

## Intel Science Talent Search 2009 Finalists



### Arizona

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#### **Smitha Ramakrishna** **Corona del Sol High in Tempe**

Smitha Ramakrishna, 17, of Chandler, submitted an Intel Science Talent Search **environmental science** project investigating what happens to sucralose (the artificial sweetener marketed as *Splenda*) after it passes through our bodies and ends up in a wastewater treatment plant. In the laboratory, Smitha confirmed that the sweetener resists the two types of bacterial digestion, as well as other techniques, typically used in conventional wastewater treatment plants. Only the use of both titanium oxide and ultraviolet light broke the sucralose into biodegradable molecules, but with extensive time and concentration requirements. From this latest phase of her three-year study, she concluded that virtually all of the sucralose consumed is entering the environment and accumulating in downstream ecosystems. At **Corona del Sol High School** in Tempe, Smitha heads the science research club, enjoys Indian classical dance and raises funds to help children get clean drinking water, an interest she developed during a visit to the slums of India at age 12. Winner of numerous science awards, she is the daughter of B. L. and Pushpa Ramakrishna and hopes to study at Yale or MIT.

### California

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#### **Aniruddha Sandeep Deshmukh** **Bellarmine College Preparatory School in San Jose**

Aniruddha Sandeep Deshmukh, 17, of Cupertino, submitted a **botany and plant sciences** project to the Intel Science Talent Search. Ani's research focused on boosting the regrowth of California sagebrush, *Artemisia californica*, in order to outgrow invasive grasses following wildfires. He studied five other native plant species in parallel to determine the best method of revitalizing the coastal sage scrub (CSS) ecosystem, which has declined by 70 percent over the past 20 years. He believes his research, conducted in his backyard and kitchen, resulted in a novel method of understanding CSS loss by analyzing the accumulation of cyanide in the soil after wildfires. Ani found that application of a specific concentration of dicobalt edentate reduces cyanide accumulation, boosts regrowth of native vegetation and may help to prevent possible extinction of the CSS ecosystem. Active in the science club and debate team, and on the yearbook and newspaper staffs at **Bellarmine College Preparatory** in San Jose, Ani plays first flute in the symphonic band. The son of Sandeep and Anagha Deshmukh, he hopes to attend Harvard or Princeton. He says his mission is to improve nature, and by doing so, improve humanity.

#### **Nitish Lakhanpal** **University High School in Irvine**

Nitish Lakhanpal, 17, of Irvine, created an algorithm for predicting one aspect of protein structure called beta structures for his Intel Science Talent Search **bioinformatics and genomics** project. The functions of proteins are defined by their shapes, and the difficult task of experimentally determining protein structure has sparked interest in computational approaches. Nitish developed an algorithm for predicting beta structure from a primary amino acid sequence using the statistical properties of known beta structures combined with a Monte Carlo-like (repeated random sampling) method to optimally partition the sequence into various segments. He believes his results compare well to existing

algorithms on two test sets of sequences related to two pathologically relevant proteins, amyloids and autotransporters, and plans to refine his approach. Nitish is president of the science and computer science clubs, Mock Trial team, and Amnesty International club at **University High School**, and has earned many awards. After school he plays piano, tap dances and mentors at-risk youth. The son of Bharat and Rita Lakhanpal, he hopes to attend Princeton or Harvard and dedicate his life to research.

### **Marianna Yuling Mao**

#### **Mission San Jose High School in Fremont**

Marianna Yuling Mao, 17, of Fremont, submitted a **physics** project to the Intel Science Talent Search using perturbation theory and the laws of general relativity to model gravitational radiation from binary star systems. As compact binary and single stars in globular clusters orbit around their center of mass, they are expected to lose energy, emitting gravitational waves as they draw closer to each other over time. Although the Laser Interferometer Space Antenna to be launched in 2018 will be the first observatory to detect space-based gravitational waves, Marianna's research estimates the wave emissions, luminosity and radiation frequency for future binary cluster and single star encounters. First in her class of 538 at **Mission San Jose High School**, Marianna heads the math club, is opinion editor for the school newspaper and tutors math students online. An accomplished pianist, Marianna also enjoys photography and debate and served as a member of the first national girls math team that competed in the Girls Math Olympiad in China. She is the daughter of Chengye Mao and Lin Wang, hopes to attend Harvard or MIT, and intends one day to earn a doctorate in physics.

### **Julia Dory Ransohoff**

#### **Menlo Atherton High School in Atherton**

Julia Dory Ransohoff, 17, of Menlo Park, investigated the impact of donor gender differences on the outcome of stem cell transplantation for her Intel Science Talent Search project in **medicine and health**. Her *in vitro* project focused on mesenchymal stem cells (MSCs) that can differentiate into a variety of cell types, and the factors affecting their successful use in restoring damaged cardiac tissue after a heart attack. Although recent research proposes that females possess naturally greater cardioprotection than males, Julia believes otherwise. Her investigation showed that female stem cells release a markedly higher amount of immune-system-activating proteins that may attack MSCs and limit their survival after transplant. These findings may contribute to advancing the field of stem cell biology and transplant immunology. Julia is a teaching assistant and peer tutor at **Menlo-Atherton High School** in Atherton. The winner of both academic and community service awards, she is co-founder of a sports-service club to raise awareness of end-of-life care, and is active in teen literacy initiatives worldwide. The daughter of Paul Ransohoff and Nan Link, she hopes to attend Harvard or Stanford.

