bharadwaj Parthasarathy and Yuwen Zou.

Pravalika Gayatri Putalapattu She/Her/Hers

Thomas Jefferson High School for Science and Technology
VIRGINIA

Pravalika Gayatri Putalapattu, 17, of **Centreville**, submitted a Regeneron Science Talent Search **computer science** project designed to monitor surgeries in real time to help detect errors. Prompted by the accidental death of a close cousin due to a "tired, overworked, underpaid surgeon in India," Pravi developed a system that uses machine learning to detect the surgical steps taken in the operating room. Using annotated video recordings of gall bladder surgeries, she trained her system to monitor the surgical tools used between video frames to identify what actions the surgeon is performing. The algorithm uses image segmentation and network optimizations to achieve a runtime that's five times faster than current methods. Pravi believes this approach would allow surgeons to verify their actions as they perform gallbladder surgery and quickly detect errors. Pravi attends **Thomas Jefferson High School for Science and Technology** in Alexandria where she is on the varsity math team. She has spoken at Mathfest about diversity, equity and inclusion in math communities and helped manage a chapter of inteGIRLS, which helps 3,000+ individuals bridge the gender gap. Pravi's parents are Sreevani and Sobhan Putalapattu.

Neil Rathi He/Him/His

Palo Alto High School
CALIFORNIA

Neil Rathi, 17, of **Palo Alto** used his Regeneron Science Talent Search **behavioral and social sciences** project to model how human minds optimize language on the word level for efficient communication. The smallest meaningful unit of a word can convey multiple features. An example is how "ed" in the word "talked" signals both past tense and word completion. Neil looked at linguistic patterns that display this "informational fusion" to quantify the degree to which it occurs. He trained his machine learning model to search syntax datasets in four languages to test whether the tiny units are used less frequently, are less tightly fused, and whether they are more closely located when the fusion of two features is high than when fusion is low. Both premises held, suggesting that language may have evolved for efficient communication. His work is a step toward understanding how the human mind processes and produces language. At **Palo Alto High School**, Neil leads the linguistics and math clubs and is editor-in-chief of the fine arts magazine. He plays trumpet and is section leader in the Peninsula Youth Orchestra and is first author of two peer-reviewed papers. His parents are Manish Rathi and Shama Pagarkar.

2022 FINALISTS

Aseel Rawashdeh She/Her/Hers

L.C. Anderson High School
TEXAS

Aseel Rawashdeh, 17, of **Austin**, developed an inexpensive way to kill the larvae of the mosquitos that spread viral illnesses, such as malaria, for her Regeneron Science Talent Search **environmental science** project. Aseel incorporated essential oils, a known larvicide, into baker's yeast. This procedure avoided the many problems associated with using oils alone, which include their sensitivity to light and heat, the large dosage required to be effective and toxicity to non-targeted organisms. She found it to be simple to encapsulate a relatively large quantity of essential oils into yeast microcapsules, which the targeted larvae readily ate. Aseel demonstrated the high toxicity of three encapsulated essential oils (cinnamon, garlic and orange) to the targeted mosquito larvae and showed that ingesting the oils prevented any surviving larvae from developing into mosquitos. Equally important, the treatment appeared to be benign to algae and non-targeted insect larvae, though this still must be tested in a natural ecosystem. The daughter of Omar Rawashdeh and Dima Jaradat, Aseel attends **L.C. Anderson High School**, where she captains the debate team, lifts weights and founded and leads the Diversity and Inclusion Council.

Desiree Rigaud She/Her/Hers

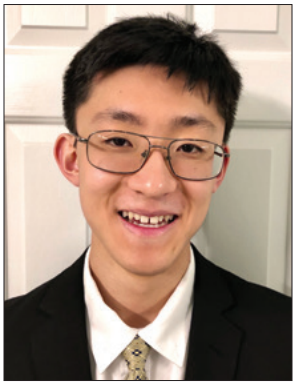
John F. Kennedy High School
NEW YORK

Desiree Rigaud, 17, of **Bellmore**, surveyed the impact of financial hardship on marital stress and the effectiveness of therapeutic interventions for her Regeneron Science Talent Search **behavioral and social sciences** project. She designed a questionnaire based on accepted measures of financial hardship and marital functioning and recruited 100 married subjects to complete it. Desiree found that perceptions of financial difficulty were more often associated with aggressive marital behavior than objective data, such as an actual decline in income. Her second survey measured the impact of stress-reducing interventions she designed from known psychology methods and theories. Results showed that frequency of economic stress increased for those tasked with budgeting for a week and declined for the group asked to reflect on personal values in the same time frame. Desiree's work may lead to more effective counseling for financial stress. At **John F. Kennedy High School**, Desiree leads the Gay Straight Alliance and the Diversity, Equity and Inclusion Committee. As the Director of Education for The Reclamation Project, she curates bias-free materials for early childhood education. Her parents are Denise Galli and Gianni Rigaud.

