80TH ANNIVERSARY

REGENERON

SCIENCE TALENT SEARCH

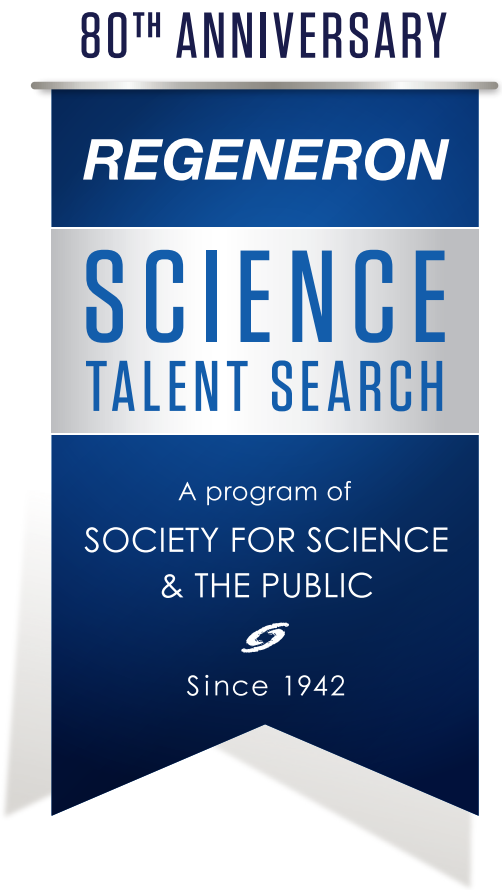
A program of

SOCIETY FOR SCIENCE & THE PUBLIC

Since 1942

REGENERON SCIENCE TALENT SEARCH

2021 FINALISTS



2021 FINALISTS

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 2021

MARCH 11–17, 2021

The 40 finalists of the Regeneron Science Talent Search 2021, 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 1,760 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 2021 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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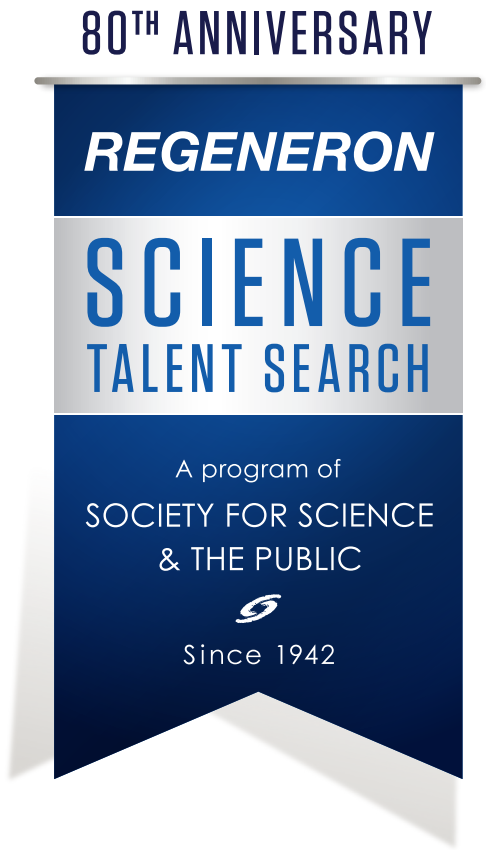


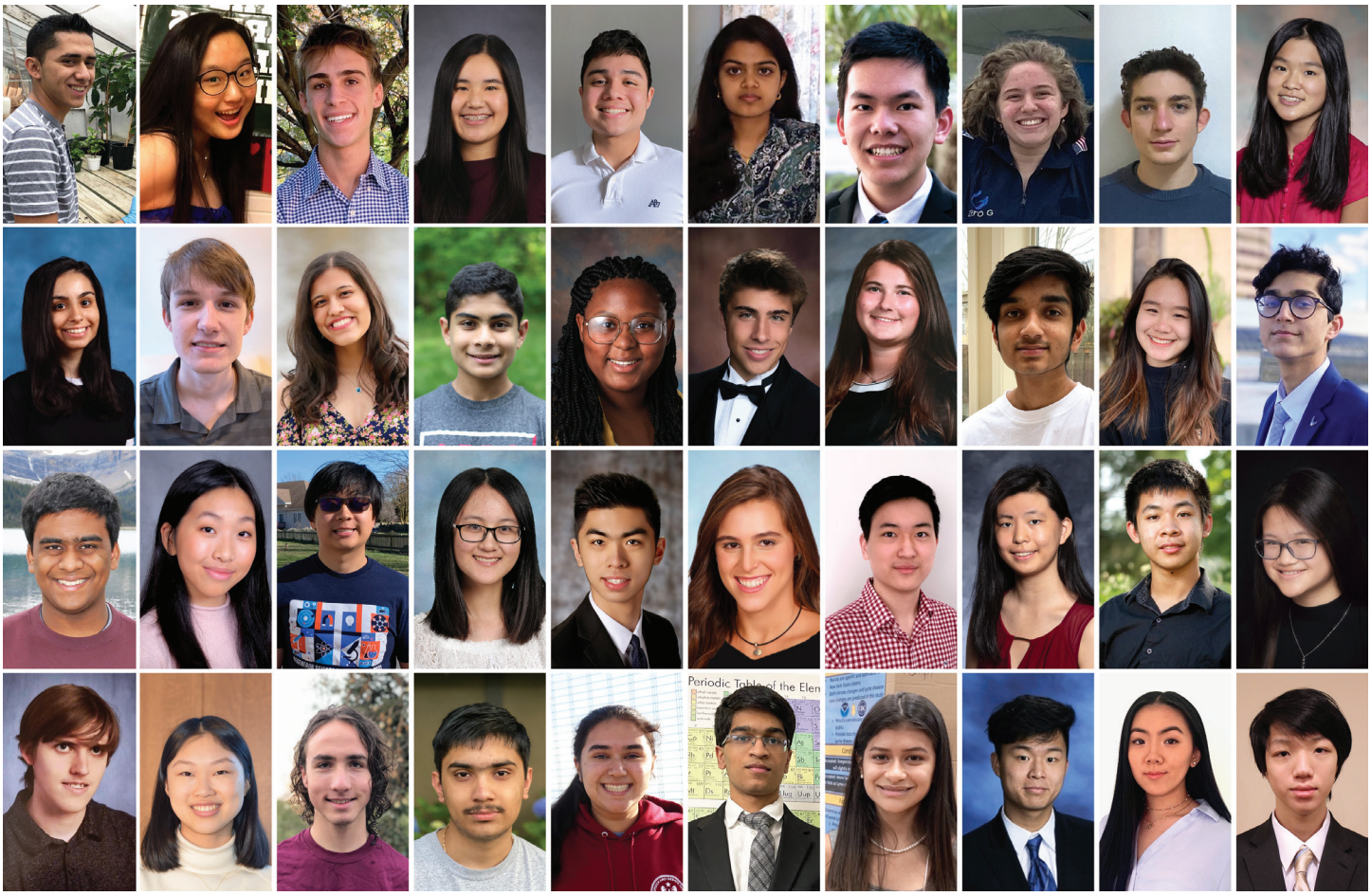
HISTORY

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 2021 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 24,171 finalists and scholars who have received $29.2 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. 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., but held virtually in 2021 due to the pandemic. Finalists meet leading scientists, visit institutions of historic and political importance and meet with distinguished national leaders. Finalists will display their research at to the public in a virtual forum on March 14, where they describe their work to the public. Many of those studying the exhibits arehighly 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 17.