### **Nilesh Tripuraneni**

#### **Clovis West High School in Fresno**

Nilesh Tripuraneni, 18, of Fresno, formulated a set of hydrodynamic equations investigating quark-gluon plasma (QGP) for his Intel Science Talent Search **physics** project. QGP is a distinct super-hot state of matter believed to have existed immediately following the Big Bang. Nilesh investigated particle collision experiments that suggested that QGP behaves like an extremely low shear viscosity super-fluid, and he established that the fluid's viscosity is much more significant than its other properties. By modifying Navier-Stokes equations, Nilesh was able to one-dimensionally model QGP's hydrodynamic expansion and predict energy density fluctuations. His research provides a potential method to better understand the first moments of the universe and could aid in the development of a quantum theory of gravity. Nilesh attends **Clovis West High School** where he is first in his class of 603. He plays guitar, and also volunteers as a judge in regional science fairs. The son of Bhaskara and Indira Tripuraneni, Nilesh plans to attend Stanford or MIT. For Nilesh, finding pure discoveries reminds him "of the power of nature and the unique ability of humans to discover things that will outlast us all."

## Connecticut

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### **Aditya Rajagopalan** **Choate Rosemary Hall in Wallingford**

Aditya Rajagopalan, 17, of Glastonbury, submitted an Intel Science Talent Search **biochemistry** project that demonstrated a more efficient and less expensive approach to make ethanol, a clean burning alternative fuel that is derived from the fermentation of sugars extracted from plant biomass. Adi developed a novel enzyme synergy model that he believes demonstrates how enzyme synergy works and may reduce by 50 percent the need for high cost enzymes, while nearly doubling the extracted sugar content from biomass to generate liquid fuels. His research could help reduce cellulosic ethanol production costs. Adi attends **Choate Rosemary Hall** in Wallingford where, as the shortest player on the volleyball team, he discovered that he could substantially improve his game by analyzing the physics behind the float serve; he is now team co-captain. He also heads the school debate team, top ranked in New England, and increased its membership from 20 to 70 students. Born in Canada, he is the son of Ramesh and Jayashree Rajagopalan and hopes to study at Harvard or Princeton. One day, Adi plans to lead an alternative energy company and fuse his passions for science, math and economics.

## Florida

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### **Maxim Rabinovich** **Shorecrest Preparatory School in St. Petersburg**

Maxim Rabinovich, 17, of Wimauma, submitted a **mathematics** project determining the scaling limits of generalized anisotropic models to the Intel Science Talent Search. Max's work addressed a random process of diffusion in which a finite set of particles start out on points on a grid, and those particles which share a site move randomly to unoccupied points until no site has more than one particle. Levine and Peres showed that the shape of the expected result would be rectangular under certain assumptions. Under a more general assumption concerning the probabilities of motion, Max showed that the resulting shape is an ellipsoid. Max is a student at **Shorecrest Preparatory School** in St. Petersburg where he plays violin in the concert band. He is first in his class of 55 and received perfect SAT scores. Max has also received a University of Chicago Book Award and enjoys creative writing and weightlifting. Born in the Ukraine, he is the son of Paul Rabinovich and Julia Roebuck. He plans to attend Harvard or Princeton and hopes to develop solutions for some fundamental math problems that provide insight into the nature of mathematics.

## Illinois

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### **Elizabeth Jie Rao** **Lincoln Park High School in Chicago**

Elizabeth Jie Rao, 17, of Chicago, studied the relationship between neurodegenerative disease and a protein called TDP-43 for her Intel Science Talent Search project in **medicine and health**. Recent studies have established a causal relationship between mutations in the 414 amino acid TDP-43 protein and amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig's disease. To develop a genetically flexible model for studying the pathogenesis of mutated TDP-43 in a living organism, Liz generated transgenic *Drosophila melanogaster* (fruit fly) lines. She demonstrated the presence of terminal fragments that could lead to protein aggregation, often associated with neurodegenerative disease. Her current model may provide a framework for further animal model investigation and development of possible drug treatments. First in her class of 511 at **Lincoln Park High School**, Liz is captain of the women's varsity volleyball team, and active in the science and math clubs, mock trial and academic decathlon. She is a

published photographer and an award-winning pianist. The daughter of Yi Rao and Jane Wu, she hopes to study anthropology or medicine at Stanford or Columbia.

## **Eric Shyu**

### **Illinois Mathematics & Science Academy in Aurora**

Eric Shyu, 18, of Naperville, synthesized and characterized novel metal-organic polymer networks for his Intel Science Talent Search project in **chemistry**. Eric investigated the role that cadmium perchlorate would play in the creation of coordination polymers. His work resulted in 12 new polymer solids, two of which had unprecedented structures. Moreover, one of these was the first-ever example of a specific polymer lattice pattern - a significant discovery, and something numerous investigators had been seeking for more than a decade. Both polymers were found to emit intense blue-white light when exposed to ultraviolet light. This luminescent property may contribute to the development of better light-emitting diodes. It is believed that six or more peer-reviewed publications will result from this work. The son of Kae Shyu and Chung-Jeing Yuan, Eric attends **Illinois Math and Science Academy** in Aurora. He is a member of Mu Alpha Theta and heads up his school's InvenTeam project to build a low-cost, durable water filter. He plans to attend MIT or Caltech and hopes to reveal the connections between different fields of study such as chemistry and mathematics.