Luke Robitaille He/Him/His

Robitaille Homeschool
TEXAS

Luke Robert Robitaille, 18, of **Euless**, untangled the entropy of simple braids for his Regeneron Science Talent Search **mathematics** project. Mathematical braids are a formal way of describing and tabulating the patterns that can arise from intertwining multiple lengths of string. Braids that intertwine lengths of string can become very complicated, and so mathematicians use the concept of topological entropy to compare braids to each other. Topological entropy describes how complicated a given braid is by assigning each braid a number that is always either positive or zero. In his work, Luke studied what are called simple braids. He showed that for low numbers of strands, most simple braids are orderly, but as the number of strands grows large, nearly all simple braids are chaotic. This shows that a random simple braid will never be too simple, topologically speaking, if you have a lot of strands braided together. Braid theory has recently been used to better understand the chaotic mixing of fluids. The son of Robert and Mary Robitaille, Luke is **home schooled**. He has won three consecutive gold medals in the International Math Olympiad and also won the Harvard-MIT Math Tournament three times.

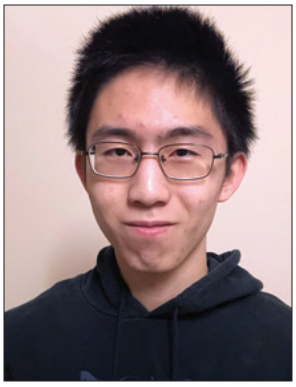


Daniel Shen He/Him/His

William G. Enloe High School
NORTH CAROLINA

Daniel Shen, 18, of **Cary**, enabled much faster comparisons of time series data for his Regeneron Science Talent Search **computer science** project. For example, how do temperature variations from one week compare to those of an earlier week? Comparing one set of measurements is hard enough, but what if other variables, such as wind speed and air pressure, are also measured? Daniel made a key tweak to an algorithm called Dynamic Time Warping, which considers many ways in which a time series might be similar, and then used a mathematical rule-of-thumb, called a lower bound, to rule out as many unpromising options as possible. Realizing that the lower bound could be adjusted to consider only the most promising possibilities, Daniel made the algorithm, on average, eight times faster than the old one. His algorithm has already been applied to hurricane prediction and healthcare. The son of Xiaoyan Song and Xipeng Shen, Daniel is first author of a published paper about his research. At **William G. Enloe High School** in Raleigh, he leads the Math Honor Society. He was a top winner at the Regeneron ISEF for his AI-powered facial-cue module, which turns sheet music pages on his tablet as he plays piano.

2022 FINALISTS



Atticus Wang He/Him/His

Princeton International School of Math and Science
NEW JERSEY

Atticus Zifan Wang, 17, of **Princeton**, proved the stability of representations of a class of groups of linear transformations for his Regeneron Science Talent Search **mathematics** project. The field of topology is concerned with the properties of a geometric object that are preserved under continuous deformations, such as stretching and twisting, without closing or creating holes, tearing, gluing or passing through itself. Atticus demonstrated the representation stability of the finite orthogonal groups, the group of transformations on vector spaces that preserve a symmetric bilinear form. To complete his project, Atticus studied a recent research-level mathematics paper that showed representations stability of the symplectic group, and he modified those arguments to apply to the orthogonal group. In the process, Atticus generalized an older result from 1987. His work could potentially allow a more concrete description of such spaces. The son of Weijun Wang and Jihong Shi, Atticus is school prefect at **Princeton International School of Math and Science** where he plays basketball and leads the math team. He also organizes the school rock band, for which he plays lead guitar.

