



Thermo Fisher Scientific

Junior Innovators Challenge

A program of Society for Science

+ Thermo Fisher Scientific
Junior Innovators Challenge 2026

FINALISTS

+ 2026 Thermo Fisher Scientific Junior Innovators Challenge

October 23–28, 2026

The Thermo Fisher Scientific Junior Innovators Challenge (JIC), a program of Society for Science, is the premier middle school science and engineering research competition in the United States.

The Thermo Fisher JIC is the only middle school Science, Technology, Engineering and Math (STEM) competition that leverages Society-affiliated fairs across the nation. The top 10% of 6th, 7th and 8th grade students from these fairs are nominated to compete in the 2026 Thermo Fisher JIC. The Top 300 Junior Innovators are selected by scientists, engineers and educators through comprehensive scoring of their online applications.

From the Top 300, 30 finalists are selected to participate in Finals Week in Washington, D.C., where they compete in team STEM challenges that test their abilities in critical thinking, collaboration, communication and creativity through project-based learning. Top awards total more than \$100,000, including the \$25,000 Thermo Fisher Scientific ASCEND Award, stipends for educational activities and more.

Society for Science thanks the following for their support of the Thermo Fisher JIC:

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Thermo Fisher Scientific

Competition Sponsors

- Broadcom Foundation
- Citadel | Citadel Securities
- DoW STEM and Defense STEM Education Consortium
- The Lemelson Foundation

Educational Partners

- Smithsonian Environmental Research Center
- Society for Science's affiliated state and regional science and engineering fairs
- Parents/guardians, teachers and mentors of all the Thermo Fisher JIC nominees

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+ Why Middle School?

Middle school is a time of transition, when many students begin to drift away from their interests in science and engineering. During this critical period, it is important to bolster young people's confidence in STEM. The Thermo Fisher JIC provides a means for students to be celebrated for their accomplishments in STEM at this significant time.

Participants in the Thermo Fisher JIC are inspired, mentored and encouraged to continue to follow their passion for scientific research through high school and beyond so that they are prepared to pursue exciting STEM careers.

Students who participate in the Thermo Fisher JIC are better equipped through project-based learning to meet the challenges of the future. They will lead the way with scientific breakthroughs, engineering innovations and technological know-how.

+ The Process

To participate in the Thermo Fisher JIC, 6th, 7th and 8th grade students enter an independent science or engineering project in their Society-affiliated state or regional science fair. Judges nominate the top 10% of these competitors to enter the Thermo Fisher JIC. There are thousands of nominees each year.

Nominees go online to complete the comprehensive Thermo Fisher JIC application. Their entries are scored by a cohort of scientists, engineers and educators during the summer.

The Society announces the Top 300 Junior Innovators in late summer each year. The Top 300 and their teachers receive prizes to recognize their achievements.

Thirty competitors are selected from the Top 300 to compete as Thermo Fisher JIC finalists. Finalists receive an all-expenses-paid trip to Washington, D.C. to showcase their projects and compete in teams to demonstrate their STEM acumen along with their skills like communication, collaboration and creativity. They also visit historical sites in the nation's capital that celebrate innovation.

+ Awards

Finalists receive a cash award of \$500 from the Thermo Fisher JIC in recognition of their advancement to Finals Week. Based on their performance during three days of competition, finalists may receive top awards, including:

- **Thermo Fisher Scientific ASCEND Award (Aspiring Scientists Cultivating Exciting New Discoveries)** of \$25,000, which recognizes the finalist who demonstrates the greatest mastery of science, technology, engineering and math. This finalist exemplifies how research, innovation and teamwork come together to achieve STEM goals.
- **Broadcom Coding with Commitment® Award** of \$10,000, is presented to the student who combines STEM learning with coding to solve a community problem they care that aligns with the 17 Sustainable Development Goals of the United Nations.
- **Citadel | Citadel Securities Innovation Award** of \$10,000, awarded to a finalist who utilizes data-driven decision making to create innovative solutions to problems.
- **DoW STEM Talent Award** of \$10,000, awarded to a finalist who demonstrates excellence in science, technology, engineering or math, along with the leadership and technical skills necessary to excel in the 21st Century STEM workforce and build a better community for tomorrow.



- **The Lemelson Foundation Award for Invention** of \$10,000, awarded to a young inventor who exemplifies the ideals of inventive thinking by addressing a critical societal problem in order to improve the lives of others. This finalist demonstrates the application of empathy, STEM knowledge, design thinking and an entrepreneurial mindset in the research and development of a tangible product.
- **First place and second place awards**, issued in each category of STEM, of \$3,500 or \$2,500, respectively, to be used towards finalists' education. All STEM Award winners also receive an iPad.
- **Team Award**, which awards a \$200 gift card to a science supply company in support of their interests in STEM to each member of the team that best demonstrates an ability to work together and solve problems through shared decision making, communication and scientific and engineering collaboration.
- The **Thermo Fisher Scientific Leadership Award** is bestowed upon the Thermo Fisher JIC finalist elected by their peers to speak on behalf of their class at the Awards Ceremony. The Class Speaker demonstrates the collegiality and spirited leadership that has earned the collective esteem of the class throughout the Thermo Fisher JIC competition and united them around common goals.

+ Honoring Finalists' Schools and Teachers

Thermo Fisher Scientific and the Society recognize the important contributions of the teachers who educate, mentor and support the Thermo Fisher JIC competitors by awarding a gift of \$1,000 to each of the 30 finalists' schools to be used for STEM programs.