## **Massachusetts**

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### **Noah Maxwell Arbesfeld**

#### **Lexington High School in Lexington**

Noah Maxwell Arbesfeld, 17, of Lexington, entered a **mathematics** project in the Intel Science Talent Search that concerned the structure of the free associative algebra on finitely many generators. The free algebra has no special properties; as such it is important because all other algebras can be built from it. Using both theoretical and computational tools (representation theory and MAGMA, respectively) Noah studied the dimension of certain subspaces inside quotients of the lower central series. In the case of two generators he improved a known bound from quadratic to linear, and he also gave a precise description of the first few quotients. Noah attends **Lexington High School** where he participates in the multicultural club and the Chinese Exchange. The recipient of numerous awards in math, debate and science, he enjoys playing the saxophone in the school band. In his spare time Noah also enjoys amateur astronomy, geography, and improvisational theater. He plans to continue researching mathematics at MIT or Harvard, and hopes that his work will help communicate complex ideas to a non-scientific audience. He is the son of Stuart and Lisa Arbesfeld.

## **Minnesota**

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### **Michael Sheng Cherkassky**

#### **Edina High School in Edina**

Michael Sheng Cherkassky, 17, of Edina, entered a **computer science** project in the Intel Science Talent Search, that applied two statistical machine learning classification methods to improve the accuracy of heart disease and breast cancer diagnoses. Machine learning is concerned with the question of how to program computers to learn from experience. Michael was inspired to apply machine learning to medicine after witnessing the misdiagnosis of an anemic relative in an emergency room where, he says, more than 20 percent of cases are typically misdiagnosed. He is sole author of the paper about his project appearing in *Chance*, published by the American Statistical Association, describing how his computerized methods resulted in diagnostic accuracies up to 98 percent. Most of his research was conducted from his home lab consisting of "my desk, my laptop and a diet Coke." At **Edina High School**, Michael is co-president of the philosophy club and captain of Destination Imagination. A violinist and pianist, he founded a volunteer group to

play classical music at area retirement homes. The son of Vladimir Cherkassky and Beihua Anna Sheng, he hopes to attend Harvard or Stanford.

**Stephen Walter Trusheim**  
**Breck School in Golden Valley**

**Stephen Walter Trusheim**, 18, of **Chaska**, engineered software that reduces the cost of hospital surveillance for methicillin-resistant *Staphylococcus aureus* (MRSA) by accurately targeting at-risk patients for testing for his Intel Science Talent Search **bioinformatics and genomics** project. He developed software to identify high-risk patients, recommend optimal testing methods, assess the hospital's overall cost for the MRSA surveillance program, and deliver public reports about MRSA infections. By implementing Stephen's "predictive MRSA surveillance" strategy, which uses more personalized test methods during patient admission, he believes hospital costs can be reduced without decreasing the quality of patient care. In conjunction with his research Stephen created a public MRSA website to provide personalized risk analysis as well as an up-to-date model of public MRSA outbreaks. The winner of numerous awards in computer science and information technology, Stephen attends **Breck School** in Golden Valley. The son of John Trusheim and Martha Nance, he plans to attend Stanford or Yale. He hopes to design software that will map, monitor, and predict worldwide epidemics.

## Missouri

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**William Jayang Sun**  
**Parkway Central High School in Chesterfield**

William Jayang Sun, 17, of Chesterfield, submitted to the Intel Science Talent Search a **biochemistry** project that researched the potential of a recently discovered molecule, Golgicide A (GCA), as a potential drug to inhibit intracellular transport of bacterial toxins. William demonstrated that although GCA affected a specific gene, GBF1, that regulates intracellular transport, it had no effect on canine cells. Through cloning and genetic sequencing, he discovered a single amino acid difference between the canine gene and all other mammalian genes. He then introduced this substitution into human GBF1 genes, and showed how the substitution provided resistance to the drug. William's efforts may lead to therapeutic approaches for preventing neurodegenerative disorders such as Alzheimer's disease. He is first author of a manuscript submitted to *Nature Chemical Biology* and hopes to attend Harvard or Yale. At **Parkway Central High School**, William is first in his class of 336, has perfect SATs and enjoys debate and piano. An award winning community volunteer, he is also general assembly president of the St. Louis area Model UN. He is the son of Ruofei Sun and Weijia Xu.

## New Jersey

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**Doris Chen**  
**Tenaflly High School in Tenaflly**

Doris Chen, 17, of Tenaflly, submitted an Intel Science Talent Search project in **medicine and health** that identified how a novel mitochondrial enzyme, MHBD, is a key factor for neuron survival in patients with neurodegenerative diseases such as Parkinson's disease (PD). Her research identified a connection between decreased enzymatic activity and exaggerated neuronal death relative to both PD and Alzheimer's disease (AD). Doris, whose research began after her grandfather was diagnosed with Alzheimer's disease, hopes her findings will contribute to new methods for diagnosis and treatment of neurodegenerative disorders. She is co-author of a paper on her research that was published in *Nature Medicine*. First in her class of 272 at **Tenaflly High School**, Doris is active on the debate team and participates in the Model UN club. In her spare time she also enjoys swimming, drawing, playing violin and viola, and participates in a chamber music club that organized a benefit concert for children in Cambodia. The daughter of John

Xi Chen and Shirley Shidu Yan, she hopes to pursue a career as a surgeon at Harvard or Yale.

