

2016 SIEMENS COMPETITION IN MATH, SCIENCE & TECHNOLOGY Regional Finalists – Carnegie Mellon University



NAME: BLAKE HORD

SCHOOL: Dobbs Ferry High School, Dobbs Ferry, NY

YEAR: Senior

HOMETOWN: Dobbs Ferry, NY

PROJECT: "High Mass Planet Spiral Shocks as a Source of Infrared Emission in Protoplanetary Disks"

FIELD: Physics

MENTOR: Wladimir Lyra, Assistant Professor, Physics and Astronomy, California State University - Northridge

"To study our origins, one must study the general origins of all planets. Once we understand where other planets came from, we can infer how we came to be and the specific processes that formed us and our planet."

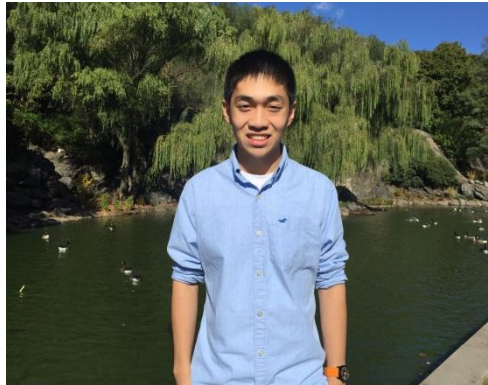
For his project, Blake improved on a computer simulation of a planet in formation. The results from this new model matched a previous observation of the gas and dust around a star

He has been interested in space for as long as he can remember even though his family's only connection to professional science is his paternal grandfather, who had worked for NASA at one point, before pursuing medical illustration. What fascinates Blake about science is the intense desire to discover the unknown.

Blake is most passionate about the future of space exploration, which may eventually save the human race from extinction. He says it is essential for us to become a multi-planetary species in order to provide a safety net in case another mass extinction event (either human caused or not) occurs in the near future.

Blake is a member of the National Honor Society and a National Merit Semifinalist. He plays volleyball on his high school team. His proudest accomplishment is becoming an Eagle Scout and teaching himself how to code C. He likes reading Kurt Vonnegut books because of his witty humor and social commentary. Blake says that Elon Musk is his role model because of Musk's desire to mix technology with business in a way that benefits the entire human race, and the ability to do it extraordinarily well.

He looks forward to pursuing a career in science and/or physics someday.



NAME: DYLAN LI
SCHOOL: Hunter College High School, New York, NY
YEAR: Senior
HOMETOWN: New York, NY
PROJECT: "Designing and Testing a Novel Compound Targeting the Divergent Roles of Adipose PPAR γ in Regulating Metabolic Homeostasis"
FIELD: Biology
MENTOR: Li Qiang, PhD, Assistant Professor of Pathology and Cell Biology, Columbia University

"Science has the capacity to change the world and is always surrounding us."

Dylan discovered important structural differences between two proteins that have been linked to diabetes and obesity in animals and humans. Based on this, he helped co-develop a new drug that can target one of these proteins that could help offset the development of obesity and the onset of associated diseases.

Numerous news stories and the shocking increasing incidence of obesity inspired Dylan to apply his love of science to helping to find ways to eliminate obesity and weight-related diseases like high cholesterol, heart disease, and type-2 diabetes. He loves researching articles and finding ways to improve his experiments. He is also motivated by the prospect of developing a drug that can help treat obesity and diabetes to address the lack of sufficient treatment options.

Dylan became interested in STEM at an early age. Sharing a love of cars with his father but recognizing their polluting qualities, he attempted to come up with his own design for a more efficient hybrid system that could create an infinite supply of electrical power. Although he knew very little about physics and how such a system would actually work at the time, the idea sparked his curiosity and passion for STEM that he carries today. Dylan looks up to tech entrepreneur Elon Musk as his role model who he says inspires him to "think out of the box" with his fantastical ideas about the next mission to Mars and new, efficient high-speed transport systems.

Dylan is already an accomplished scientist; he was the leader of an international collaboration on the distinctions between the two proteins and has published a first author paper. He is also busy outside of school and his research as pianist at the Manhattan School of Music and a winner of the National Young Musicians Showcase Competition. He is a fan of the band Coldplay and One Republic and participates on his school's cross country and swim teams.