Each of the 300 students named a scholar in the Regeneron STS 2021 receives a $2,000 award for their outstanding science research, in addition to any amount that students may win as finalists.

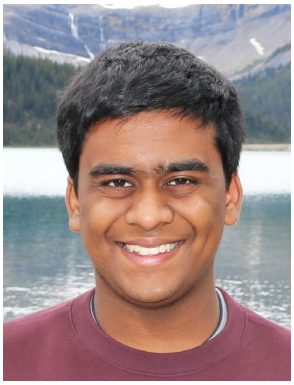
Each of their schools receives an award of $2,000 for each scholar named in the Regeneron STS 2021. The award is used to advance excellence in science, math and/or engineering education at the recipient school.

2021 FINALISTS

Laalitya Acharya

William Mason High School
Ohio

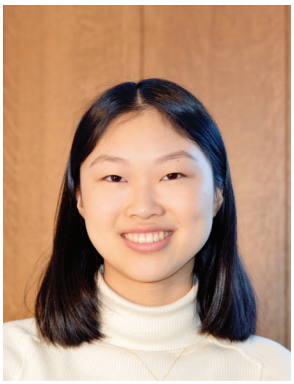
Laalitya Acharya, 17, of **Mason**, engineered an effective and inexpensive microbe-contamination detection system for global water systems for her Regeneron Science Talent Search **computational biology and bioinformatics** project. After falling ill from drinking contaminated water on a visit to India, Laalitya decided to create a microbe-image-based water tester, powered by machine learning. She made her own camera for capturing microscopic images of bacteria by combining a readily available tiny computer/camera that she enhanced with a microscope lens, alongside her own 3D printed components. She independently researched machine learning algorithms, built a database of the images she made of selected microbes and used it to train a detection system. Her resulting portable prototype tester, named Nereid, is designed to quickly and easily identify contaminating microbes by transmitting results by radio to a research computer for further analysis. The daughter of Reema and Rajesh Acharya, Laalitya attends **William Mason High School** where she is a varsity debater and tutor. Employed as a violin specialist and demonstrator, she repairs string instruments (violins, cellos, violas, etc.) and advises customers on their "musical journey."



Akhilesh Varadan Balasingam

Archbishop Mitty High School
California

Akhilesh Varadan Balasingam, 17, of **San Jose**, modeled the **physics** of nanoscale memory devices for his Regeneron Science Talent Search project. Akhilesh was motivated by ongoing research on brain-inspired computer architectures for performing artificial intelligence tasks in a fast and energy-efficient manner. Resistive random access memories (RRAMs) are well-suited to this type of architecture. Akhilesh developed a statistical simulator for RRAMs and then validated the simulator by comparing its predictions with published experimental results. Using his simulator, he characterized two-terminal and three-terminal RRAM devices, and compared their performance on typical machine learning tasks. The benefit of this work will be realized if integrated circuits based on these devices can be fabricated. The son of Esha and Pratheep Balasingam, Akhilesh is an avid ham radio operator and attends **Archbishop Mitty High School**. He enjoys playing squash, painting with oils on canvas, and performing on the mridangam, a South Indian classical drum, at local concerts and festivals.



Sarah Chen

Phillips Academy
Massachusetts

Sarah Li Chen, 17, of **Houston**, integrated a series of computational processes into a prediction pipeline that can identify alternative splicing events in messenger RNA (mRNA) and the potential neoantigens they yield for her Regeneron Science Talent Search **computational biology project**. Neoantigens are cancer-specific proteins that serve as cancer biomarkers, and identifying them may aid in creating new immunotherapies. Sarah focused her research on the retained introns (RI) normally removed in the creation of an mRNA transcript. She used her pipeline to identify RI candidates using RNA-sequencing and ribosome-sequencing data from an existing cancer cell line and validated the candidates using mass spectrometry. She then analyzed well-established leukemia cell lines and primary patient samples to identify tens of thousands of neoantigens per sample as potential targets for immunotherapy. At **Phillips Academy** in Andover, Mass., Sarah is starting setter for the volleyball team and co-president of the computer science club, and teaches coding. She is also prose editor of the literary magazine, digital editor of the paper, and co-president of the classics club. Sarah is the daughter of Peng Li and Bill Chen.

Yunseo Choi

Phillips Exeter Academy
New Hampshire

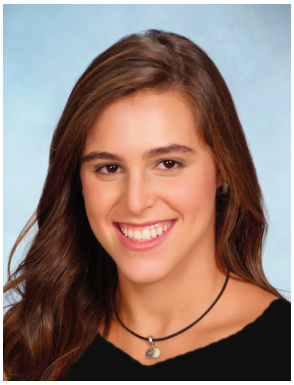
Yunseo Choi, 18, of **Exeter**, played theoretical "match maker" for an infinite number of things or couples for her Regeneron Science Talent Search project in **behavioral and social sciences**. Matching theory has numerous real-life applications: pairing potential couples in dating apps, assigning medical school applicants to rotations, and matching organ donors to recipients. For her project, Yunseo studied properties of finite matching algorithms and helped deduce which of them applied to problems with an infinite number of potential partners. To do this, she had to creatively use arguments from formal logic and combinatorics along with more traditional economics, a surprising connection. Although almost everything in real life is finite, understanding infinite markets is a useful exercise, as it gives a new perspective that may apply to other situations with a very large, albeit finite, number of participants. The daughter of Daesik Choi and Jiyoung An, Yunseo attends **Phillips Exeter Academy** where she DJs and produces her own radio program. In her free time, she is president of a nonprofit organization and editor-in-chief of its math journal, which publishes student research papers and aims to spread math literacy to its student readers.

2021 FINALISTS

Sam Christian

Liberal Arts and Science Academy
Texas

Samuel Christian, 17, of **Austin**, submitted a **space science** project to the Regeneron Science Talent Search outlining his comprehensive observational study of wide-binary star systems (systems separated by a distance of up to a light year) with exoplanets. Using a collection of publicly available datasets from numerous observatories and the TESS telescope, Sam identified 69 such systems with exoplanets. He modeled the movements of these exoplanets with their star systems computationally, observing that the exoplanet orbits aligned to a significant extent with the orbit of their binary system. He further noted that, with a larger data sample, his work could validate existing theories of how planets are formed. An avid cellist who enjoys playing at local nursing homes, Sam is first chair in the Austin Youth Orchestra and performs in the school orchestra at **Liberal Arts and Science Academy**. He also volunteers at Bowls of Hope, a community club he co-founded that organizes food donations to area food banks. Sam is first author on a previous astrophysics paper published by the peer-reviewed *Monthly Notices of the Royal Astronomical Society*. He is the son of Heather Way and William Christian.