**Radomir Kratchmarov**  
**Livingston High School in Livingston**

Radomir Kratchmarov, 17, of Livingston, submitted an Intel Science Talent Search project in **microbiology** that explored the link between live cell nibbling and how it can regulate immune function. Rad studied how plasmacytoid dendritic cells (pDCs) ingest portions of live, virus-infected cells through "nibbling" and then often mature into antigen-presenting cells. These matured cells preferentially nibble on the virally-infected cells, and simultaneously induce an immune response in them. Rad's research suggests a critical link between innate and adaptive immunity *in vivo*, and potentially offers a novel method to treat infected cancer cells. A student at **Livingston High School**, Rad earned a perfect 2400 on the SAT exams. He volunteers weekly at both St. Barnabas and Mountainside Hospitals and organized a volunteer program within the Intensive Care Unit to gain first-hand experience in the medical field. A guitar player for over eight years, he enjoys practicing both independently and with friends in local bands. The son of Tchavdar and Anita Kratchmarov, Rad was born in Germany and speaks fluent Bulgarian. He hopes to study molecular biology at Brown University or Princeton.

**Hayden Craig Metsky**  
**Millburn High School in Millburn**

Hayden Craig Metsky, 17, of Millburn, submitted a **computer science** project to the Intel Science Talent Search that he hopes will help people, who speak different languages, communicate more easily. Hayden created software aimed at increasing the accuracy of automated computer translation, called "machine translation." Specifically, he sought to improve the ordering of words in the translated text. By studying English machine translation from Urdu (the official language of Pakistan that he does not speak), Hayden noticed that when entire phrases were translated, they maintained proper word order. However, when subphrases were translated, the words were not always placed correctly. To address the problem, his translation software combined existing phrase pairs to improve translation quality. At **Millburn High School**, Hayden plays the cello, French horn, trumpet and piano, and in his spare time enjoys photography and independent software development. He was a member of the physics bowl team that placed first in the nation, and he hopes to continue his studies in computer science and math at MIT or Harvard. Hayden is the son of Richard Metsky and Joy Siegel-Metsky.

**New York**

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**Patrick Jeffrey Abejar**  
**Smithtown High School West in Smithtown**

Patrick Jeffrey Abejar, 17, of Smithtown, used a boron isotope found in the calcite shells of fossilized brachiopods to model atmospheric carbon dioxide, the primary cause of the greenhouse effect, for his Intel Science Talent Search project in **earth and planetary science**. The level of carbon dioxide in the atmosphere affects the pH of seawater and this is known to cause changes in the boron isotope ratio. This isotopic signature of ancient seawater is recorded in the shells of the brachiopod, *Neospirifer*, which lived in deep water. When he examined samples taken from fossilized *Neospirifer* shells from the late Pennsylvanian and early Permian periods, Patrick observed that the boron isotope level increased as temperatures decreased, and vice versa. He believes this relationship can be used to model climate change in any period. The son of Ludovico and Imelda Abejar, Patrick attends **Smithtown High School West**. He is captain of the Science Olympiad team, webmaster for the French honor society and president of both the mathematics honor society and the multicultural club. Patrick is a first degree black belt in Okinawan karate. He hopes to study chemical engineering at MIT or Cornell.

### **Jocelyn Chuang**

#### **Bronx High School of Science in Bronx**

Jocelyn Chuang, 17, of New York, investigated the genetic basis of anxiety disorders and potential hormonal influence for the **behavioral and social sciences** project she submitted to the Intel Science Talent Search. Over a two-year period, she studied a mouse model of a human genetic alteration in BDNF, a growth factor susceptibility gene implicated in a variety of anxiety-related behaviors. She was quickly able to show that female mice with variant BDNF displayed increased anxiety-related behaviors, like male mice. But by studying the females throughout their lives and across their estrous cycles, she found that post-adolescents showed altered anxiety states, indicating that female hormones temper anxiety-behavioral changes. Jocelyn believes her findings may lead to new treatment strategies, and she will be first author of a paper on this project being prepared for submission to a scientific journal. At **Bronx High School of Science**, Jocelyn participates in cross-country and track and field. She is also executive chief photography editor for the yearbook. The daughter of Jen-Zen Chuang and Ching-Hwa Sung, Jocelyn hopes to study biological and biomedical sciences at Princeton or Wellesley.

### **Abigail Sara Greene**

#### **John Jay High School in Cross River**

Abigail Sara Greene, 17, of Katonah, investigated face and object recognition among patients with Alzheimer's disease (AD) to improve understanding of the AD neurological progression for her **behavioral and social sciences** entry in the Intel Science Talent Search. In her pilot study, she compared differences in visual accuracy and reaction time between healthy individuals and those with AD. While the control group exhibited a significant "inversion effect" (slower recognition of inverted faces as compared to upright ones), the AD patients did not. Abby believes this implicates the brain's right occipito-temporal lobe, largely responsible for upright facial discrimination, as a region of early neurodegeneration in AD patients. She believes that an extended study could have significant impact on treatment of this disease. Abby is editor-in-chief of the school paper and president of the Mock Trial team at **John Jay High School** in Cross River, where she plays violin in the symphonic orchestra. She is also an accomplished pianist and has perfect SAT scores. The daughter of William Greene and Susan Lee Feinberg-Greene, Abby plans to study neuropsychology and journalism at the college level.