Ella Wang She/Her/Hers

BASIS Chandler
ARIZONA

Ella Wang, 17, of **Chandler**, created a digital method to anticipate the effects of light-induced fading on colored cultural and historical artifacts for her Regeneron Science Talent Search **computer science** project. Currently, such tests are difficult to interpret, but because Ella's digital results are displayed visually, the original colors can be compared side-by-side with the faded versions. The images also highlight photo-sensitive components that are especially vulnerable to light damage. In addition, she predicted the fading of art objects that lacked detailed fading information by using data that have already been collected. She went on to refine her model to extrapolate fading data beyond an object's testing period. She hopes her model will help museums and exhibitors better protect the important cultural artifacts they wish to conserve and display. Ella attends **BASIS Chandler** where she is a debate team competitor, the founder and captain of the robotics team and president of the Red Cross club. Five years ago, she founded the Childhood Cancer Survivor & Sibling Association for families impacted by cancer and raised $1,000 for Phoenix Children's Hospital. Ella's parents are Yiqun Bai and Yuhang Wang.

Ethan Wong He/Him/His

Arcadia High School
CALIFORNIA

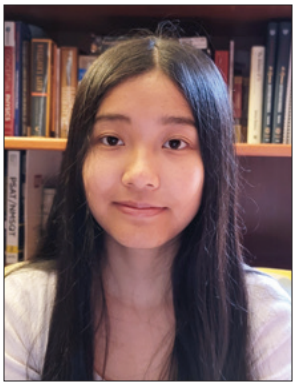
Ethan Wong, 17, of **Arcadia**, tested a simplified wing manufacturing method that could one day make aircraft more efficient for his Regeneron Science Talent Search **engineering** project. Bell-shaped lift distribution (BSLD) has intrigued Ethan ever since he saw a video of an experimental BSLD aircraft that flew beautifully without a tail. These aircraft, he learned, do not need tails because they have intrinsic yaw (side to side rotation) stability and have less induced drag. BSLD aircraft are difficult to manufacture because the wings are designed with a complex non-linear twist. Ethan believed he could simplify manufacturing and create the needed twist by making the wings in segments, and he tested his concept by building two flying models. Flight data collected from an onboard smartphone and video confirmed that his modular wings had the characteristics of a viable BSLD aircraft. Ethan attends **Arcadia High School** where he competes on the math team and is structural design lead for the robotics team and technologist for the Real World Design Challenge team. The son of Jimmie Wong and Shan Yuan, he also helped organize a stem cell donor drive. Ethan operates his own business designing, manufacturing and selling custom model airplanes.

Leo Wylonis He/Him/His

Conestoga High School
PENNSYLVANIA

Leo Wylonis, 17, of **Berwyn**, designed and built a prototype of an MRI-compatible motor that could one day power guided robots for minimally invasive surgeries for his Regeneron Science Talent Search **engineering** project. To use safely in an MRI scanner, a motor must be nonmagnetic, nonmetallic and non-conductive. Engineering efforts to date have tried to address this using stepper motors, but they have inherent speed and torque limitations. Leo created a pneumatic servo motor that combines a bladeless turbine, a silicone brake system and an optical encoder that interfaces with an Arduino controller to manage speed, braking and direction. When compared to conventional stepper motors it ran at speeds up to 67% faster, demonstrated improved torque and was able to achieve better positioning accuracy. Leo attends **Conestoga High School** where he is co-captain of the Science Olympiad team, president of the science fair club and active in STEM community outreach. He enjoys playing French horn in the wind ensemble and is refining his solo performance of Tchaikovsky's 5th Symphony. Leo loves mountain biking, races with a local team, maintains trails and advocates for the sport. He is the son of Edward and Kathleen Wylonis.

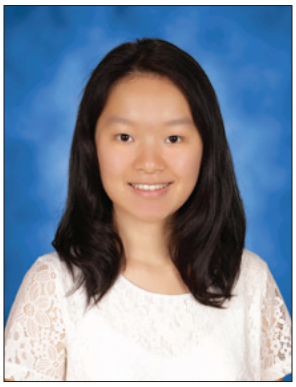
2022 FINALISTS



Zoe Xi She/Her/Hers

Boston University Academy
MASSACHUSETTS

Zoe Xi, 17, of **Boston**, quickly computed distances for her Regeneron Science Talent Search **computer science** project. When comparing two sequences of data, scientists often try to get a sense of how similar they are, such as when comparing pairs of genes in DNA. Measuring similarity can be made objective by computing the 'Dynamic Time Warping' (or DTW) distance, which is widely used in areas of data analysis, including bioinformatics, signature verification and speech recognition. The algorithm which computes the DTW distance is very useful, but it can take a very long time to run when the sequences being compared are long. For her project, Zoe showed that, even though computing the DTW distance exactly can take a long time, one can quickly get a close approximation to the distance if the sequences are 'run-length encoded strings,' in other words, long sequences that have many repeated letters one after another. By carefully using the patterns in these special strings, Zoe was able to design an algorithm that can approximate the DTW distance in a fraction of the time. At **Boston University Academy**, Zoe is editor-in-chief of the newspaper and a teaching assistant and peer tutor. Her parents are Jinning Liu and Hongwei Xi.