NAME: SHARON LIN

SCHOOL: Stuyvesant High School, New York, NY

YEAR: Senior

HOMETOWN: Corona, NY

PROJECT: "A Novel Multiparameter Optical Sensor Using CMOS Imaging and Remote Neural Networks for Microbial Analysis"

FIELD: Environmental Science

MENTOR: Jason Econome, Research Coordinator, Stuyvesant High School

"I love that the possibilities for new technologies are endless, with there always being room for innovative ideas to improve the world. What I really love about science is there is so much unknown left to be discovered, so many different parts and levels of complexity that make the universe truly beautiful."

Sharon developed a portable water quality analyzer that uses smartphones that can identify polluted water.

Sharon has always been curious about computer science, engineering and the environment, but she wasn't always interested in pursuing research or a career in STEM. Growing up she had a hard time deciding between numerous possible careers like law, journalism, or the arts. It was a trip to her family's village in Fujian, China, however, that sparked her interest in finding solutions to issues with polluted water. Sharon was confronted with the lack of access to clean water that many people in rural areas had to navigate. She later learned that water quality analysis is a difficult task to perform in many communities and disease can often arise from the inability to detect harmful microbes in drinking water. Sharon's love of innovation and building hardware, combined with her desire to help solve this simple but devastating problem, spurred her research.

Sharon has been honored as a Google Science Fair Finalist and an MIT THINK Scholar. She speaks Fujianese, Mandarin and Spanish. Outside of academics, Sharon plays varsity golf and plays the flute, piccolo, and piano. She volunteers her time as a Youth Ambassador for Buddhist Global Relief and is the Founder and Executive Director of StuyHacks, a student-run New York City hackathon. Sharon is also a member of the Youth Advisory Board for Facebook InspirED, a resource center designed by teens, educators and SEL experts to empower high schools to create a positive school climate and greater well-being for young people.



NAME: ERIKA NEMETH

SCHOOL: Smithtown High School East, Saint James, NY

YEAR: Senior

HOMETOWN: Smithtown, NY

PROJECT: "Cell-Based Delivery of Gene-Silencing Products Via Gap Junction Channels"

FIELD: Biochemistry

MENTOR: Peter Brink, PhD, Department of Physiology and Biophysics, Stony Brook University

"Being involved in science research has helped me realize that science is extremely tangible. This has inspired my passion to make my own contributions."

Erika investigated a method to deliver small molecules, from cell to cell, which are capable of silencing the genetic information that cancer needs to grow and metastasize.

Erika's interest in science expanded once she was exposed to the endless possibilities of science through her school's research program. With the help of her school research teacher, she became exposed to the tangibility of science and after conducting in-house experiments, she sought a more hands-on experience in a professional research laboratory. Cancer, a devastating disease, is especially prevalent on Long Island where clusters are part of large epidemiological studies. Erika was inspired to investigate therapeutic cellular delivery treatment methods.

When she is not conducting research, Erika plays piano and clarinet in her school's symphonic band and All-County Band Ensemble. She also competes on her school's varsity tennis team. Erika is president of Tri-M Music Honor Society and vice president of her school's Senior Class Council. She also volunteers through a local environmental stewardship program.

Erika's role models and mentors at Stony Brook University have inspired her to pursue an advanced degree and a career in clinical research.



NAME: NESTOR TKACHENKO

SCHOOL: Ward Melville Senior High School, East Setauket, NY

YEAR: Senior

HOMETOWN: East Setauket, NY

PROJECT: "Can Cars Fly? Eddy Current Magnetic Levitation as Viable Technology"

FIELD: Physics

MENTOR: Sergey Suchalkin, Assistant Professor, Optoelectronics Group, Stony Brook University

"I am passionate about exploring futuristic and fascinating concepts from a scientific perspective, and trying to make them into reality. I strongly believe that science is the key to our dreams."

Through investigating magnetic levitation for commercial use, Nestor found that this technology could potentially be applied to create levitating vehicles that would be much more efficient than cars.

Nestor's interest in his research topic started at a young age. In first grade, he was walking with his family through the university where his father worked and remembers being intrigued by the physics department showcase which featured a magnetically levitating globe. He wondered about the applicability of magnetic levitation to create "flying cars." Since this initial encounter, Nestor has been devoted to the concept of magnetically levitating vehicles and has experimented with dozens of different forms of levitation, from pinning a superconductor above a magnet to create levitation to inducing levitation with two magnetic substances. It was after coming across a Kickstarter campaign for a magnetic hover-board, that he got the idea for his project that uses a coil with alternating magnetic current passing through it rather than just spinning magnets.