Tali Finger

Dr. Michael M. Krop Senior High School
Florida

Tali Finger, 18, of **Miami**, modeled four neurodevelopmental disorders, depicting them together as a spectrum of behaviors rather than discrete illnesses for her Regeneron Science Talent Search **medicine and health** project. For example, a person with obsessive-compulsive disorder (OCD) may have behaviors more in common with someone on the autism spectrum or with Tourette syndrome than another OCD patient. She described a range of symptomatic behaviors, from simple repetitive motions to complex cognitive compulsions, and used machine learning to identify groups of microRNAs that control genes throughout the defined spectrum. Her work offers promising therapeutic targets that could be further explored in the leading-edge field of microRNA research. Tali attends **Dr. Michael M. Krop Senior High School** where she is president of the mathematics honor society, Mu Alpha Theta. A native of Brazil who moved to Florida in 2017, Tali benefitted from English as a Second Language classes, a transition program at her school that she now chairs. Her parents are Mara and Natan Finger.

Jessie Low Gan

San Diego Jewish Academy
California

Jessie Low Gan, 17, of **San Diego**, focused her Regeneron Science Talent Search **cellular and molecular biology** project on predicting cell metastasis, associated with 90 percent of cancer deaths, including that of her grandfather. Jessie used a technique called a bead-pipette assay to compare the force with which metastatic cancer cells and normal cells cling to their surroundings. Using a thin glass rod, she touched a protein-coated bead to a cell's surface. By noting how much the rod bends as the cell is pulled away from the bead, she found that metastatic cells consistently exerted greater adhesion force than normal cells. Jessie's application of a physics solution to a biological problem may lead to earlier diagnosis of metastasis through identification of "stickier-than-normal" cells. At **San Diego Jewish Academy**, Jessie captains the robotics team, competes on the varsity swim team and volunteers as an upper school origami teacher. In addition to spending 20 hours weekly as a research intern at University of California, San Diego, Jessie has served as editor-in-chief of the *Journal of Youths in Science*. The daughter of Su Lin Low and Chock Gan, Jessie also writes award-winning essays, poetry and young adult novels.

Noah Benjamin Getz

Bronx High School of Science
New York

Noah Benjamin Getz, 17, of **New York**, used an approach to training computer models that identify compounds with promising pharmaceutical properties for his Regeneron Science Talent Search **computational biology and bioinformatics** project. Traditional machine learning methods treat drug discovery as a "yes" or "no" question. While these binary classifiers perform well on datasets where the number of effective and ineffective compounds is equal, drug discovery datasets are imbalanced. Noah's method treats classification as an information retrieval task, similar to the ranking results from a browser search. His model successfully predicted two compounds that nearly eliminated the production of inflammation markers for both Alzheimer's disease and COVID-19 in lab testing. Noah's technique could improve the process of new drug discovery. At **The Bronx High School of Science**, he is a varsity member of the debate team. He has enjoyed competitive bouldering for years but now he recommends it as a recreational activity. Passionate about social justice, he was Head of Technology for a student-run gun-control activist group formed after the Parkland school shooting. Noah's parents are Jodi Caplan and Keith Getz.

2021 FINALISTS

Gopal Krishna Goel

Krishna Home School
Oregon

Gopal Krishna Goel, 17, of **Portland**, contributed to the fields of mathematical physics and probability for his Regeneron Science Talent Search **mathematics** project. His work relates a random distribution, the beta-Hermite ensemble that lies at the intersection of random matrix theory, electrostatics, and nuclear physics to the Gaussian free field, which is used in two-dimensional statistical mechanics and quantum field theory. Prior work by others had shown that a connection existed, but Gopal proved this connection to be much more general in nature. Gopal believes that his work can be useful to the fields of nuclear physics, quantum field theory and meteorology, and hopes that it will aid in the search for the true nature of quantum gravity, more commonly known as "the theory of everything." The son of Purushottam Goel and Gunjan Tiwari, Gopal attends the **Krishna Home Schoo**l. He leads the Oregon Harvard MIT Math Tournament team and is first author of two articles and second author on a third published in peer-reviewed journals. Gopal is a paid coach for the USA Physics and Math Olympiads and volunteers in the memory care unit of an assisted living facility. He also holds a Taekwondo black belt and enjoys performing Indian classical music.

Hannah Goldenberg

Greenwich High School
Connecticut

Hannah Goldenberg, 17, of **Old Greenwich**, documented compounds found in e-cigarettes and linked them with pulmonary disease for her Regeneron Science Talent Search **medicine and health** project. In a two-year study, Hannah identified more than 50 harmful chemicals in e-cigarettes, including diacetyl, a flavoring compound known to cause irreversible scarring called "popcorn lung." She then designed and engineered a two-chamber human lung model to simulate breathing. Through gas chromatography and fluorescent imaging, she showed that all of the compounds are inhaled in just three puffs, and most are subsequently swallowed as re-condensed gas. In year two, Hannah exposed human lung epithelial cells to e-cigarette compounds and found increased expression of known genetic markers for chronic obstructive pulmonary disease, confirming the hazards of a product marketed as a safe alternative to tobacco. Hannah attends **Greenwich High School** where she captains the varsity ice hockey team. She also volunteers with Greenwich Special Olympics and mentors elementary school students. The daughter of Sarah Zeegen and Mark Goldenberg, Hannah is a named author in three peer-reviewed journal articles.

Michael Gomez

Bergen County Academies
New Jersey

Michael Gomez, 17, of **Fairview**, studied the effect of celecoxib, a medication for arthritis pain, on melanin production and cell proliferation and its potential to treat pigmentation disorders for his Regeneron Science Talent Search **medicine and health** project. Melanin is the pigment that determines skin color. Conditions that affect melanin, or the melanocyte cells that produce it, can lead to hypo- or hyper-pigmentation. Using a combination of in vitro research and computer modeling, Michael found that high-dose celecoxib stimulated production of melanin, while low-dose celecoxib suppressed melanocytes. His results show that celecoxib concentration has an impact on the cellular process responsible for melanin production and these findings may someday help mitigate the disfiguring effects of severe pigmentation conditions. Michael attends **Bergen County Academies** in Hackensack. A motivated athlete, he plays varsity volleyball, teaches tumbling and captains the cheerleading team. He hopes to continue cheerleading in college. Michael chairs the Relay for Life, has volunteered at Palisades Medical Center in the histology department and worked as an intern for Fairview Borough. He is the son of Diana and Conrado Gomez.