+ 2026 Finalists

MYREEN AHASAN

Friendswood Junior High
Science Engineering Fair of Houston

ANKITH BURKI

BASIS Independent Silicon Valley
Synopsis Silicon Valley Science
and Technology Championship
presented by the Santa Clara Valley
Science and Engineering Fair
Association

ISHAAN DOKANIA

Willamette Valley Academy
Northwest Science Expo

WILEIDY ENID FELICIANO-RIVERA

Escuela Intermedia Rafael Irizarry
Rivera
Ponce Regional Science Fair

BAILEY QUINN FRANK

Pine Crest School — Fort Lauderdale
Campus
State Science and Engineering Fair
of Florida — Ying Scholars

SARTAJ SINGH GANDHI

Monroe Township Middle School
Bergen SciChallenge

ISABELLA GARRY

Central Middle School
Minnesota Academy of Science State
Science & Engineering Fair

ALEKHA GOLDBERG

Peak to Peak Mountain Charter School
Kern County Regional Science Fair

HENRY GROVER

Riverside STEM Academy
Riverside County Science
and Engineering Fair

JACK GROVER

Riverside STEM Academy
Riverside County Science
and Engineering Fair

ELLIANNA GU

Wasatch Junior High
University of Utah Science
and Engineering Fair

HANNA RYAN HEITEFUSS

Long Beach Middle School
Long Island Science
and Engineering Fair

LINDEN HUNTER-PINSKY

Gateway Middle School
Santa Cruz County Science
and Engineering Fair

SEIJI IIGAYA

Tenafly Middle School
Bergen SciChallenge

SAMHITHA KIRAN MADDU

The Globe Academy
Georgia State Science
and Engineering Fair

VIRINCHI MADIREDDY

California Connections Academy
at Ripon
Orange County Science and
Engineering Fair

SAI SRI VALLI MOGILINEEDI

Mountain View Middle School
Capital Area Science
and Engineering Fair

NATHAN GAEL MONTELONGO

Lorenzo De Zavala Middle School
Rio Grande Valley Regional Science
and Engineering Fair

PARTHVI NASWA

Canyon Hills Junior High School
San Bernardino, Inyo, Mono (SIM)
Science and Engineering Fair

KIANOOSH NAWAI

West Virginia Virtual Academy
West Virginia State Science
and Engineering Fair

SANAT PANDIT

Greenhills School
Science and Engineering Fair
of Metropolitan Detroit

SHRIKARI PUNJALA

Quest Academy
Illinois Junior Academy
of Science State Exposition

ISABEL ROSSI

James Blair Middle School
Tidewater Science and Engineering Fair

RYE LYNN ROST

Baker Junior High School
Montana Science Fair

OLYMPIA STERNSON

The Rhoades School
California Science & Engineering Fair

ANDREW SUN-ZHUANG

The Evergreen School
Washington State Science
and Engineering Fair

LILLY SWIGERT

The Archer School for Girls
Los Angeles County Science
and Engineering Fair

BOWEN WANG

Central Middle School
San Mateo County Office of Education
STEM Fair

LOCKLYN RAYE WARD

Grove Middle School
Oklahoma State Science and Engineering Fair

ALEC ZELENOVIC

Gunston Middle School
Northern Virginia Science and Engineering Fair





MYREEN AHSAN

Friendswood, Texas

Millions to Molecules: Dual Mechanism
Small-Molecule Discovery via HTVS and
Machine Learning-Guided Molecular
Dynamics for Frontotemporal Dementia

Project Background: When Myreen's grandfather was diagnosed with dementia, at first, Myreen felt helpless. She soon learned that there was no medication that could help. "It wasn't until that moment that I wasn't just scared for him, I realized that neurodegenerative disease knows no generational bounds," she says. "If it could happen to him, then it can happen to my father, my brother, or even me." Myreen learned that frontotemporal dementia was caused by problems with a protein called tau, and she decided to find a molecule to fight back.

Tactics and Results: In frontotemporal dementia, the protein tau becomes misfolded and hyperphosphorylated by enzymes. Then the misfolded tau clumps together into tangles. She wanted to find a molecule to address both problems. Myreen used a program called AutoDock Vina to screen molecules for how well they could bind to three versions of the tau protein and one of the enzymes that adds phosphate groups to the protein, tau kinase. Then she used machine learning to identify structures within her molecules that bound best. Myreen ended up training her machine learning algorithm on 1,363 different molecules, to get a correlation of 0.911. Then, she tested how well the top four molecules in her set bound to her four targets. One stood out, a molecule called CNS-11. Finally, Myreen applied her machine learning to another 46,320 molecules to find a total of 129 molecules she hopes to test in the lab.

Other interests: Myreen has been doing Bollywood dance since she was four. "It allows me to connect with my culture, learn discipline, and be creative when science life gets too hectic," she says. She also competes in Brain Bee and other science competitions. Myreen likes making awareness videos on topics like teen mental health, autism and neurodegenerative disease to help other people understand complex topics. "It makes me feel like research and advocacy can have the most impact when they're available to people," she says. Myreen would like to become a neurologist.



ANKITH BURKI

San Jose, California

Investigating the Effect of Low-Frequency Sound in Enhancing the Efficiency of Water Generation in Thermoelectric Atmospheric Water Generators

Project Background: Ankith knows that more than 4 billion people don't have enough access to fresh water, and that water problems will only increase with climate change. One way to get drinkable water is to use atmospheric water generators, which extract water from humid air. But currently they don't have very good output. Sound-induced vibrations "could coalesce water droplets and cluster water vapor, both of which would maximize water generation," Ankith says. He decided to modify an atmospheric water generator with low-frequency sound to see if he could generate more water.

Tactics and Results: Ankith started by designing his own atmospheric water generator, using a mechanism called the Peltier effect, which transfers heat from one side of a material to the other with an electric current. After several trials, he got a prototype that could reduce the temperature around it by 7.5°C, dropping below the dew point of water in the environment, allowing water to collect. Then he ran his water generator in sets of four-hour tests. 5 tests were in silence, and 10 more were with low-frequency sound in two different waveforms — a sine wave or a triangle wave — played through a speaker. The sound would force water droplets to come together. Ankith then measured how much water his generator produced in each condition. He found that the low-frequency sine waves increased the water collected by 117 percent.

Other interests: Ankith is a singer, and performs Indian Carnatic Classical vocal music. "Practicing and singing the traditional Indian music that my ancestors have learnt for generations is soothing and helps me connect with my cultural roots," he says. He would like to become an environmental engineer. "I have been fortunate enough not to have faced any significant personal hardship," he says. "I have a responsibility to create solutions that are accessible to those with fewer resources and opportunities than me." Being an environmental engineer would help him "create a healthier, safer, and overall better place for us to live in."



ISHAAN DOKANIA

Beaverton, Oregon

Eye in the Sky: From Pixels to Predictions for Lithium and Beyond

Project Background: While doing a Science Olympiad competition, Ishaan took on two topics: Remote Sensing, and Rocks and Minerals. He began to wonder if he might combine his two interests to solve a real-world problem and learned about the lithium bottleneck. The world needs a lot of lithium for electronics and energy storage. “Traditional methods to find lithium is inefficient, wrecks the environment and is costly,” Ishaan says. He wondered if he could use remote sensing with satellite images to automatically identify lithium deposits.