### **Chelsea Lynn Jurman**

#### **Roslyn High School in Roslyn Heights**

Chelsea Lynn Jurman, 17, of Roslyn, studied factors predicting underage drinking for her Intel Science Talent Search in **behavioral and social sciences**. For her study, 123 students were randomly selected to complete a survey about their drinking behaviors and attitudes toward alcohol, as well as their perceptions of their parents' drinking and parenting behaviors. Chelsea's analysis of her survey's results suggests that a teen's perception of his or her parents' behaviors as an adolescent is positively linked to the teen's own alcohol use, and that teens are less likely to drink when they are supervised. She advises parents not to share stories about their own underage drinking with their children, but to be supportive and maintain strict supervision. Chelsea is editor-in-chief of the school paper, co-captain of the Mock Trial team and vice president of Habitat for Humanity at **Roslyn High School** in Roslyn Heights. She was invited to present her work in a poster session at the 2009 meeting of the Society for Personality and Social Psychology. The daughter of Julian and Vicki Jurman, Chelsea hopes to attend Yale or Princeton, study journalism and English and become a scientific journalist or lawyer.

### **Joseph Li**

#### **Bronx High School of Science in Bronx**

Joseph Li, 18, of Flushing, developed a fruit fly model to study the unfolded protein response (UPR), which is associated with major degenerative disorders including Alzheimer's, Lou Gehrig's disease and diabetes, for his Intel Science Talent Search project in **biochemistry**. The UPR is a cellular signaling pathway activated in response to the overload of misfolded proteins in the endoplasmic reticulum (ER) that helps the ER recover

from the accumulation of misfolded proteins by increasing its folding capacity and the degradation of the misfolded proteins. In the short term, the UPR can reduce stress caused by misfolding; however, chronic stress can lead to cell death. Josepher's fruit fly misexpressed a membrane protein, Rhodopsin-1, in its developing eye tissue, leading to a rough eye phenotype, which researchers have used to identify genes that can reduce stress in the ER. He also improved upon an existing UPR sensor and verified its efficacy. A student at **Bronx High School of Science**, Josepher builds model bridges and writes poetry. The son of Chang Kuo Li and Ming Chu Kui, he hopes to study chemical engineering at MIT or Stanford and pursue a career as a medical doctor or professor/researcher.

**Anissa Yuenming Mak**  
**Stuyvesant High School in New York City**

Anissa Yuenming Mak, 18, of Oakland Gardens, submitted an Intel Science Talent Search project in **mathematics** that involved graphs and algorithms. A fundamental question that arises about an algorithm concerns its implementation: how can we know that the computation is free of bugs? A certifying algorithm gives evidence that the result of the computation is correct. The modular decomposition of a graph is a useful way of describing a graph in terms of a certain tree. Anissa provided a certification algorithm for modular decomposition. Anissa attends **Stuyvesant High School** in New York City, where she serves as the yearbook art editor. She frequently volunteers at the local hospital, and practices Chinese calligraphy and graphic design. She also enjoys exploring modular origami, and used graph theory to create a tri-color truncated icosahedron, which resembled a soccer ball and consisted of twelve pentagons and twenty hexagons. The daughter of Randy Kaiyin Mak and Polly Tzeying Mak, Anissa was born in China and speaks fluent Cantonese and Mandarin. She plans to attend MIT to pursue a career in mathematical research.

**Adam Benjamin Sealfon**  
**Stuyvesant High School in New York**

Adam Benjamin Sealfon, 17, of Brooklyn, submitted an Intel Science Talent Search **computer science** project that explored graphs and hypergraphs, which have applications in biology, particle physics and Internet searches. A graph is a collection of vertices (points) in which certain pairs are connected by edges (lines). Adam studied algorithms for testing properties of  $k$ -uniform hypergraphs - generalizations of graphs in which each line connects exactly  $k$  points, where  $k > 2$ . An *adaptive* algorithm is a query that may depend on the outcome of earlier queries; *non-adaptive* algorithms are queries determined without attention to prior answers. Adam's results include a  $k$ -th order upper bound on the complexity gap between a non-adaptive and an adaptive algorithm on  $k$ -uniform hypergraphs. He also proposes an adaptive algorithm for testing whether a 3-hypergraph is a disjoint union of cliques, and determines the gap between his algorithm and a certain class of non-adaptive algorithms. At **Stuyvesant High School** in New York, Adam enjoys the politics and history clubs, piano and creative writing. He has perfect SATs, hopes to attend Princeton or Harvard, and is the son of Stuart and Celia Sealfon.

**Preya Shah**  
**Ward Melville High School in East Setauket**

Preya Shah, 17, of Setauket, designed and synthesized a novel tumor-targeting conjugate drug for cancer treatment that she believes represents a new generation of chemotherapy agents for her **chemistry** entry in the Intel Science Talent Search. Her project addressed the problem of drug-resistant cancer and the difficulty of targeting only cancer cells while protecting normal tissue. In developing her drug conjugate, she used two anticancer agents ("warheads") to attack cancer cells on two different fronts. She chose biotin, a vitamin consumed in large quantities by cancer cells, as the tumor-targeting molecule to guide the cytotoxic warheads into malignant cells. She believes her approach has the potential to treat multidrug-resistant cancer without causing significant side effects. At **Ward Melville High School** in East Setauket, Preya is president of the Science Bowl Club and co-captain of the Science Olympiad. She has received numerous awards for academics

and music composition and has perfect SAT scores. Preya plays the oboe and the violin and has sung at Carnegie Hall. The daughter of Ajay and Shilpa Shah, she hopes to continue her studies at Harvard or Princeton.