Nestor's passion for creating and inventing new technology led him to found his own startup, LumoPad, the first luminescent drawing board that allows users user to draw glowing images with phosphorescent light that last for 5 – 10 minutes. LumoPad was originally funded on by a Kickstarter campaign, and is now available on Amazon and won the Maker Faire Editor's Choice Award.

Nestor is President and Founder of his school's Chess Club and is the Technology Captain for his school's Science Olympiad team. When he isn't creating, Nestor plays violin and composes music. He is also a teacher assistant at School Nova, a Sunday enrichment program, where he helps young kids learn chemistry and physics.

TEAM COMPETITORS

SARAH ADAMO, Smithtown High School West, Smithtown, NY

SUSELL CONTRERAS, Brentwood High School, Brentwood, NY

PROJECT: "Using *Nematostella vectensis* to spotlight the ancient roots of Nicotinic Cholinergic Neurotransmission"

FIELD: Biochemistry

MENTOR: Dr. Joanne Figueiredo, Science Department, Smithtown High School

Sarah and Susell studied how nicotine affects the nervous systems of sea anemone with the goal of deepening our understanding of early nervous system evolution. Due to its significant responsibilities, they believe that by better understanding the functioning and evolution of the nervous system, they will be able to contribute to the knowledge surrounding many diseases, such as addiction.



NAME: SARAH ADAMO

YEAR: Junior

HOMETOWN: Smithtown, NY

"Science is near and dear to my heart because I am able to explore the unanswered questions of life."

Sarah Adamo has loved science and research experiments for as long as she can remember.

Sarah and her partner Susell used the sea anemone – one of the first animals to possess a nervous system – to make novel discoveries about the functioning and evolution of the nervous system that could one day help them contribute to learning more about many diseases, such as addiction.

When she's not in school, Sarah devotes her time to community service and helping others. She volunteers in her local library, homeless shelter, senior home, and the National Dance Institute's DREAM Project – an arts and movement program for students with disabilities. One of Sarah's proudest accomplishments to date is that she is a two-time New York State Attorney General Triple "C" Award recipient, recognized for her "character, courage, and commitment" in her school and community.

Sarah aspires to become a pediatric orthopedic surgeon so she can help children with bone and muscle injuries. She was a serious ballet dancer until nearly two years ago when she injured her foot and underwent reconstruction surgery. Her hero is her orthopedic surgeon, Dr. David Scher, who gave her hope that she would be fully mobile again. Sarah's favorite book is *Where Things Come Back* by John Corey Whaley, and her favorite band is Twenty One Pilots.



NAME: SUSELL CONTRERAS

YEAR: Senior

HOMETOWN: Bayshore, NY

"Studying how the nervous system works is one of the most complicated research areas. The fact that it is challenging intrigues me. There are always crucial questions that need to be investigated."

Susell has been interested in science and chemistry since she was a young child. Growing up, Susell watched her mother, a doctor, do her best to understand the root causes of her patients' illnesses. That inspired Susell to pursue scientific research and find the solutions to the problems she studied.

Susell and her teammate Sarah discovered the presence of nicotinic receptors in the sea anemone which could lead to functioning and behavior studies that will deepen the understanding of the nervous system in other creatures.

Outside of the classroom, Susell is active in Medical Brigades, an international program where volunteers have the opportunity to shadow licensed doctors in rural and poor communities, and help implement local public health initiatives. Susell's favorite author is Brazilian novelist, Paulo Coelho, and her favorite band is Hillsong. She hopes to one day become a doctor.

TEAM COMPETITORS

LOUIS GOLOWICH, Lexington High School, Lexington, MA

RICHARD ZHOU, Lexington High School, Lexington, MA

PROJECT: "Maximum Size of a Family of Pairwise Graph-Different Permutations"

FIELD: Mathematics

MENTOR: Chiheon Kim, Graduate Student in Theoretical Computer Science, Optimization, Combinatorics at Massachusetts Institute of Technology

Louis and Richard's project examines a mathematical problem related to how efficiently messages can be transmitted over a noisy communications network in which the original signal may be corrupted. Their research aims to make progress on a problem in mathematics related to information theory, which explains how fast information can be sent through a channel.