Tactics and Results: Ishaan trained a machine learning model on satellite image data from Google Earth Engine, and data from the United States Geological Survey Mineral Resources Data System. He also identified features for his model that would predict lithium deposit locations. He tested several machine learning algorithms and identified several potential sources of noise in his data. For example, the models tended to have biased readings if they detected plants under heat stress, and would flag any hot region as containing lithium, making the model inaccurate. Ishaan added a test called Leave One Feature Out, to get rid of the noise. He also found that using different satellites for data could result in overlapping maps. Once his sources of noise were fixed, Ishaan’s model could detect lithium deposits with 89 percent accuracy.

Other interests: “I love playing badminton with my dad because we try to rally the birdie (keep on passing it back and forth) and we try to get a new record each time. My younger brother also competes with me in this and we each take turns playing with my dad,” Ishaan says. He would like to be an aeronautical engineer. “It is always fun for me to watch airplane videos on what parts of planes went wrong and different theories about how a plane might have done a crash or emergency landing,” he says.



WILEIDY ENID FELICIANO-RIVERA

Peñuelas, Puerto Rico

Evaluation of the Effect of EcoMusa:
Bioplastic Mulch Based on *Musa paradisiaca*
for Weed Control (Phase II)

Project Background: Wileidy is very concerned about pollution, particularly excessive plastic waste. She is especially concerned with the amount of plastic used in agriculture. Plastic is even used to create mulch sheeting to prevent weed growth. “I found it very interesting that it had become possible to create materials with properties similar to plastic, but less harmful to the environment, by using vegetables or fruits,” she says. Wileidy decided to see if she could create a biodegradable mulch using the plantain peels being thrown away from the school cafeteria.

Tactics and Results: Wileidy chopped up plantain (*Musa paradisiaca*) peels into small pieces. She blended them up with water, acetic acid, glycerin, and cornstarch, heated it, and let it dry into trays of bioplastic. She made two different versions, which she called EcoMusa 1 and EcoMusa 2. Wileidy then spread them on the ground, and compared them against unprotected soil and commercial black plastic mulch sheeting. She measured the weed density, soil moisture, soil temperature and plastic degradation over four weeks. She showed that her EcoMusa mulches reduced weed growth by 47 and 53 percent each, making them comparable to the plastic sheeting. Her plantain mulch also kept the soil one to three degrees Celsius cooler than uncovered soil and kept the soil moist. She hopes that waste-derived mulches like hers could help people manage weeds more sustainably.

Other interests: Wileidy loves art, and likes crafting, drawing and painting. “I use different materials such as acrylic paints, canvas, clay, fabric, thread, markers, and colored pencils. I make paintings, drawings, clay figures, and crochet flowers, among other things,” she says. Last summer, she traveled from Puerto Rico to Florida to visit the Kennedy Space Center. “It strengthened my dream of working at NASA,” she says. She got her first telescope when she was eight years old and wants to be an astrophysicist. “Since I was very young, I have been curious about understanding how the universe works,” she says.



BAILEY QUINN FRANK

Fort Lauderdale, Florida

Designing an eDNA Sampler To Provide Health Surveillance Through the Detection and Identification of Bacterial Pathogens in Rural Communities

Project Background: Bailey recently learned about environmental DNA (eDNA), and that it is used to capture genetic material from the environment to determine which species are present in an area. She also learned about health surveillance — how scientists track diseases as they spread. Bailey was concerned to learn that health surveillance is often difficult in rural areas with few resources. “I decided to further explore if an eDNA sampler constructed from inexpensive materials could efficiently collect airborne DNA that could then be applied to pathogen detection,” she says.

Tactics and Results: Bailey started by making samplers that could collect eDNA. She bought small fans and attached filter paper to them. When she turned on the fans, the air would be pulled through the fan and through the filter paper, leaving eDNA behind. She collected two samples of indoor air and one sample of outdoor air. Bailey purified the DNA on the papers, and transferred half of the sample to petri dishes to grow bacteria she collected. After one week, she recorded the number of bacterial colonies and tried to identify them. Bailey also sent off her best samples to have them sequenced for 16S rRNA to identify the bacteria. She showed that indoor air samples contained more genera of bacteria and more human-associated bacteria. Outdoor samples had bacteria from soil, water, air and plants. She hopes simple and cheap systems like hers could help people in rural areas do surveillance for bacteria.

Other interests: Bailey was inspired to learn more about health and the human body in part because of her own experience with celiac disease, she says. “It allowed me to develop empathy at a very young age for other kids and adults alike who are different from their peers,” she says. She loves making art, from digital art to watercolor, fabric and clay. But her favorite activity is the Technology Student Association. “It has helped me build fundamental technical skills through events such as Community Service, Medical Technology, Career Preparation, and Leadership,” she says.



SARTAJ SINGH GANDHI

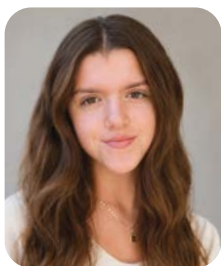
Monroe Township, New Jersey

Meat Freshness Monitor

Project Background: That chicken in your fridge has been there for a while; is it safe to eat? “Most people often rely on printed expiration dates or the “smell test” to decide if food is safe to eat,” Sartaj says. Getting it wrong could put someone at risk of food poisoning, or throwing out perfectly good meat. Sartaj was surprised to learn that there were no low-cost, easy ways to determine if meat is fresh. He decided to create a reliable way to monitor meat and determine if it has spoiled.

Tactics and Results: Digging into food science, Sartaj learned that as meat decays, it releases ammonia gas, which goes from eight to 15 parts per million when the meat spoils. He hooked up an ammonia gas sensor to a Raspberry Pi to monitor gas production, and attached it to a 3D-printed specialty container. Then he put different meat samples — turkey, chicken, pork and beef — in the device. He tested each meat type with his meat monitor, collecting 10 samples per day for 10 days. His sensor showed that chicken, turkey, and pork all released ammonia that spiked most on day 6, and that each kind of meat spoiled at a slightly different rate. Sartaj hopes that his monitor could be used in refrigerators at home, and his next goal is to test it on different foods, “such as slices of pizza or a plate of spaghetti.”