Margaret L. Yang She/Her/Hers

Cranbrook Kingswood School
MICHIGAN

Margaret L. Yang, 17, of **Bloomfield Hills**, developed a way to potentially improve the efficiency of converting cellulose into biofuels for her Regeneron Science Talent Search **environmental science** project. This conversion process is complex, involving four enzymes to catalyze the breakdown of cellulose. To improve reaction rates, researchers have used yeast with engineered "scaffolding" for these enzymes on the cell surface, resulting in about 60% active cell biocatalysts, but improvements can be lost over generations of cells. Marggie addressed this drawback using CRISPR technology to adjust key genes in the cells, creating whole-cell uniform biocatalysts with high enzyme (up to 97% of the cells) efficiency, along with the ability to produce stable offspring that retain the high catalysis capacity. She is now optimizing the processing conditions to amass large quantities of multi-enzyme biocatalysts. The daughter of Mei Li and Jun Yang, Marggie attends **Cranbrook Kingswood School**, where she leads the science research club and is skipper of the varsity sailing team. A violinist, she is co-concert master of the Cranbrook Symphonic Orchestra and two-time winner of Carnegie Hall's Concert Festival International Grand Prix solo award.

Christine Ye She/Her/Hers

Eastlake High School
WASHINGTON

Christine Ye, 17, of **Sammamish**, analyzed the gravitational waves emitted from collisions between neutron stars (collapsed, super-dense stars) and black holes for her Regeneron Science Talent Search **physics** project. Scientists study the gravitational waves resulting from such collisions to estimate the mass of astronomical objects. Christine built a statistical model using data from a gravitational wave observatory (known as LIGO) and simulated future observations. Her work implies that a quickly spinning neutron star could be extra massive, making it larger than typical neutron stars, though still not as large as a small black hole. It also suggests that the spin of rapidly rotating neutron stars must be accounted for when determining their maximum mass. Christine is a LIGO outreach ambassador doing public speaking about gravitational waves to increase public trust in science. At **Eastlake High Schoo**l in Sammamish, she heads the astronomy club and is active in student government. She is the co-Vice President for Girls Rock in Science and Math and first author on a paper published in the peer-reviewed journal, *Physical Review D*. The daughter of Ann Zhou and Andy Ye, Christine is a talented pianist, violinist and ballerina.

Han Byur Youn She/Her/Hers

Roslyn High School
NEW YORK

Hailee Youn, 17, of **Roslyn**, applied her Regeneron Science Talent Search **behavioral and social sciences** project to studying what makes people form the intent and feel the responsibility to vote. Knowing that many eligible U.S. voters choose to sit out national elections, Hailee explored two possible influencers on that decision: awareness of the voting behavior of others and whether one holds a minority or majority political viewpoint. She combined these elements in a survey that showed participants random versions of a get-out-the-vote flyer that predicted expected turnout and identified the percent of registered voters of a given party. She then assessed subjects' likelihood and perceived responsibility to vote using scales from previous studies. Hailee found that a positive description of turnout led to the highest intent and sense of duty to vote, while believing one holds a minority viewpoint boosted perceptions of voting as a responsible act. Her work may aid efforts to increase voter participation. At **Roslyn High School** in Roslyn Heights, Hailee is president of a nationally ranked debate team and editor-in-chief of the literary magazine. The multi-lingual daughter of Charlie Youn and Ji Lee, she is first author of a peer-reviewed article on this project.

REGENERON SCIENCE TALENT SEARCH 2022 | Finalists by State

REGENERON SCIENCE TALENT SEARCH 2022 | Finalists by Last Name

REGENERON SCIENCE TALENT SEARCH 2022 | Finalists by Category

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Society for Science
1719 N Street, NW
Washington, DC 20036-2801
202.785.2255
sts@societyforscience.org
societyforscience.org/regeneron-sts