**Christine Lee Shrock**  
**Ward Melville High School in East Setauket**

Christine Lee Shrock, 18, of Setauket, built computer models to carry out molecular dynamics simulations in studying the protein MDM2 and its effect on tumor suppression for her Intel Science Talent Search project in **bioinformatics and genomics**. She specifically focused on MDM2's effect on p53, an important tumor-suppressing protein. When it is bound to MDM2, p53 is inactivated, and a crucial part of the binding process is a segment of an amino acid residue on MDM2 that forms a "lid." Through her computer simulation, Christine showed that when the lid stays open, p53 is bound; when the lid is closed, p53 is free to perform its tumor-suppressing function. She believes her results identify the lid opening mechanism as a target for a new class of cancer drugs. Christine is president of the Spanish Honor Society at **Ward Melville High School** in East Setauket, where she performs with the chamber orchestra as violin soloist and concertmaster. She is an award-winning violinist, and has performed at Carnegie Hall. Christine is first author of a manuscript being submitted for publication in *Protein Science*, and hopes to attend Harvard or Princeton. She is the daughter of Robert Shrock and I-Hsiu Lee.

## Ohio

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**Elizabeth Charlotte Coquillette**  
**Hathaway Brown School in Shaker Heights**

Elizabeth Charlotte Coquillette, 18, of Cleveland Heights, designed, built and programmed a fully autonomous search-and-rescue robot as her **engineering** project entry in the Intel Science Talent Search. Lizzie designed the electrical and mechanical parts, incorporated sophisticated sensors and infrared camera, and programmed her customized software allowing her robot to "actually think," i.e. control its own movement, monitor its location, navigate through a building, find humans, and record their locations. She believes her work has immediate application on rescue sites that are too chaotic or dangerous for rescuers to enter, and hopes her autonomous robot can increase the safety, efficiency and accuracy of rescue missions. At **Hathaway Brown School** in Shaker Heights, Lizzie is a member of the advanced modern dance company and editor of the literary journal. Her many awards include a fully funded fellowship to design and teach a robotics summer curriculum to middle school girls from under-resourced public schools. Lizzie has a perfect ACT composite score and plans to study computer science on the college level. She is the daughter of William and Janet Coquillette.

**Caitlin Maureen Mann**  
**Hathaway Brown School in Shaker Heights**

Caitlin Maureen Mann, 18, of Rocky River, submitted the latest phase of a three year **engineering** project to the Intel Science Talent Search that described her biosensor that may quickly and inexpensively detect skeletal muscle damage. Caitlin's micro-electrochemical biosensor indirectly measures creatine kinase (CK), an enzyme that indicates the presence and severity of muscle damage caused by events such as heart attacks. She created a solution containing CK and a blood sample, and used her miniaturized sensor to apply an electrical current to monitor the generation of hydrogen peroxide and the corresponding electric current response. Caitlin found that the current increased in a direct linear relationship to the concentration of CK in the solution. Caitlin's sensor compares favorably with current testing that is costly, takes longer, and requires larger blood samples. Caitlin attends **Hathaway Brown School** in Shaker Heights where she heads the Latin club. An internationally ranked Irish dancer, she volunteers to aid Cleveland's homeless and tutors middle school math students. She is the daughter of Gordon Mann and Lucy Andrews-Mann and hopes to study biomedical engineering in

college.

## **Tong Zhan**

### **William Mason High School in Mason**

Tong Zhan, 16, of Mason, investigated Rainbow Ramsey Theory, which asks about combinatorial properties of the natural numbers for his Intel Science Talent Search project in **mathematics**. A rainbow coloring of a set of numbers is one in which each of the numbers is assigned a different color. Tong showed that a coloring of the natural numbers in which each of three colors is assigned sufficiently often must contain a rainbow coloring  $a, b, c$  such that  $a - b = c^2$ . He conjectured that there is also a rainbow triple  $a, b, c$  such that  $a^2 + b^2 = c^2$ . Earlier Rainbow Ramsey results involved solutions of linear equations; Tong improved certain ones of these en route to his results on quadratic conditions. A student at **William Mason High School**, Tong is first in his class of 662. A violinist in the Cincinnati Symphony Youth Orchestra, he has earned perfect SAT scores. The son of Yunsong Zhan and Jihong Chen, Tong was born in China, and spent the summer of 2008 researching in the Clarks Scholar Program at Texas Tech University. Tong hopes to attend Yale or Princeton, and aims to discover connections between math and science that will contribute to problems such as protein folding and cryptography.

## **Oklahoma**

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## **Melissa Nicole Carvell**

### **Bartlesville High School in Bartlesville**

Melissa Nicole Carvell, 18, of Bartlesville, conducted research to improve body armor for her Intel Science Talent Search **engineering** project. Body armor worn today typically consists of a ceramic plate in a Kevlar sleeve. When a bullet strikes the ceramic plate it deflects, putting the front surface in compression and the back side in tension. Ceramics are strong in compression, but weak in tension. By combining the ceramic plates with composite materials, known to be strong in tension, Melissa sought to improve their impact strength. Working in her garage, she tested the impact energy necessary to pierce and fail ceramic plates and ceramic plates bonded to layers of Kevlar, fiberglass or carbon fiber. While all three composites increased the impact strength of the ceramic tiles, Kevlar was the most effective, increasing the impact strength by almost 19,000 percent. First in her class of 379 at **Bartlesville High School**, Melissa studies creative writing at the University of Tulsa and mentors students at Camp Invention. Her many honors include awards from the Air Force and the Navy. Melissa is the daughter of Lee and Brenee Carvell. She hopes to study engineering at Stanford or the University of Kansas.