Other interests: Sartaj runs cross country. “Often, your stomach is cramping and you’re desperate for water, but you know there is only half a kilometer left,” he says. “Embracing that physical grind allowed me to climb from a rank of 24th to 12th by the end of the season.” During the summer, he attends STEM summer programs for science and medicine, but he also loves to catch up on the latest sci-fi movies. He hopes to become a cardiothoracic surgeon. “Combining surgical precision with the physiology of the heart and lungs offers the ultimate opportunity to save lives.”



ISABELLA GARRY

Eden Prairie, Minnesota

A Novel Method for Microplastic Removal
From Simulated Gastric Fluid Using Plant
Mucilage Flocculants

Project Background: “Four years ago, I learned that microplastics were in everything we eat, drink, wear, and breathe,” Isabella says. At first, she thought that people could just avoid plastic. But “when I discovered that babies are being born with microplastics already in their bodies, I knew prevention alone couldn’t solve this,” she says. Isabella decided to find a way to remove microplastics from inside the human body, using natural mucilages, plant compounds that could form gels. The gels, she thought, might be able to absorb microplastics.

Tactics and Results: Isabella started by creating an acidic environment like the stomach using water, vinegar and salt at a pH of 1.8 to 2.2. She sanded down plastic utensils to make microplastics. For her mucilages, she chose okra (*Abelmoschus esculentus*), fenugreek (*Trigonella foenum-graecum*), and psyllium (*Plantago ovata*). These plants all form mucilages in water. Isabella added her one and two percent concentrations of her mucilages and 0.5 grams of microplastics to Mason jars with her acidic fluid, with one jar containing only water and plastics as a control. She swirled the jars every 15 minutes to simulate digestion, and tested each mucilage 6 times. She then weighed the microplastics left in each jar, to see how much the mucilages absorbed. All of the mucilages removed microplastics from the fluid within 60 minutes; okra removed up to 81 percent, fenugreek 82.7 percent, and psyllium 93.3 percent at the highest concentration.

Other interests: Isabella is a figure skater. She also participates in Technovation, an all-girls coding club and competition, developing apps to solve problems in the world. She has been able to participate in the Technovation Global Challenge, which allowed her to pitch her apps to investors. Isabella would like to become an environmental scientist, and learned from her grandmother that nature and plants can provide many answers. “I have found it critical to protect our earth from the effects of plastic, i.e., micro- and nano-plastics, because it is my responsibility to protect the earth’s healing properties,” she says.



ALEKHA GOLDBERG

Pine Mountain Club, California

Blue-reka! Investigating Methylene Blue as a Neuroprotectant for Traumatic Brain Injury Using a Novel *In Vivo Drosophila* Model

Project Background: During a violent attack while he was walking in Washington, D.C., Alekha's older brother suffered a traumatic brain injury (TBI). "He suffered long-term memory, thinking and brain fatigue issues affecting his work and daily life," Alekha says. She also learned that 67 percent of veterans have also suffered from TBI. She became especially worried about secondary TBI, effects that can occur after the original trauma. After she learned that the medication methylene blue was neuroprotective, she decided to see if it could help secondary TBI.

Tactics and Results: Alekha started with 350 fruit flies (*Drosophila hydei*), with one group as a control and four other groups eating methylene blue at two, four, six, and eight mg/kg for five days. She then gave her flies three hits of TBI using a device called a High-Impact Trauma device, which uses a spring to strike vials of flies onto a pad, mimicking a hit like a car accident. Then, Alekha tested her flies' abilities in a climbing assay, seeing how well they could climb, and how many of them survived the next 24 hours. She showed that flies treated with methylene blue could climb higher after injury, and those getting the highest dose both climbed highest and were most likely to survive for 24 hours.

Other interests: Alekha is from a small town in the middle of Los Padres National Forest, and loves backpacking and hiking with her parents and dog in the High Sierras. "Last summer, I camped with my family and friends where I sold crowdfunds that I caught daily in the river to neighboring campers (we named the business 'Rad Dads')," she says. She is also very interested in history, and last year, was one of the winners of the National History Day Finals competition, working on a project about returning Blue Lake to the Taos Pueblos, who consider it sacred.



HENRY GROVER

Riverside, California

Sprayable Hydrogels for Preventing the Rekindling of Wildfires

Project Background: The 2025 Palisades fire in California was actually started by another fire, the Lachman fire, which was still smoldering and re-lit six days later. Henry and his twin brother Jack knew that firefighters struggled to put enough water on burned areas to keep them from reigniting. “We knew that hydrogel was capable of absorbing hundreds of times its weight in water and releasing it over a short period of time, so we wanted to use it to prevent rekindling,” Henry says.

Tactics and Results: Henry and Jack soaked nine hydrogels in water, weighed them, and dried them in an oven, measuring them every 15 minutes. They then tested how well the hydrogels stuck to surfaces, spreading them on leaves, hanging the leaves vertically and measuring how much hydrogel weight the leaf lost. This allowed them to narrow down their options to two hydrogels, and they measured which hydrated faster, soaking both in water and weighing them for up to three hours. Their top choice was sodium polyacrylate, which hydrated in 15 minutes. The twins applied their gel to hot charcoal briquettes and measured how long they took to reignite, and showed that charcoal sprayed with water re-lit in only three minutes, while their hydrogel took 27 minutes. Finally, they designed a sprayer, which could spray their gel 18.3 meters.

Other interests: Henry has worked to restore a robot from the 1980s, updating it to make it compatible with modern technology. “The change was nothing short of magical. From a robot covered in yellowed plastic, it turned into a fully functioning robot capable of pouring drinks and serving muffins,” he says. He also likes collecting old cameras and understanding how they work. Henry also enjoys 3D animation. “I wrote a screenplay that I am now animating with characters modeled and rigged all by myself,” he says. He’d like to work at an animation studio.