NAME: LOUIS GOLOWICH

YEAR: Junior

HOMETOWN: Lexington, MA

"I was inspired to pursue mathematical research by my eighth grade math class. Both making progress in combinatorics research and algorithmic problem solving involve similar types of in-depth creative thought, which I really enjoy."

Louis began competing in math competitions in middle school, and quickly developed an interest in learning mathematics. During his freshman year he began competing in the USA Computing Olympiad which sparked his interest in computer science, and specifically algorithms, so he began learning more advanced algorithms. During Louis' sophomore year he qualified for the USACO finalists' summer training camp, an experience that greatly furthered his interest in computer science. The same year, he also began working on this research project in extremal combinatorics through MIT PRIMES, a program that gives research opportunities to high school students.

Louis is captain of his high school's Computer Science Club, member of his high school Tennis Team and volunteers for middle school math tournaments. He was one of 26 high school students in the US to be selected for the USA Computing Olympiad in 2015-2016. One day he hopes to apply math and computer science to help solve real-world problems.



NAME: RICHARD ZHOU

YEAR: Junior

HOMETOWN: Lexington, MA

"Mathematics is inherently beautiful. There's structure in areas which, on the surface, appear completely random. Patterns from seemingly unrelated branches of mathematics occur where they are least expected. And the feeling of solving a problem after struggling with it for long periods of time is unlike any other."

Richard's interest in mathematics began as a middle school student, when his math teacher inspired him to think of math as an exploratory subject rather than a mundane set of tools designed to solve problems from other sciences. Richard's favorite part of math is the feeling of finally solving a difficult problem after struggling with it for a long time. After thinking about a problem for days or even weeks to no avail, the feeling of coming to a sudden realization that finally cracks the problem he feels is extremely rewarding.

Richard's love for math and his ability to see its beauty stems from a quote he read by his role model, Paul Erdos, a 20th century Hungarian mathematician who said, "It's like asking: Why is Beethoven's Ninth Symphony beautiful? If you don't see why, someone can't tell you. I know numbers are beautiful. If they aren't beautiful, nothing is." Richard also admired Erdos' keen eye for tweaking and modifying problems that appeared impossibly difficult until they were still highly nontrivial, but more within reach. This is a strategy that Richard and Louis have found to be extremely valuable to their research, and one that he hopes to employ effectively in future endeavors.

Richard is a wind ensemble concert master, plays the clarinet in the Boston Youth Symphony Orchestra, and volunteers at the Winchester Chinese School.

TEAM COMPETITORS

HYUNSUN (HEIDI) KIM, Trinity School, New York, NY

SEUNG HWAN AN, Taft School, Watertown, CT

JOO SUNG (DANIEL) YI, Taft School, Watertown, CT

PROJECT: On the Polychromatic Number of the Plane

FIELD: Mathematics

MENTOR: Dan Ismailescu, PhD, Professor of Mathematics, Hofstra University

Heidi, Seung Hwan, and Joo Sung explored a 50+ year old geometric graph problem – the Hadwiger-Nelson Problem: what is the smallest number of colors needed to color a plane of two-dimensional space? In their investigation, they tested different patterns of colored shapes and discovered a new way to color almost an entire plane using only six colors. Thus far, their work has come the closest to proving that the chromatic number of the plane could potentially be less than seven. In the process, they've also demonstrated that the world can be described as a set of patterns. For now, the meaning in their work draws mainly from the mathematician's perspective. Looking forward, though, the teammates hope their work could be applied to affect positive change in fields like urban planning or transportation.



NAME: HYUNSUN (HEIDI) KIM

YEAR: Senior

HOMETOWN: Cresskill, NJ

"I'm most passionate about pursuing science for the rest of my life, because it unites the two elements to my personality that I consider the most fundamental: my curiosity and my interest in helping others."

Heidi aspires to one day become an engineer with a background in computer science. Her recently realized love for the field inspired her to pair it with her fascination with geometry and her background as an artist to find questions of her own to answer through science.

When she is not working on mathematical equations, she likes to explore self-reflection, raw emotion, and subjectivity through drawing, painting, and mixed media.

At school, she is the president of a local chapter of the non-profit organization Baja Bound, and has helped raise \$90 thousand dollars for three annual trips to Ensenada, Mexico, which have empowered students from five different schools to engage with and construct houses for local homeless families.