## **Oregon**

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## **Eric Kerner Larson**

### **South Eugene High School in Eugene**

Eric Kerner Larson, 17, of Eugene, studied the classification of integral fusion categories for his Intel Science Talent Search project in **mathematics**. Fusion categories are of current interest in mathematics and applications. Earlier work classified those categories of dimensions  $p, pq,$  or  $pqr$ , where  $p, q, r$  are distinct prime numbers. Eric classified those of dimension  $pq^2$  where  $p$  and  $q$  are again distinct primes; unlike the previous cases, this class contained examples not arising from group theory. He also classified some other families of graded fusion categories. Eric attends **South Eugene High School** where he is active in the math, chemistry and programming clubs. He is the recipient of numerous awards in math, and in 2007, he attended the International Math Olympiad in Hanoi, Vietnam, where he received the silver medal. An accomplished classical pianist, he is a four-time gold medalist at the Oregon Junior Bach Festival. The son of Steven Larson and Winifred Kerner, he hopes to pursue a career as a mathematical researcher or professor at Harvard or MIT. Eric enjoys conducting his own investigations and thinking about questions that nobody knows how to answer.

## **Michael Loy**

### **Oregon Episcopal School in Portland**

Michael Loy, 18, of Portland, submitted a **materials science** project to the Intel Science Talent Search that may help increase the useful life of our nation's concrete infrastructure by protecting steel rebar from corrosion. The steel rebar gives load-bearing concrete much of its strength. Michael demonstrated that when he added inexpensive chemical buffer solutions to the initial concrete mixture, the pH of the solidified concrete could be maintained above 11 or even 12, about the same alkalinity as household bleach. The steel rebar in the buffered concrete was found to resist the corrosive effects of salt and carbonic acid, but the steel in the control group, which was not buffered, did not. His work is to be published in two international journals. At **Oregon Episcopal School**, Michael mentors robotics students and heads the InvenTeam that designed a human-powered irrigation pump for Africa. His avocation is promoting his multi-generational swing band, which he formed after learning that big band music was the only high point during his grandparents' time in a west coast World War II internment camp. The son of Michael Loy and Bette Yada, he hopes to study engineering in college.

## **Pennsylvania**

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## **Janet Song**

### **Methacton High School in Norristown**

Janet Song, 17, of Audubon, developed a novel method of isolating low molecular weight (MW) DNA from urine as a first step toward developing a non-invasive test for the early detection of cancer for her Intel Science Talent Search project in **medicine and health**. Urine contains low MW DNA that comes from the circulatory system, and therefore from possible tumor sites. In her study, Janet developed and optimized a method using carboxylated magnetic beads (CMB) to separate low MW DNA from high MW DNA, which is also found in urine. Her CMB-urine method enhanced the detection of the cancer-related K-ras mutations. The next step, she says, is to develop a panel of biomarkers for the detection of cancers of interest. Janet co-authored an article on the research and is named as co-inventor in a patent application. First in her class of 457 at **Methacton High School** in Norristown, she writes poetry and fiction and plays first violin in the school orchestra. An accomplished pianist, she has performed at Carnegie Hall. The daughter of Wei Song and Ying-Hsiu Su, in 2007, Janet was a presenter at a medical conference in Moscow, Russia. She hopes to attend Harvard or MIT.

## **Texas**

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## **Wen Chyan**

### **Texas Academy of Mathematics & Science in Denton**

Wen Chyan, 17, of Denton, entered the Intel Science Talent Search with a **chemistry** project involving polymerized hydrogels that can be used to coat inserted medical devices, such as catheters and breathing tubes. Infection caused by the formation of bacterial biofilms on such medical devices now afflict millions of patients annually in the U.S. Wen's hydrogel composites release silver ions, a potent antimicrobial agent. Wen also designed and developed a novel analytical procedure that can provide quantitative real-time data on the silver release rates, at silver concentrations as low as 50 parts per billion. Using this method, Wen was able to demonstrate that the silver release rates increased at elevated temperatures, such as might accompany an infection, which ideally means that more of the antimicrobial agent would be released when it is most needed. A patent application based on his work is being prepared. Wen has won many science and music composition awards and enjoys the violin, piano, swimming and engineering. His parents are Oliver Chyan and Jin-Jian Chen. Wen attends the **Texas Academy of Mathematics and Science** and he hopes to attend MIT or Harvard.

**Michael Tyler Wham**  
**Sterling Ridge Home School in Woodlands**

Michael Tyler Wham, 19, of Woodlands, submitted to the Intel Science Talent Search a **zoology and animal sciences** project studying the vocalizations of the endangered Red-cockaded Woodpecker that inhabits the nation's southeastern pine forests. Inspired by a request from officials at Jones State Forest to monitor its population of these woodpeckers, Mike set up cameras to unobtrusively record sound and video of the birds in the wild over several months. He found that certain calls were indicative of specific behaviors and his paper describes his computer assisted analysis of the birds' calls, distinguishing greeting, begging and distress. During his observations, he also captured the stealing of a woodpecker roost by a flying squirrel (called kleptoparasitism) believed to be the first episode of its kind on video. Winner of numerous science and filmmaking awards, his work has appeared in 22 film festivals in four countries, Mike has won grants to make documentaries in the wild from Antarctica to northern Alaska. Mike, who is **home schooled**, is a black belt martial artist, scuba diver and underwater photographer. He is the son of G. Mark Wham and Rene Rogers and hopes to study biology or ecology at Rice or Brown.