JACK GROVER

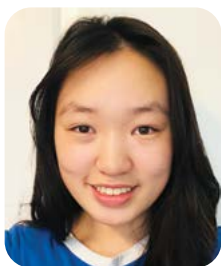
Riverside, California

Sprayable Hydrogels for Preventing the Rekindling of Wildfires

Project Background: Jack Grover and his identical twin brother Henry nearly lost their home in a wildfire. Later, they learned that the Palisades fire was caused by the rekindling of an earlier fire that was still smoldering. The twins also learned that fire retardants contain dangerous heavy metals like arsenic and lead. “Knowing the harmful materials being dumped into our waterways and forests and residences, we wanted to make a more environmentally friendly fire retardant using a more biodegradable material, hydrogel,” Jack says.

Tactics and Results: In a previous science fair project, Jack and Henry had worked on hydrogels. They decided to see if a hydrogel could be sprayed on burned areas to stop them from catching fire again. They tested nine different hydrogels, seeing how fast they dried out at high heat in an oven, how well they stuck to leaves, and how quickly they hydrated. Their top-performing gel was sodium polyacrylate, which hydrated fully in 15 minutes. Then they tested how well this hydrogel cooled hot charcoal briquettes, and found their gel cooled for much longer than water alone. Finally, with a 3D printer, they then designed a sprayer for their hydrogel and got it to spray well with a garden hose. Jack and Henry hope a hydrogel like theirs could help save lives and property.

Other interests: Jack enjoys robotics, and has had fun restoring 40-year-old robots. He’s recently gotten into old cameras, and likes picking up antiques. He also likes amateur archaeology, and when he goes to Canada in the summer, he spends time unearthing “china, electronics, and glass pieces, many of which are currently residing in a small local museum dedicated to that area’s history,” he says. “Unearth a piece of china, buy a new camera and fiddle with it, fix an old robot; they all let me do something instead of just being bored all the time.”



ELLIANNA GU

Salt Lake City, Utah

Bot-ting Up Emotions: How AI Chatbots Interpret & Respond to Emotionally Challenging Scenarios

Project Background: The average child gets a smartphone at 8.5 years old.

Ellianna learned that many teens are turning to AI chatbots on their phones — such as ChatGPT and Anthropic’s Claude — for friendship and emotional support. She began to wonder how well the bots could respond to emotional scenarios. “In a previous project conducted by Stanford, it was found that at times, AI chatbots can lack effectiveness and can have dangerous responses,” she says. She decided to compare chatbots, testing them with different emotional scenarios.

Tactics and Results: Ellianna first used AI to generate realistic emotional scenarios for common teen issues: Academic stress, social anxiety, friendship problems, family conflict, loneliness, anger and sadness. She also made sure the writing style varied, including slang and more formal language. She came up with a total of 84 emotional scenarios that she fed to ChatGPT, Anthropic’s Claude and Google Gemini. Then, Ellianna hand-analyzed and AI-analyzed the chatbots’ responses for empathy, clarity, problem-solving and helpfulness on a scale of one to three (or one to four for empathy). She found that the AI responses are clear and structured, but they aren’t very empathetic. The chatbots also varied in their responses depending on the writing style they were presented with. And they weren’t especially effective — only Anthropic’s Claude scored a three for effectiveness.

Other interests: Ellianna plays the piano and clarinet, and she recently went on an extended trip overseas in the summer to see her grandparents. She would like to become a neurologist. “I think that the human brain is really fascinating and I would love to learn more about it,” she says. “I also want to help people, especially those suffering from life-altering conditions such as Alzheimer’s, Parkinson’s, and Huntington’s disease.”



HANNA RYAN HEITEFUSS

Lido Beach, New York

Investigating Saltwater Intrusion on the Development and Growth of *Vigna radiata* and Heart Modulation of *Daphnia magna*

Project Background: Living on Long Island, Hanna sees the beach as more than a vacation. “The beach isn’t just a place I visit but it’s a part of my routine, my community, and my identity.” She watched with concern “changes that affect my time spent at the beach such as rising water levels, and increased flooding,” she says. Hanna became especially worried about saltwater intrusion into freshwater areas near her home. She decided to find out how different amounts of salt in water could affect plant growth and aquatic organisms.

Tactics and Results: Hanna prepared solutions of salt and water at five different concentrations, from zero to 0.5 percent salt. Then she tested different organisms and how they might respond to the salt and water mix. She placed mung bean seeds (*Vigna radiata*) in dishes with different concentrations of salt, and measured how long they took to germinate. Hanna also looked at the effects of salt on *Daphnia magna*, a tiny freshwater crustacean. She transferred the *Daphnia* into different salt solutions for five minutes each, and measured their heart rate under a microscope for 60 seconds. While the mung beans did not show differences in their germination, higher concentrations of salt made the *Daphnia*’s tiny hearts beat fast — meaning their bodies were under stress. This could mean that freshwater organisms are sensitive to more salt in the water they call home.

Other interests: For Hanna, environmental damage is personal. “Our island community faced devastation in the past with severe weather events such as Hurricane Sandy which brought major impacts on homes and property,” she says. “Living so close to a real-world problem makes me want to protect not only mine but all coastal regions in the future.” Hanna knows that sea level rise and extreme weather affect not just ecosystems, but the people who live in them. Hanna participates in local beach cleanups in her community during the summer, as well as being in environmental clubs. She also plays volleyball and sings.



LINDEN HUNTER-PINSKY

Santa Cruz, California

Investigating the Relationship of Sea Urchins (*Echinoidea*) to Giant Kelp (*Macrocystis pyrifera*) Bed Recovery

Project Background: Linden learned about how important kelp forests are, serving as habitat, protecting shores from erosion and absorbing carbon. “I found that California kelp declined because of a sea star wasting disease in 2013 and a heatwave in 2013-2016,” he says. While some kelp beds are starting to recover in Monterey Bay near where Linden lives, he also noticed more sea urchins (*Echinoidea*) in the tide pools, and knew that sea urchins grazed on giant kelp (*Macrocystis pyrifera*). He decided to find out if recovering kelp beds had fewer sea urchins.

Tactics and Results: Using satellite data from a site called Kelpwatch, Linden selected two declining, two recovering, and two stable giant kelp beds in Santa Cruz. Then, he borrowed a small Remotely Operated Vehicle (ROV), and used it to take videos of the beds. The hardest part, he says, was getting the ROV to the kelp. They can’t be accessed from shore, and are too close to use a motorboat, so Linden had to use a rowboat. “It wasn’t very stable and I got seasick often,” he says. He carefully counted all the urchins in his videos, and calculated both the density of the sea urchins and the recovery of the kelp. He found that all of the kelp beds had relatively low numbers of sea urchins, so the urchins are probably not preventing recovery of the ecosystem. Instead, he says, other factors like runoff or sediment could be preventing kelp comeback.