Amy Guan

Texas Academy of Mathematics and Sciences
Texas

Amy Shilin Guan, 18, of **Plano**, explored potential ways to speed up methane-to-methanol conversion for her Regeneron Science Talent Search **chemistry** project. Easily producing methanol, a clean energy source, from the common gas methane would be a fantastic achievement. Unfortunately, the stable nature of the methane molecule makes this difficult and costly. Motivated after snorkeling past a decaying coral reef near an oil refinery, Amy developed computer simulations of protein-inspired catalysts that would expedite this desirable conversion. To identify potential candidate enzymes, she used formate as a base compound and computationally added various chemical groups to manipulate atomic distances and simulate protein interactions. Her results identified a promising candidate and provided insight into catalyst design. Amy is first author of a paper published in the *Journal of Physical Chemistry A*. The daughter of Hong Guan and Jin Miao, Amy attends **Texas Academy of Mathematics and Sciences** in Denton. She is a violinist with the Greater Dallas Youth Orchestra and volunteers with Habitat for Humanity and the Girls Engineering Club, which introduces STEM topics to disadvantaged girls.

2021 FINALISTS

Wenjun Hou

Jesuit High School
Oregon

Wenjun Hou, 18, of **Portland**, studied the well-known **computer science** optimization problem called the "knapsack problem" for his Regeneron Science Talent Search project. The knapsack problem is familiar to every hiker. Given lots of choices, how can one optimally load a backpack with useful things, without making it too heavy? The question is difficult to address on a large scale, like the logistical organization of millions of products in hundreds of warehouses. Wenjun designed a quantum algorithm and corresponding quantum circuits in order to solve this problem with optimal runtime efficiency. Wenjun wrote the computer code to solve the problem, and designed the quantum hardware needed to actually implement the linchpin calculation of his algorithm. Further, Wenjun did a rigorous analysis of his algorithm, in terms of both runtime and cost. This is believed to be the first time someone has successfully designed quantum hardware and software to solve the knapsack problem. Wenjun's parents are Zhaorong Hou and Weiwei Huang. He attends **Jesuit High School** where he is a varsity swimmer and founder and leader of the state champion National History Day team. In the summer of 2020, he cofounded an online camp to introduce "the quantum world" to younger students.

Jared Ilan

Byram Hills High School
New York

Jared Ilan, 17, of **Pleasantville**, explored the potential of decellularized plant-based scaffolds for cultured meat production which could help to supply the world with affordable and ecologically sound meat products for his Regeneron Science Talent Search **bioengineering** project. When COVID-19 denied him lab access, Jared developed a homemade tensile testing device to study organic materials he decellularized with dish soap. He first established the ideal mechanical properties for a cultured meat scaffold by measuring the modulus of elasticity of decellularized skeletal muscle. He then compared the results with decellularized cabbage, celery and kale. While none had the same elastic deformation as muscle, their porosity and biocompatibility could yet make them viable alternatives. Jared believes his process could be a model for gauging the viability of other plant-based scaffolds. The son of Doron and Ella Ilan, Jared attends **Byram Hills High School** in Armonk, where he is vice president of Youth Against Cancer and president of eNable, an organization that designs and builds assistive devices for children with disabilities. He plays varsity lacrosse, captains the cross-country team and works as a lifeguard.

Vedanth Iyer

Sunset High School
Oregon

Vedanth Balaji Iyer, 17, of **Portland**, computationally developed a cathode material that could someday be used to create far better lithium-based batteries for his Regeneron Science Talent Search **materials science** project. Vedanth then computationally characterized this chromium-doped vanadyl-oxide based cathode material. His model predicts that this material could be used to create batteries that would be much more efficient and could operate at higher voltages than current lithium batteries. In addition, it appears that the battery would have greater energy storage capabilities, although next steps would include demonstrating all of this promising potential in the laboratory. Vedanth sees superior cathode materials as essential to keeping pace with the demand for electric vehicles and other renewable energy innovations. Vedanth is president of the **Sunset High School** research club and the Breakthrough Junior Challenge Club. He also takes pride in having mastered the South Indian classical Carnatic drum, or mridangam. The son of Balaji and Priya Iyer, Vedanth has helped to organize and conduct several STEM-related camps and competitions in the Portland area with hundreds of elementary and middle school participants.

Eshani Jha

Lynbrook High School
California

Eshani Jha, 17, of **San Jose**, investigated ways to improve drinking water quality for her Regeneron Science Talent Search **chemistry** project. Eshani began her quest to develop cost-effective water filters five years ago after seeing the devastating effects of water contamination on people in India. During this past year, Eshani developed a filter based on biochar (a carbonaceous material produced in the absence of oxygen) that can be formed from agricultural wastes, such as rice husks. She treated the biochar with chemicals to enhance its effectiveness and found that increasing its carbon content and surface area also improved performance. In the lab, her new filters removed over 96 percent of heavy metal toxins such as arsenic, lead, mercury, and cadmium; 95 percent of microplastics; 94 percent of pesticides; and 53 percent of pharmaceuticals in just ten minutes. She estimates that these filters could be used to treat water for less than $1 per month. Eshani founded a company to develop and test her patent-pending filter and organized and leads a chapter of Girls Who Code. A student at **Lynbrook High School**, Eshani is also a published novelist, a performer of classical Indian music, and an avid promoter of social justice. Her mother is Anjali Mishra.

2021 FINALISTS

Marvin Fangzhou Li

James M. Bennett High School
Maryland

Marvin Fangzhou Li, 17, of **Salisbury**, developed machine learning models to predict red tides along the West Florida Shelf for his Regeneron Science Talent Search **environmental science** project. To establish a link between the toxic *Karenia brevis* algal blooms that cause these red tides and environmental factors, Marvin collected 20 years of data on cell density, stream flows, riverine nutrient concentration, wind and water temperature and used it to train four machine learning classifiers. Of the four, one correctly predicted the blooms 85 percent of the time. He found that northerly winds generate coastal upwelling and onshore transport of *K. brevis*, while large river flows supply nutrients to fuel the blooms, information that could be used to design effective strategies to mitigate the devastating impacts of toxic algal blooms. The son of Xiaohong Wang and Ming Li, Marvin attends **James M. Bennett High School** where he is vice-chair of the Maryland Youth Advisory Council and co-founder and president of the Our Earth Club. Dedicated to environmental action and climate justice, he chairs planning efforts for the Youth Environmental Action Summit and edits a blog for This is Zero Hour, an international youth-led movement for climate justice.

James Licato

Washington-Liberty High School
Virginia

James Licato, 17, of **Arlington**, developed and tested a composite filter material to remove "forever chemicals" from water for his Regeneron Science Talent Search **environmental science** project. These persistent organic micropollutants include pharmaceuticals, microplastics and components of materials, such as Teflon, that are designed to resist degradation. They accumulate to potentially toxic levels in streams because they are not removed by conventional wastewater treatment. Some of these compounds are carcinogenic, while others cause birth defects and nearly all of them harm the aquatic environment. James created a sand-like filter material by fusing together natural and synthetic microporous adsorptive materials called zeolites with sodium silicate and then crushing the resultant composite. He then demonstrated that this composite material effectively decreased concentrations of these harmful chemicals to safe levels. James captains the varsity cross country and indoor track teams at **Washington-Liberty High School**. The son of Richard and Amy Licato, James is an Eagle Scout, enjoys fishing and plays lead guitar in a band with four of his friends. He has also volunteered as a youth recreational basketball coach.