Heidi is an assistant editor of Synapse, her school's science magazine, and part of the staff of Columbus, the school art and literature publication. In her free time, she enjoys Pilates, yoga and listening to Chance the Rapper.



NAME: SEUNG HWAN AN
YEAR: Senior
HOMETOWN: Boston, MA

"In a world in which nothing is certain (especially in politics), math and science provides the only certainty in the world. Numbers are the basis on which society should design its policies and legislations, because they are for certain, what they are. Numbers do not lie. People who interpret those numbers do, but numbers, themselves, do not lie."

For this project, Seung Hwan found inspiration in an unusual place: bathroom tiles. He said that as a child he would sometimes stare at floor patterns for long periods of time attempting to find the rules of the pattern. So when he found Ramsey Theory, a branch of mathematics that studies the conditions under which order must appear, and problems regarding the geometric graph theory like the one posed by Hadwiger and Nelson, he was immediately inspired to follow this area of research.

He said his love for mathematical concepts was spurred by a book called *The Number Devil*, which is about a boy named Robert who hates mathematics. In a dream, a number devil appears and shows Robert that the world of mathematics is actually fantastic and awesome.

Besides mathematics, Seung Hwan is passionate about ensuring that Americans are aware of and educated about politics. He believes that democracy functions well if and only if the constituents are educated and are able to hold the politicians accountable for their actions.

Seung Hwan is captain of the Debate Team and participates in Student Government. He plays tennis and the violin and is a fan of TV personality John Oliver, as well as the Boston Red Sox.



NAME: JOO SUNG (DANIEL) YI
YEAR: Junior
HOMETOWN: Cresskill, NJ

"I am extremely excited about the effect of technological developments that has on other STEM fields. Examples of how science is applied in real life always fascinates me."

Joo Sung credits his love of math and science to his parents, especially his father, who encouraged him to solve puzzles and observe wildlife on family vacations. He really enjoys being able to see real-life

application of science, especially in biology. One day, he hopes to become a doctor and see the effect that developments in technology have on STEM fields.

When he is not working to expand his knowledge of math and science, he spends time playing soccer, baseball, crew and playing the piano.

TEAM COMPETITORS

STEPHEN LEE, Manhasset Senior High School, Manhasset, NY

FRED CHU, Manhasset Senior High School, Manhasset, NY

PROJECT: "Optimizing Dye-Sensitized Solar Cells: Novel Methods of Cost Efficiency and Validation"

FIELD: Chemistry

MENTOR: Alison Huenger, Science Research Teacher, Manhasset High School

Stephen and Fred found a potential way to create a cheaper and more environmentally friendly alternative to normal solar cells. They hope to implement affordable renewable energy solutions in developing economies to help combat the growing use of fossil fuels.



NAME: STEPHEN LEE

YEAR: Junior

HOMETOWN: Manhasset, NY

"My favorite school subject is chemistry, because I find it fascinating how so many seemingly small, inconsequential things interact with each other to shape everything we do."

Stephen has always been interested in STEM subjects, but his interest was never fully cemented until he joined his school's research program in 8th grade. He loved being able to conduct his own experiment and gather his own results while being around all of his friends. When Stephen went to his first science fair and won first place, he knew that he had found something that he was not only good at, but that he loved. Stephen's favorite part about STEM is the social aspect where people get together to solve each other's problems.

Taking a Brown University summer course in solar and wind energy during his freshman year solidified Stephen's interest in renewable energy. Additionally, he started learning chemistry that year, and he loved the subject. So when he was brainstorming ideas for his project, he knew he wanted to incorporate solar energy and chemistry into the same project, and eventually he stumbled upon dye-sensitized solar cells, and he built a project around that.

Stephen is a member of the Math, Science, English, History, and French honor societies and Red Cross Club. He plays piano, marimba, the cello and is a member of the Marching band. Stephen is a silver medal winner at I-SWEEEP (International Sustainable World Energy Environment Engineering Project

Olympiad) 2016 in the energy category and won first place at LISEF JV(Long Island Science and Engineering Fair) in chemistry.



NAME: FRED CHU
YEAR: Junior
HOMETOWN: Manhasset, NY

"My favorite thing about the STEM world is that there are new discoveries being made every single day, that science is ever changing with revolutionary advancements in technology."