Other interests: Linden plays soccer and basketball and runs cross country, but soccer is his favorite. “I love that it isn’t just me out on the field: it is all my teammates who support me and have my back even if I have a hard game,” he says. He’s also gone to Invention Convention Nationals, a convention for student inventors. He’d like to be a mechanical engineer. “I love building different electric vehicles and models. I also love challenges and trying to figure out what is wrong or how to solve them,” he says.



SEIJI IIGAYA

Tenafly, New Jersey

Modeling Violin Expression: Timbral
Dynamics at the Instability Boundary

Project Background: Seiji plays the violin, and has been trying to play with more expression. “I have been getting better at it, but I still don’t quite understand how exactly it’s done,” Seiji says. Expressivity, after all, is subjective. The key might be in the stability of the sound, a combination of the bow’s speed and the pressure on the string. Seiji suspected the most expressive playing would be close to unstable. He decided to develop a mathematical model to find out which pressure and speed produced the most expressive sound.

Tactics and Results: Using the programming language Python, Seiji simulated a violin string. He divided it into 100 potential points of interaction between the bow and string. He then calculated a range of bow speeds and bow pressures. Each combination would produce a slightly different sound waveform, and he could calculate the expressivity and instability index of each one, based on the desirable solo tone of a violin, which is brilliant and has a lot of sound spectrum variation. Seiji’s expressivity index measured the variability of the sound waveforms, while the instability index measured how much the waveforms overlapped. He found that expressivity was highest at the moment right before the waveform became unstable, and that there is a small zone in pressure and speed where the sound is most expressive before it becomes unstable.

Other interests: Seiji of course plays the violin. “It allows me to express myself in a quiet space,” he says. Over the last two summers, he’s also been playing Japanese chess, or shogi, in Japan. “It’s similar to playing the violin. I get to express myself. But there is also an opponent,” he says. He also enjoys contributing to citizen science on Zooniverse, an online citizen science platform, where he has worked on a project that asks visitors to the site to classify images to help scientists do research on asteroids. Seiji would like to become an astrophysicist.



SAMHITHA KIRAN MADDU

Atlanta, Georgia

Plasticizers in Pads: A Study of Phthalate
Content

Project Background: Two years ago, Samhitha read an article on NPR about toxic metals in menstrual products. “As someone who uses menstrual products myself, I obviously became concerned regarding what else might be present and what that might entail for my health,” she says. When Samhitha went to choose a science fair project, she immediately decided she wanted to look for plasticizers in menstrual products. Plasticizers such as phthalates are chemical compounds that make products flexible and durable. But they can also mimic reproductive hormones such as estrogen.

Tactics and Results: Samhitha purchased four brands of menstrual pads from the store. Two were drugstore brands, while two others labeled themselves as organic. As a positive control, she also tested a plastic bottle cap and plastic packaging. She cut three samples out of each pad, and soaked them in ethanol to extract the phthalates. She then used different chemicals and heat to turn the phthalates into a bright green-yellow dye called fluorescein, where the strength of the color would indicate the amount of phthalates in the product. Finally, she exposed each sample to a spectrophotometer, which measured the light absorbed by the dye. She showed that while all of the menstrual products had phthalates, the two drugstore products had the highest levels of phthalates, while the two organic brands had lower amounts.

Other interests: Samhitha fell in love with math before science, but when she saw the Science Bob website, she discovered her passion. She has since attended science camps and volunteers at the Fernbank Museum of Natural History in Atlanta. “I’m most excited to run the astronomy and anatomy cart,” she says. Samhitha plays the piano, but “my most fulfilling activity is the student-formed band I’m in,” she says. “From gigs to rehearsals, nothing quite encapsulates the feeling of joy that music brings us all.” She also likes to crochet, and says it quiets her mind.



VIRINCHI MADIREDDY

Ripon, California

Hidden Threats in Organic Fertilizers:
A Study of Antibiotic Resistance in
Commercial Animal-Based Fertilizers

Project Background: Antibiotic resistance is a major threat to human health. But Virinchi learned that most antibiotics aren't prescribed to people, they're used in livestock to prevent disease and help animals grow faster. More antibiotic use could promote antibiotic resistance, and using livestock manure "poses a significant public health concern as antibiotic-resistant bacteria can spread through soil environments," Virinchi says. From there, they could end up on plants and in the food chain. He decided to find out if animal fertilizers might contain antibiotic-resistant bacteria.

Tactics and Results: Virinchi compared cow manure, chicken manure, fish manure and bat guano with regular garden soil. He mixed each manure or soil into a solution and spread them on agar plates containing the antibiotic ampicillin. The antibiotic would kill non-resistant bacteria but allow the resistant bacteria to grow. Virinchi allowed the bacteria to grow at room temperature for two weeks. Then, he extracted the DNA from the bacterial colonies that grew and sent them to a company for sequencing. He found antibiotic-resistant bacteria in regular soil, cow and chicken manure, but no resistant bacteria in bat guano or fish manure. Cow manure, Virinchi showed, had the highest richness of antibiotic-resistant bacteria, some of which could cause disease.

Other interests: Virinchi is a Scribe in his Boy Scout troop and keeps his troop's records. He loves public speaking and writes both poems and short stories. One of his short stories has been published by the Young Inklings Society and his poems have been published with PoeticPower. Virinchi would like to be a microbiologist. "Microbiology is a highly impactful field with applications in food production, healthcare, renewable energy, and environmental sustainability," he says. "What fascinates me most is the environment, particularly the microscopic organisms that live within our soil."



SAI SRI VALLI MOGILINEEDI

Mechanicsburg, Pennsylvania

**A Novel Controlled Release System for GERD
Drugs Using Immobilization Techniques**

Project Background: Sai Sri Valli's grandfather suffered from heartburn. He tried taking over-the-counter medications called antacids, but they "only gave him short-term relief," she says. "This was not only the case for my grandfather, but it was the case for many people struggling with Gastroesophageal Reflux Disease (GERD)." Sai Sri Valli knew that part of the reason the drugs didn't work for very long is because they dissolved rapidly. She decided to try to create a controlled-release antacid that would last longer.