Andrei Mandelshtam

University High School
California

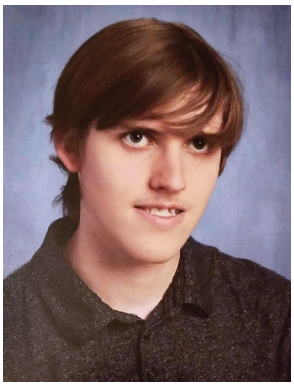
Andrei Mandelshtam, 17, of **Irvine**, studied polynomials for his Regeneron Science Talent Search **mathematics** project. He researched abstract algebra, a branch of mathematics that looks to generalize familiar algebraic notions to more abstract concepts. For his project, he proved that the values of a certain family of polynomials evaluated at a given complex number form a ring, an object of great mathematical significance, when the given number is a root of a polynomial. He also gave a simple description of these rings, which may make further computations on them much faster. A recent paper found connections between his field of study and quantum field theory, and he hopes that his work will one day have practical applications. Andrei is the son of Vladimir Mandelshtam and Svetlana Jitomirskaya. An aspiring polyglot and lover of languages, he is president of the linguistics club at **University High School**. He is fluent in English, Russian and Spanish and is currently learning both Polish and Hebrew. Andrei also shows musical talent as a singer who has participated since fifth grade in musical theater and vocal performances with the District Honors Chorus.

Rebecca Monge

Carmel High School
New York

Rebecca Monge, 17, of **Carmel**, identified specific zonal influencers on polar amplification (PA), a key driver of climate change for her Regeneron Science Talent Search **earth and planetary sciences** project. PA, the accelerated rate of warming at higher latitudes, threatens the natural planetary cooling system of the Arctic. To better understand the relative roles of temperature, snow cover, heat fluxes and other factors that influence PA, Rebecca analyzed scores of data from the most recent and comprehensive climate models available. She then plotted zonal maps that highlighted geographical drivers and components of PA, specifically temperature and heat flux increases surrounding Norway and reduced snow cover in upper Greenland. Her findings suggest targeted regional mitigation may be an especially effective strategy to lessen Arctic warming. Rebecca attends **Carmel High School** where she is a varsity distance runner and member of the mock trial club, winners of the 2020 Putnam County tournament. She co-founded and co-directs the Copula Program, matching academic mentors with high school students, and co-directs and teaches the Putnam County English as a Second Language program. Her parents are Sergio and Gloria Monge.

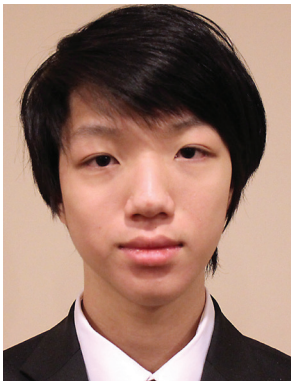
2021 FINALISTS



Michael John Pavelchek

Ossining High School
New York

Michael John Pavelchek, 18, of **Ossining**, who suffered from allergic asthma as a child, studied the role genes play in the immune response that causes allergic inflammation for his Regeneron Science Talent Search **cellular and molecular biology** project. The primary cause of this inflammation in conditions such as rhinitis, asthma and eczema, is a certain cell (IgE antibody secreting plasma B cell), a type of white blood cell produced by one of two types of memory B cells. Michael's work started as laboratory research and became a computational study when COVID-19 closed his lab. It revealed that two genes, Swap70 and Myc, are involved in the production of IgE secreting cells. He reasoned that drugs that inhibit Swap70 and Myc, thereby stopping the production of IgE secreting cells, could be effective long-term treatments for allergic diseases. Michael, who shares his interest in biology with a love of engineering, attends **Ossining High School** where he is president of the engineering club. Outside of school he is a passionate sailor, drum instructor in a youth music program, an Eagle Scout and a member of the Order of the Arrow. The son of Michael and Martha Pavelchek, he hopes to study bioengineering in college.



Timothy Chenglei Qian

Montgomery Blair High School
Maryland

Timothy Chenglei Qian, 18, of **Rockville**, conducted research in the field of quantum metrology for his Regeneron Science Talent Search **physics** project. Quantum metrology uses quantum entanglement to improve measurement accuracy. Tim extended the previous model for measuring field properties to account for redundant information in the fields. He then developed a measurement protocol using quantum sensor networks. Using an innovative linear programming approach, he formally proved the optimality of his measurement protocol. His results are applicable to real world problems where the field measurements are typically correlated, such as in nanoscale nuclear magnetic resonance imaging. Tim is a student at **Montgomery Blair High School** in Silver Spring where he captains the math, computer science and science bowl teams. He writes problems as an organizer of his school's math and informatics tournaments, competitions that expanded worldwide in 2020 when the pandemic forced them to go online. Tim also volunteered as a coach for his local middle school math team. In his free time, he enjoys playing viola as a part of his local youth orchestra. Tim is the son of Feng Qian and Minglei Cui.

Anushka Sanyal

Homestead High School
California

Anushka Sanyal, 17, of **Los Altos**, explored the use of RNA as a therapeutic tool to treat amyotrophic lateral sclerosis (ALS) for her Regeneron Science Talent Search **cellular and molecular biology** project. As a volunteer in a memory support center for seniors, Anushka has seen the devastating effects of neurodegenerative diseases. Since a key driver of ALS is the clumping (aggregation) of RNA binding proteins, she reasoned that RNA might be used to counteract it. Previous research found that deleting the gene DBR1 potentially could have that effect, so Anushka tested the hypothesis using budding yeast as a disease model. She found that while knocking out DBR1 allowed inherent lariat RNA (circular, short-tailed molecules) to protect against the toxic protein aggregation found in ALS, the gene's total loss negatively affected cell stress and survival. Anushka suggests this may be addressed by developing synthetic lariat RNA optimized for their beneficial properties as a competitive inhibitor. Anushka presides over the speech and debate club at **Homestead High School** in Cupertino and is ranked first statewide in Declamation by the National Speech and Debate Association. Her parents are Chayanika and Amit Sanyal.