**Virginia**

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**Alexander Mee-Woong Kim**  
**Thomas Jefferson High School for Science & Technology in Alexandria**

Alexander Mee-Woong Kim, 17, of Fairfax, conducted morphological and genetic analyses of the giant American river prawn (*Macrobrachium carcinus*) for the **zoology and animal sciences** project he submitted to the Intel Science Talent Search. Alex has been studying fresh water prawns since he was 13, and in this project, he investigated differences in genes and body structure among geographically diverse specimens from Venezuela to the Galapagos. He collected these fresh water shrimp in Puerto Rico, recorded and analyzed their morphological data, used tissue samples and preserved specimens for DNA extraction and sequencing, and compared island-specific genetic families. Alex believes his research into the evolution of regional differences will affect our understanding of how species evolve and perhaps identify strategies to reverse the decline of these crustaceans. At **Thomas Jefferson High School for Science and Technology** in Alexandria, Alex is co-captain of the debate team and captain of the National Ocean Sciences Bowl team. He has perfect SAT scores and hopes to study at Harvard or Yale. He is the son of John Sang-Young Kim and Duckju Kim.

**Narendra Pundarik Tallapragada**  
**Thomas Jefferson High School for Science & Technology in Alexandria**

Narendra Pundarik Tallapragada, 17, of Burke, used a "bottom up" atomic level approach to develop a complete theory for the bulk electrical properties of one type of crystalline solid for his Intel Science Talent Search project in **physics**. Over a two-year period, Naren devised a sophisticated, but computationally efficient methodology for the modeling of bulk materials from some of the functional properties of their constituent atoms and molecules. His new approach produced a new model of dielectric behavior of alkali halide crystals, was faster and less expensive than conventional, high-cost quantum mechanics calculations, and his results, in large part, were comparable. His discoveries may be useful in designing new molecules atom-by-atom. At **Thomas Jefferson High School for Science and Technology** in Alexandria, Naren is president of the Model UN club and co-captain of the Quizbowl team. He also serves as a math tutor for minority and socioeconomically disadvantaged students, and his honors include reaching the semifinals of the *Jeopardy! Teen Tournament*. He is the son of Ravi and Jyotsna Tallapragada and hopes to study electrical engineering at MIT or Harvard.

### **Gabriela Aylin Faran** **West High School in Madison**

Gabriela Aylin Farfan, 18, of Madison, entered the Intel Science Talent Search with an **earth and planetary science** project investigating a type of feldspar commonly referred to as "Oregon sunstones." Previous investigators had established that Oregon sunstones shimmer because they contain metallic copper. Gabriela investigated why some sunstones that were collected at the Dust Devil Mine in Oregon appeared to be red when viewed from one angle and green when viewed from another. She used x-ray diffraction, optical microscopy and scanning electron microscopy and found, for the first time, that some of the samples contained zinc that, when combined with copper, appeared to produce a more golden color. She believes that the red-green color shift is caused by nano-scale metal platelet inclusions in the feldspar that are aligned; the rock appears to be one color when the inclusions are looked at end-wise, and another when looked at lengthwise. First in her class of 412 at **West High School**, Gabriela enjoys mineral and gemstone collecting, art and voice. She is daughter of Carlos Peralta and Abigail Farfan and hopes to attend the University of Wisconsin or Stanford.

### **Suvai Gunasekaran** **James Madison Memorial High School in Madison**

Suvai Gunasekaran, 18, of Madison, entered the Intel Science Talent Search with a **materials science** project focused on developing new methods to inhibit bacterial biofilm growth on the surface of implanted medical devices. Biofilms can make bacteria 1,000 times more resistant to antibiotics and are implicated in several hospital acquired infections, including multi-drug resistant *P. aeruginosa*. Working in a lab, Suvai observed the effect of a specific synthetic compound on the bacterial chemical signaling processes, which play an important role in biofilm growth. Her research indicates that biofilm growth is inhibited through the controlled release of synthetic compounds, introduced via biodegradable polymers. This combination blocks natural bacteria from binding with biofilms and developing on them. The daughter of Sundaram and Sujatha Gunasekaran, Suvai is first in her class of 494 at **James Madison Memorial High School**. She is active in forensics and debate, editor-in-chief of the school paper and a violinist in the Wisconsin Youth Symphony. She hopes to attend Harvard or Stanford and develop novel ways to combat life-threatening illnesses.

### **Philip Vidal Streich** **Home School in Platteville**

Philip Vidal Streich, 18, of Platteville, entered the Intel Science Talent Search with a **chemistry** project that disproved current assumptions that carbon nanotubes are virtually insoluble. His work may lead to the development of revolutionary ultra-strong materials and ultra-fast nano-electronics. Philip systematically tuned solvent surface tension and maximized the thermodynamic solubility of not only carbon nanotubes, but also graphene (a single-atom-thick sheet of carbon) and cellulose nanocrystals thought to be the next important generation of electronic material. He also identified a new method for determining maximal strength of polymer composites. Philip's work has resulted in five provisional patent filings and the formation of a start-up graphene company of which he is co-founder and co-owner. The son of Joel and Amanda Streich, Philip works on the family farm and tackled high electric bills by designing a windmill connected to a geothermal heat source to create a low-cost hydrogen storage and heating system. Philip has perfect SATs, is **home schooled** and hopes to attend Harvard before pursuing a career in research and, perhaps, politics.