Tactics and Results: Sai Sri Valli crushed up antacid tablets, which contain calcium carbonate, and dissolved them into water at two different concentrations. She also compared two different concentrations of sodium alginate, which is a complex sugar found in algae that helps molecules form into a gel. She dropped the alginate mixture into her calcium chloride mix, which created beads of calcium alginate. To test whether the beads were stable in stomach acid, she tested them at different pH levels to see how quickly the antacid beads changed the pH of the solution. Her calcium alginate beads released their calcium carbonate more slowly at an acidic pH comparable to stomach acid, while they quickly released their contents in a basic solution. She hopes a more controlled slow release of the drug will provide long-lasting relief.

Other interests: Sai Sri Valli loves Science Olympiad. "I get to learn more about topics that interest me than just my school's curriculum," she says. She especially enjoys ecology and has gone to an ecology summer camp and a forensics camp. She plays the violin and oboe, does Kuchipudi, a form of Indian classical dance, and volunteers with a group called Caitlin's Smiles to help put together craft kits for kids in the hospital. Sai Sri Valli would like to become a surgeon. "I love learning about human anatomy, physiology, and the diseases and disorders that affect it," she says.



NATHAN GAEL MONTELONGO

La Joya, Texas

Shellfish Contributions to Ecosystem and
Human Health: Evaluating Chitosan's Natural
Ability to Remove Microplastics

Project Background: On a fishing trip to the Rio Grande, Nathan and his older brother were getting ready to clean their catch. "A local fisherman told us to make sure we cleaned the fish thoroughly because recent catches had been found to be excessively contaminated with microplastics and weren't consumable," he recalls. Nathan became determined to find a way to clean microplastics out of water. He landed on shellfish. "They can filter water, because their shells contain chitin, which can be converted into chitosan, a biodegradable material known to bind pollutants."

Tactics and Results: Nathan collected water samples with visible plastic from the Rio Grande. Then, he took shellfish shells from local restaurants, dried them, and ground them up to make chitosan powder. Chitosan sticks to pollutants and pulls them out of the water. Nathan first tested his chitosan on glitter, and found it picked up between 55 and 75 percent of the glitter. He then tested it on his river water samples. "As the chitosan coagulated the water color began to clear," he says. A test with Arduino sensors also showed the water quality was improving. He also tested his chitosan on zebrafish (*Danio rerio*) embryos, watching their development for four days. The embryos in chitosan-treated water survived more often and had better development than those in regular river water. Finally, Nathan designed a raft that could measure water quality, and release chitosan to clean the water in response.

Other interests: Nathan is part of a year-round baseball team, including playing in a youth baseball world series. "It is an amazing experience I get to share with my younger brother, because we play on the same team," he says. He also runs track. Nathan would like to become a mechanical engineer. "My grandma was bedridden due to cancer when I was smaller and I watched my grandpa struggle," he says. "My brother and I built him a small ramp to be able to help her into the shower. Later I learned that these are the types of things engineers do."



PARTHVI NASWA

Chino Hills, California

Rebuilding Pyrogenic Soils: Evaluating Stress Impacts and Bioremediation Viability for Ecosystem Recovery

Project Background: Parthvi lives in Southern California, where wildfires are a yearly danger. After visiting a family friend who had been impacted by the 2025 Eaton Fire, “I became curious about what happens to the soil after a wildfire and how long those effects remain,” she says. The damage to homes and plants was obvious, but what about the soil? Parthvi decided to study how fire might impact soil microbes, nutrients and its ability to hold water. She set out to test different ways to improve soil after a fire has burned its way through.

Tactics and Results: Parthvi started by comparing samples of soil that had been through a wildfire with similar samples of control garden soil, testing each three or four times. She measured the bulk density, the pH and nutrients. Parthvi also measured how well the soil absorbed and held water and measured the carbon dioxide the soil gave off to determine the activity of the microbes in the soil. She found soils that had been through a wildfire were more compact and repelled water, making them more prone to erosion. Next, Parthvi tested different ways to improve the soil. She tried compost, biochar, mulch and a soil restoration kit (that contained all three and seeds), testing each method by growing sunflowers and mustard plants in her samples, testing them weekly for 16 weeks. While all of her methods improved soil structure, microbe activity and erosion, the soil kit worked best. A bioblanket also helped to reduce soil runoff.

Other interests: Parthvi is the president of her school's newspaper club and also contributes to the local newspaper, the Chino Valley Champion. “I enjoy sharing stories about students, community events, and issues that matter to youth,” she says. “I have learned how important communication is in creating positive change.” She also plays the violin and does debate. Parthvi volunteers as a debate coach and tournament judge for younger kids. Debate has helped her become a confident public speaker and has honed her critical thinking, and she hopes to pass on those skills to others.



KIANOOSH NAWAI

Charleston, West Virginia

Design, Optimization and Evaluation of
a Low-Cost, Compact Bionic Hand for
Functional Restoration and Accessibility

Project Background: Kianoosh knows that technology can be very helpful for people with disabilities. His younger sister uses a cochlear implant. “Watching how this type of bionic technology helps her hear and communicate made me realize how powerful assistive devices can be,” he says. But he also sees how much the technology needs to improve. Kianoosh learned that prosthetics to replace hands and feet are expensive, and not everyone can get one, and decided to see if he could design a more affordable solution.

Tactics and Results: Kianoosh started by studying how a human hand works, and focused on the tendons that flex and extend the hand and fingers. Then, he used a 3D printer to print out a prosthetic hand, and used pulling line as his “tendons,” while thermoplastic polyurethane provided resistance and allowed him to control the motion. Kianoosh then tested each version of his hand, measuring grip strength and the force to flex each finger using a force gauge. He made adjustments to the pulling lines, where the pivots were placed, the geometry of the joints and more. Kianoosh’s final hand can grip things consistently, and he hopes to eventually power the hand with an actuator to produce the force it needs, and to study how to produce hand movements with an efficient use of power.

Other interests: Kianoosh has been taking things apart and rebuilding them since he was five, and brings his engineering talents to his other hobby, motocross — off-road motorcycle racing. “I constantly analyze performance, solve problems, and make small adjustments to improve both my riding and my bike,” he says. He’s used his engineering skills to upgrade the motor on his bike and has used his 3D printer to design and print his own parts. He also likes road biking and gravel biking. He hopes to use his fascination with anatomy and regenerative medicine to become a surgeon.