Alay Shah

Plano West Senior High School
Texas

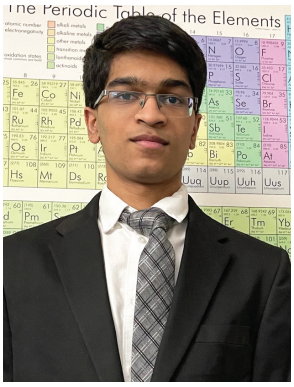
Alay Rajal Shah, 17, of **Plano**, designed and tested a diagnostic tool that uses eye movement as a neuropsychological biomarker for understanding human behavior, intent and cognitive issues for his Regeneron Science Talent Search **neuroscience** project. To develop his device, Alay used software to track pupil and gaze movements and created deep learning algorithms to identify abnormal eye reflexes. Using a series of animations, he conducted clinical tests on patients with Parkinson's, dementia, multiple sclerosis and ADHD and found unique eye patterns associated with each condition. He believes his results show that eye tracking could, in the future, be an effective, low-cost way to provide early diagnosis for a wide range of neurological disorders and brain injuries, especially in areas where an MRI may not be readily available. Alay attends **Plano West Senior High School**. He co-leads an organization that has mentored more than 300 students in research and has organized programs in India that provide wheelchairs and sewing machines to stroke and paralysis patients. The son of Rajal and Ami Shah, Alay enjoys kayaking and hiking and expresses his artistic side by sketching and creating art using artificial intelligence.

2021 FINALISTS

Justin Yang Shen

Jericho Senior High School
New York

Justin Yang Shen, 17, of **Glen Head**, studied a potential way to reduce the likelihood of becoming afflicted with Parkinson's disease for his Regeneron Science Talent Search **medicine and health** project. Trichloroethylene (TCE), a common water pollutant, destroys neurons that produce the neurotransmitter dopamine and thus increases the risk for Parkinson's. Recent literature suggests that L-Theanine (L-Th), a component found in green tea, could play a protective role. Driven by his passion for environmental toxicology, Justin treated cell cultures *in vitro* and roundworms *in vivo* with TCE solutions, with and without L-Th. In both the *in vitro* and *in vivo* tests, he found that L-Th reduced the neurotoxic effects of TCE and TCE-induced Parkinson's disease hallmarks. Justin is first author of a paper on his research published in *Journal of Toxicology and Environmental Health Sciences*. Justin also leads the Environmental Club as the Co-President at **Jericho Senior High School**. The son of Ying Shen and Jing Yang, Justin is a nationally ranked tennis player, and a cellist who has performed at Lincoln Center and Carnegie Hall.



Fareed Sheriff

Mills E. Godwin High School
Virginia

Fareed Sheriff, 17, of **Glen Allen**, motivated by his father's complaints about badly timed red lights, used machine learning and graph theory to model traffic flow at intersections and created an algorithm to better control traffic lights for his Regeneron Science Talent Search **engineering** project. Like a chess player thinking several moves ahead, Fareed's algorithm models future traffic flow and uses this model to maximize present traffic flow while decreasing future traffic congestion. Fareed's algorithm relies solely on data from commonly installed traffic cameras and can be easily applied to intersections without the need for new equipment or tearing up the road. In computer simulations, Fareed's algorithm achieved a higher throughput rate than today's sensor-based systems. Fareed, who self-learned multivariable calculus, linear algebra and graph theory over the summer, attends **Mills E. Godwin High School** in Richmond, where he is strategy lead for the robotics team, competes with the math modeling team, and is president and team captain of the quiz bowl club. The son of Rahuman Sheriff, Fareed loves chess, especially making many mental calculations to simulate his moves and his opponent's possible responses for a given position.

Eleanor Sigrest

Forest Park High School
Virginia

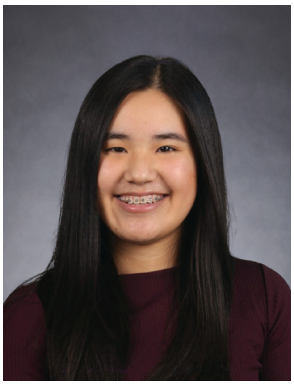
Eleanor Sigrest, 18, of **Woodbridge**, developed a new method to manage slosh, the unwanted movement of fluids in microgravity for her Regeneron Science Talent Search **physics** project. Slosh can cause spacecraft to move erratically and lead to mission failure. Current management devices add complexity, weight, and cost. Eleanor showed that custom surface energy profiles can be used to retain fluid in desired locations using an array of spherical tanks, the lower parts of which were treated with coatings that attract water, while the upper parts were treated with coatings that repel water. Other tanks were left untreated as controls. Eleanor found that the coatings dramatically improved fluid settling time and fluid aggregation in experiments that she personally conducted during a zero-gravity parabolic flight. NASA is interested in her technology, which she will test on a Blue Origin New Shepard suborbital flight in 2021. At **Forest Park High School** and the **Governor's School at Innovation Park**, Eleanor's activities, including her participation in Russian language club, are all focused on her aim to be a computer science specialist on the first Mars mission. The daughter of Christine and Michael Sigrest, Eleanor also enjoys producing and teaching textile weaving and is an accomplished violinist.

Edgar Sosa

Greenwich High School
Connecticut

Edgar Sosa, 20, of **Greenwich**, submitted a **plant sciences** research project on coffee rust fungus to the Regeneron Science Talent Search. Hooked on science from watching Albert Einstein videos as a child in Guatemala, Edgar committed himself to finding a remedy for the fungus that had destroyed the farm he co-owned with his family and forced them to emigrate to the United States when he was 13. He found his research opportunity in a class at **Greenwich High School**. Familiar with research showing that metal-oxide nanoparticles (NP) of copper, zinc and manganese are effective in treating fungal diseases on tomatoes and eggplants, Edgar chose to study their benefits on coffee plants infected with a fungus that acts similarly to coffee rust. By observing healthy plants before and after exposure, he learned that the fungus blocks coffee leaf pores with a biofilm, obstructing respiration. Edgar further found that copper NP protected his plants from the surrogate fungus and enhanced growth as much as 13 percent. He hopes to test copper NP on coffee rust in Guatemala and Brazil. Until the pandemic struck, Edgar worked full time as a waiter to help support his family. He then began installing pools. His parents are Manuel Ines Sosa and Jeannette Arriaza.

2021 FINALISTS



Claire Tang

Lynbrook High School
California

Claire Tang, 17, of **San Jose**, developed automated image-assisted diagnosis methods to improve clinical decision making for her Regeneron Science Talent Search **computational biology and bioinformatics** project. Motivated by lessons learned from the COVID-19 pandemic, Claire showed mathematically why existing machine learning methods of unknown/new disease detection often fail and worked out a modular, deep learning-based approach to overcome those limitations. Her modules include a disease classifier able to detect an unknown disease without training data; an automatic quantitative severity assessment based on approximately detected region of infection (ROI) when only image level annotations are available, and, for patients with CT scans, an innovative method for locating the ROI when pixel level annotations are available. Claire's work may eventually enhance the diagnostic capabilities of doctors with early detection and help hospitals to streamline patient care tasks, such as allocation of ventilators and ICU beds. At **Lynbrook High School**, Claire is the president of the Machine Learning Club, a dedicated member of FBLA, and a competitor in shot put and discus as a track and field athlete. The daughter of Renjie Tang and Hongxia Jin, Claire is also an avid sports fan who enjoys watching basketball.