Fred has always been interested in science ever since elementary school. Science class was always his favorite part of the week because he loved learning about why things happened. As the years went on, he became interested in power and electricity. One of his fondest memories of science class was putting together a circuit for a light bulb which he found to be amazing. No topics interest Fred more than power and electricity, which explains his admiration for his role model Ben Franklin and why he became so intrigued with the topic of his project, solar cells.

Fred has been a High Honor Roll student each year of high school and is a member of the Math, Science, Social Studies and Spanish Honor societies. In his free time, Fred is a member of the marching band, plays bassoon, clarinet, and piano, Science Olympiad Club, and the Metropolitan Youth Orchestra. Some of his most notable accomplishments include winning the silver medal at the ISWEEEP (International Sustainable World Energy Environment Engineering Project Olympiad) 2016 competition and being accepted to the New York State Summer School of the Arts, School of Orchestral Studies his freshman year.

Fred's a huge fan of author Dan Brown and his mystery novels. He aspires to be some kind of chemical engineer or researcher in the future.

TEAM COMPETITORS

ERIC PUN Syosset High School, Syosset, NY

NIKHIL SAGGI, Syosset High School, Syosset, NY

PROJECT: "Increasing Concrete Durability in Extreme Temperatures with the Use of Sodium Silicate"

FIELD: Chemistry

MENTORS: Starlyn O'Shea, School Research Mentor, Syosset High School; Veronica Ade, School Research Facilitator, Syosset High School

Eric and Nikhil evaluated how to mitigate the effects of temperature on concrete cracking and frost wedging through a chemical called sodium silicate.



NAME: ERIC PUN

YEAR: Senior

HOMETOWN: Syosset, NY

"I love how with the increased development in STEM we, as humanity, are defying nature itself and growing stronger and living longer with new drugs and treatment"

Growing up, Eric was always interested in STEM. TV shows such as The Magic School Bus and Bill Nye piqued his interest in the potential of science to improve people's quality of life.

Eric was inspired to research the effects of temperature on concrete when he noticed that the concrete around his home needed to be repaved often after extreme weather events like snow storms and freezing temperatures and when it was damaged by the weight of heavy trucks. Along with his teammate Nikhil, Eric investigated how the chemical sodium silicate could be used to mitigate the effects of temperature and weight on concrete. Their goal: to develop concrete that is more durable in different temperatures. And, while Eric wouldn't classify data crunching as fun, he is passionate about his research and says the late nights he's spent working on it have paid off.

Inspired by his role models, NBA basketball player Yao Ming, for breaking stereotypes of Asians in sports, and his brother, for his independence and determination, Eric is proud to also be a role model to others. As president of his chess club and as a chess tutor, he enjoys sharing his knowledge with future chess prospects.

Eric speaks Spanish and is an AP scholar with distinction, and in his spare time enjoys participating in track and field, listening to the Backstreet Boys and volunteering for the nonprofit, Project Milo and at the New York Langone Medical Center.

Eric plans to major in biochemistry in college.



NAME: NIKHIL SAGGI
YEAR: Senior
HOMETOWN: Syosset, NY

"I am very excited that the STEM fields have flourished in the electronic age. Digital capacity has increased exponentially, so much so that technology from merely a decade ago is considered archaic by modern standards."

Nikhil believes that science carries great potential to improve the world. Growing up, he wasn't always interested in STEM but, after watching a few documentaries about space, he became infatuated with NASA and astronomy. This led him to explore STEM more deeply, and it is now a field he admires.

Nikhil and his teammate researched how to make concrete more durable against extreme temperatures and weight using the chemical sodium silicate. Nikhil first explored how to use chemicals to create stronger concrete as a sophomore. He has also conducted research at Columbia University Medical Center, where he identified protein biomarkers for acute kidney injury.

Among his many interests, Nikhil enjoys participating in discussions about current events and global news. In addition to speaking French and Hindi, Nikhil also knows three computer languages: Java, Visual Basic and SAS. He is also an AP Scholar with Distinction and a National Merit Commended Scholar. Outside of the classroom, Nikhil is the head delegate of Model UN and volunteers at Sunrise Senior Living.

Nikhil cites Michael Phelps as his greatest role model, inspired by Phelps' determination to, "not let his age, whether too young or too old, prevent him from achieving success."

Nikhil plans to pursue scientific research in the future.