Dasia T. Taylor

West High School
Iowa

Dasia T. Taylor, 17, of **North Liberty**, designed a surgical suture that changes color if it comes in contact with infected tissue for her Regeneron Science Talent Search **medicine and health** project. Intrigued by an article describing "smart sutures" that use conductive coatings and sensors to detect wound infection, Dasia sought a way to replace expensive technology by using a naturally occurring substance that could flag infection due to pH changes, which in turn cause color changes. She used beet extract, which has antibacterial properties, to dye various suture materials. She found that thread made of polyester and cotton demonstrated the ideal combination of thickness, absorbency and noticeable darkening of color when exposed to solutions with a pH level indicative of infection. Dasia then replicated her results using the optimal thread in the form of sutures that she stitched into an artificial skin pad and exposed to various pH solutions. Her work may one day benefit developing countries where early detection of post-surgical infection could save many lives. At **West High School** in Iowa City, Dasia is a Green and Gold Academy mentoring captain and is involved in many social justice causes. She is the daughter of LaDonna Phillips.

Katherine Tung

Menlo School
California

Katherine Tung, 17, of **Menlo Park**, derived properties for partially ordered sets for her Regeneron Science Talent Search **mathematics** project. Depth-first searches are used in computer science in applications for getting driving directions or search results. When depth-first searches are applied to graphs, they induce an order on the nodes which corresponds to elements of interesting combinatorial structures called 132-avoiding intervals. In her work, Katherine proved that all 132-avoiding intervals have the Sperner property, and her result is related to important conjectures in algebraic combinatorics and geometry. Katherine hopes that her work will lead to further breakthroughs in these conjectures, which will help speed up graph searches. At **Menlo School** in Atherton, Katherine is a varsity swimmer with a top time ranking by USA Swimming, editor of the literary magazine club, and a soprano in the chamber choir, the school's only auditioned ensemble. The daughter of Helen and Mark Tung, Katherine is a primary author of a paper published in the peer-reviewed *Bulletin of the London Mathematical Society*.

Parisa Aryana Vaziri

Plano East Senior High School
Texas

Parisa Aryana Vaziri, 18, of **Richardson**, examined the potential for FOXO, a gene associated with anti-aging, to suppress PINK1, a gene linked to Parkinson's disease for her Regeneron Science Talent Search **neuroscience** project. Since both of these genes in the fruit fly are homologous with its human counterparts, Parisa used the fly as a model organism to study whether overexpressing FOXO might have a protective effect in flies predisposed to PINK1-associated neurodegeneration. Experimenting from a sterile lab she created in her bathroom, using improvised household materials (including a "shower-incubator") and imaging technology borrowed from school, Parisa showed that flies with both PINK1 and overexpressed FOXO had significantly healthier neurons, better motor function and a longer lifespan than those with PINK1 alone. Her findings may lead to gene therapies with neuro-protective effects in the human brain. At **Plano East Senior High School**, Parisa is president of the science fair club and a multi-year winner of state and local science fairs. She was also captain of her track and cross country teams and is a top cellist in the Dallas Asian American Youth Orchestra. Parisa is the daughter of Neda Gholizadeh and Masoud Vaziri.

2021 FINALISTS

Vetri Senthil Vel

Bangor High School
Maine

Vetri Senthil Vel, 16, of **Veazie**, developed a wall mounted, real time fall detection system for his Regeneron Science Talent Search **engineering** project. Distressed that an elderly neighbor had lain unassisted after a fall for nearly a day, Vetri engineered a hands-free solution that could immediately text for help after detecting a fall. He interfaced an inexpensive microcomputer with a thermal camera, collected room images that did or did not include a fallen person and used them to train a neural network. At an average accuracy above 98 percent, his deep learning system distinguished between a fallen person and those sitting, standing or sleeping, as well as nonhuman heat sources, such as pets. His approach also preserves privacy by relying solely on heat signatures for recognition. Vetri's detection system may decrease future hospitalizations and deaths after a fall, which is a leading cause of fatalities among seniors. Vetri attends **Bangor High School** where he is a varsity runner, member of the science bowl team and captain and top ranked scorer on the varsity math team. He also volunteers as a virtual math tutor for his peers and was a summer math instructor at Veazie Community School. His parents are Senthil and Valli Vel.

Jeffrey G. Wang

The Bishop's School
California

Jeffrey George Wang, 17, of **San Diego**, studied the structure of DNA in chromosomes for his Regeneron Science Talent Search **computational biology and bioinformatics** project. In the nucleus of a cell, the two-meter-long DNA molecule is systematically folded to fit inside. Because many developmental and disease processes, including cancer, are guided by (or caused by) changes in the 3D arrangement of DNA, Jeffrey created a computer application to identify and rank significant differences in this arrangement across genomes in different cell lines. His program facilitates the location of important genes and pathways based solely on the 3D shape of the DNA. He has released his model for public use so other researchers can apply it to hundreds of existing and newly released datasets to discover new pathways, regulatory mechanisms and cancer targets. The son of Xiaoyin Wang and Ying Gao, Jeffrey attends **The Bishop's School** where he heads the speech and debate team. He is also a writer for *Quora*, a popular question-and-answer website. An avid actor, he played the lead in a sophomore play. He also heads a middle school math league, which grew from 30 to 120 active student members and won second place in the state under his leadership.

Justin Xu

Charter School of Wilmington
Delaware

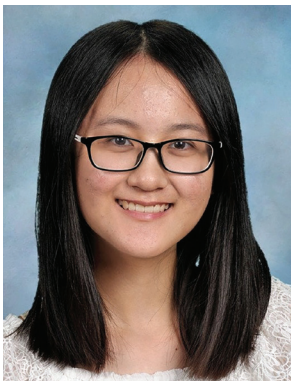
Justin Xu, 17, of **Hockessin**, developed a new computational method that simulates the effect of force on a material and used it to analyze the mechanical properties of fluoropolymers for his Regeneron Science Talent Search **materials science** project. Justin's research indicated that the mechanical strength of fluoropolymers is determined by the symmetry of the carbon-hydrogen bonds along the polymer's backbone, and that the amount of fluorine determines its toughness if it does not disrupt that symmetry. His model also predicted how different combinations of fluorine, carbon and hydrogen might yield fluoropolymers better suited for various applications, such as solar panels. It can also be used to study other materials, as Justin is currently doing with research on the mechanical basis of osteoporosis. Justin is first author of a paper based on his fluoropolymers research and co-author of three others, all published in the *Journal of Applied Physics*. The son of Zhengyi Xu and Shiyan Li, Justin attends the **Charter School of Wilmington** where he is founder and president of the 3D printing club and a competitive swimmer. He also plays viola and has performed as a soloist and principal violist in two orchestras at the PYO Music Institute.

Vivian Yee

International Academy
Michigan

Vivian Yee, 17, of **Beverly Hills**, researched disparities in COVID-19 cases and related deaths in more vulnerable communities for her Regeneron Science Talent Search **behavioral and social sciences** project. She examined metrics from two distinct datasets: the Social Vulnerability Index calculated by the Centers for Disease Control, and data on COVID-19 cases and deaths for the counties of New York City in March and May of 2020. By examining the rates of transmission, recovery and deaths alongside social determinants like housing, education and employment status, Vivian found that more vulnerable communities experienced higher rates of COVID-19 transmission and death. Further, her study suggests that government-led initiatives helped to reduce the inequality of COVID-19 outcomes for affected groups over time. Her findings are detailed in a Congressional Memorandum that has been accepted by the official Coronavirus Task Force to inform future relief legislation. Vivian co-founded Helping Hands, a non-profit organization that works to minimize education disparities for underprivileged students. She is a student at **International Academy** in Bloomfield Hills. Vivian is the daughter of Zena and James Yee.

2021 FINALISTS



Lucy Zha

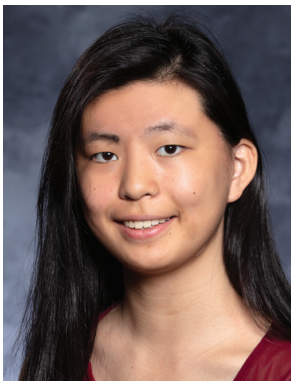
The Wheatley School
New York

Yifang (Lucy) Zha, 17, of **Albertson**, studied the potential benefits of using curcumin and capsaicin to fight neuroblastoma, one of the most common childhood cancers for her **medicine and health** Regeneron Science Talent Search project. After a relative was diagnosed with thyroid cancer, Lucy was motivated to explore the anti-cancer therapeutic potential of the plant-based chemicals curcumin and capsaicin, which are used in traditional Chinese medicine. She performed a study to test their synergistic effect in vitro on cancer cells and in vivo on zebrafish larvae. She found that when used in combination, the two chemicals do inhibit cancer cell growth, but high levels of curcumin can affect the development of hypothalamic cells, raising caution and the need for further study. Lucy is the daughter of Xielong Zha and Ronghua Sun and attends **The Wheatley School** in Old Westbury where she heads the book club and spends spare time each week volunteering for 4Ocean Cleanup. For fun, Lucy collects rocks; her favorite is gneiss (pronounced "nice"), which can "bend, morph, but not succumb to the excruciating stress underground." As an immigrant herself, she says she resonates with the rock's "spirit of resilience."

Jason Zhang

The Carol Martin Gatton Academy of Mathematics and Science
Kentucky

Jason Zhang, 17, of **Bowling Green**, produced a sustainable, photocatalytic chemical reaction that created important precursors to pharmaceuticals for his Regeneron Science Talent Search **chemistry** project. While chemists have long used light-absorbing catalysts (photocatalysts) to create new compounds, none had used photocatalysis to create them using ene-ynamides as the reacting substance. Jason determined the best solvent and optimal reaction time for the photocatalytic synthesis of useful molecules from ene-ynamides. The antidepressant milnacipran is one example of a useful compound synthesized from an ene-ynamide precursor. His method also eliminates the need for toxic metals and polluting reagents to synthesize products from these molecules. At **The Carol Martin Gatton Academy of Mathematics and Science**, Jason is co-president of the math club and competes on National Science Bowl Team A, one of the top 32 teams nationally and winner of the 2020 West Kentucky Regional High School Science Bowl. An Eagle Scout, Jason also holds a first degree black belt in Taekwondo and, prior to the pandemic, played clarinet in the Bowling Green Youth Orchestra. His parents are Rui Zhang and Lei Peng.



Jessica Zhang

Proof School
California

Jessica Jihang Zhang, 17, of **Foster City**, helped classify structures in our three-dimensional space for her Regeneron Science Talent Search **mathematics** project. To help make sense of our world, mathematicians often categorize a multitude of things into a fewer number of distinct types. Jessica did this by classifying how a contact surface behaves inside a torus-shaped object, like a solid doughnut, based on what it does on the exterior, that is, the glazed part of the doughnut. This may be the first time anyone has done this for a shape other than a solid sphere. Although doughnuts are a delicious example, understanding contact structures that reside inside tori is serious business, and can be used to better understand the physics of our entire world, doughnuts and all. Jessica attends **Proof School** in San Francisco where she volunteers as a teaching assistant in computer science and has earned numerous awards in math competitions, including a 2020 USA Bronze Medal from the S.-T. Yau High School Science Award. The daughter of Wentao Zhang and Jihong Yang, Jessica also is an accomplished pianist, named as a top talent four times by the American College of Musicians, from which she holds a diploma in piano.

Amy Siyi Zhou

William P. Clements High School
Texas

Amy Siyi Zhou, 17, of **Sugar Land**, focused her efforts on minimum entropy limits for amorphous materials for her Regeneron Science Talent Search **mathematics** project. These important materials (they look like a solid but act as a liquid, such as glass) are as abundant as they are mysterious and provide insight into the properties of solid and liquid states. Amy studied the minimum configurational entropy of these materials, taking previous work on a model system at low temperatures and extending it to amorphous materials at any state in thermal equilibrium. Her insight came when she used a mathematical model and analyzed the effect of subsystem size on the entropy of these materials. This work also provides some insight into the ground state of low-temperature liquids and glasses. Amy hopes that her work will be used by physicists and materials scientists to improve cryptographic communications and energy efficiency for a greener world. At **William P. Clements High School**, Amy is founding president of the Houston Teen Science Café, a bimonthly interactive speaker series, and competes statewide as a varsity member of the dance team. The daughter of Weijun Zhou and Lin Luo, Amy also competes nationally in classics contests.

REGENERON SCIENCE TALENT SEARCH 2021 | Finalists by State

REGENERON SCIENCE TALENT SEARCH 2021 | Finalists by Last Name

SOCIETY FOR SCIENCE

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80TH ANNIVERSARY

REGENERON
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Since 1942

About Regeneron

Regeneron is a leading biotechnology company that invents life-transforming medicines for people with serious diseases. Founded and led for over 30 years by physician-scientists, our unique ability to repeatedly and consistently translate science into medicine has led to eight FDA-approved treatments and numerous product candidates in development, almost all of which were homegrown in our laboratories. Our medicines and pipeline are designed to help patients with eye diseases, allergic and inflammatory diseases, cancer, cardiovascular and metabolic diseases, pain, infectious diseases and rare diseases.

Regeneron believes that operating as a good corporate citizen is crucial to delivering on our mission. We approach corporate responsibility with three goals in mind: to improve the lives of people with serious diseases, to foster a culture of integrity and excellence and to build sustainable communities. Regeneron is proud to be included on the Dow Jones Sustainability World Index and the Civic 50 list of the most "community-minded" companies in the United States. Throughout the year, Regeneron empowers and supports employees to give back through our volunteering, pro-bono and matching gift programs. Our most significant philanthropic commitments are in the area of science education, including the Regeneron Science Talent Search and Regeneron International Science and Engineering Fair.

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