SANAT PANDIT

Ann Arbor, Michigan

Project Soteria: A Low-Cost Fire Mitigating UAV Implemented Through Stereovision, Sonar and Path Planning Algorithms

Project Background: A few years ago, Sanat's aunt and cousins lost their house to a wildfire. Then he heard about the Los Angeles fires in 2025. "With 10+ million square miles of fires across the world annually, firefighters need help," he says. Sanat also knew that fighting fires was both dangerous and expensive. He wanted to use his passion for modified planes to see if he could come up with a less expensive, unmanned aerial vehicle that could assist firefighters, spraying water or fire retardant over a burning area.

Tactics and Results: Sanat started with a drone, which he fitted with a dual thermal camera. He also used a path-planning algorithm which builds a map of its environment using sonar to fly the drone. He then added a water launcher to the drone that could spray water over a blaze. The goal is for the drone to identify the highest temperature area within its sensor range, and to spray water over it. Sanat tested his drone and water launcher on 20 candles both indoors and outdoors. He showed his water launcher could shoot water at 8.37 meters per second. It could extinguish 18 candles outdoors and 16 indoors, and cost \$300 to make. It also only deviated from its path by an average of 0.4 meters, showing that it could fly and aim autonomously.

Other interests: Sanat has been seeing the power of robots for a long time. "One summer, in my first grade, my family, 50 volunteers, and I set out to clean an extremely polluted river in India," he says. After five hours, they had cleared a small section. "It occurred to me that if we would have small automated machine warriors across the river to support us, we could have probably done this in a matter of minutes." He's been looking to science to solve problems ever since. He also enjoys model rocketry and would like to be an aeronautical engineer.



SHRIKARI PUNJALA

Palatine, Illinois

How Do Calcium Carbonate Crystals Affect Bacterial Growth?

Project Background: Shrikari is interested in microbiology. “I did research on different interesting types of bacteria, until I stumbled across *Sporosarcina pasteurii*, a bacteria that makes calcium carbonate crystals,” she says. The bacteria could make its own minerals. She began to wonder how minerals like calcium carbonate, found in the human body in the ear and in kidney stones, could affect bacterial growth. In her reading, Shrikari learned that calcium carbonate might reduce the growth of bacteria. She decided to test the hypothesis for herself.

Tactics and Results: From her reading, Shrikari learned that some bacterial species, such as *Escherichia coli*, might have their growth inhibited by calcium carbonate, while others might prosper. She first isolated calcium carbonate from eggshells using acetic acid. She also grew four types of bacteria on agar plates: *Bacillus subtilis* (*B. subtilis*), *Escherichia coli* (*E. coli*), *Aeromonas Sobria* (*A. Sobria*), and *Sporosarcina ureae* (*S. ureae*), incubating them at 30° Celsius for three days. She then added her calcium carbonate crystals to the dishes and measured how much of bacteria growth was either reduced or increased. After calcium carbonate, *A. Sobria* coverage in the dish dropped to 55 percent, *S. ureae* dropped to 65 percent, *E. coli* to 66.25 percent and *B. subtilis* to 71.25 percent, showing that the calcium carbonate inhibited the growth of bacteria.

Other interests: Shrikari likes playing sports, including tennis, badminton, pickleball and volleyball. She also likes debate. “It has definitely helped me improve my speaking skills, and learning about a topic and trying to find arguments, even if I don’t agree with that side, has changed my point of view for a lot of things,” she says. Shrikari has also competed in the Invention Convention, where young scientists choose problems and develop solutions. “This program is what got me interested in being a biomedical engineer,” she says. Biomedical engineering allows her to combine “the things I love the most,” biology and invention.



ISABEL ROSSI

Williamsburg, Virginia

Listening in the Right Places: Game Theory and Optimization for Earthquake Sensor Placement

Project Background: Isabel admits most middle school students probably don't read old *Physics Today* magazines for fun, but that's where she came across an article about the challenges scientists face when trying to detect earthquakes. "I had experienced a big earthquake myself, which really frightened me," she says. Isabel recently enjoyed learning about game theory — mathematical ways to come up with the best decisions for different players in a game. Isabel realized she could apply game theory to determine where to place earthquake sensors.

Tactics and Results: Isabel decided to consider the variables in placing earthquake sensors, such as sensor accessibility and earthquake detection accuracy, as players in a game. She compared two different mathematical models — a weighted sum model and Nash bargaining — to predict where earthquake sensors should be placed. Isabel decided to focus her experiment on the Los Angeles region in California, and used a data library with a record of both earthquakes in the region and where the sensors were located. She coded a program that produced random sets of earthquake sensor locations and had her two mathematical models pick the best one. The best locations would be closest to the Pareto frontier, which is a solution where no one sensor placement could be improved without harming others. Isabel found that Nash bargaining produced results closest to the Pareto frontier, with a model that could improve coverage by 16.7 percent using only five extra sensors.

Other interests: Isabel truly loves math. "I like the precision of it," she says. "Over time it's become one of my favorite free time activities." But she also enjoys music and plays violin in the Williamsburg Youth Orchestra. "Music is often viewed solely as an art, but it's just as tied to math," she says. "The distance between frequencies, time signatures, and space between notes on my violin fingerboard are precise and calculated." Isabel would like to be an aerospace engineer. "There's so much to discover about our world. I want to take part in that," she says.



RYE LYNN ROST

Baker, Montana

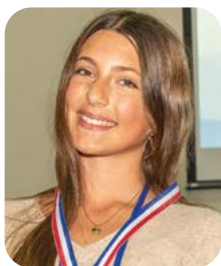
Musa acuminata and *Musa paradisiaca*

Mashup: Developing Higher Resistant
Starch Bioplastics

Project Background: “While there are many issues in the world that we can use STEM to solve, plastic pollution is the one that concerns me the most,” Rye says. She wanted to create better bioplastics — plastics made from natural materials that could break down. But while bioplastics do need to break down, Rye didn’t want them to break down too fast. “Bioplastics must withstand water, sunlight, and other environmental conditions without breaking down or losing durability,” she says. She decided to compare bioplastic from plantains (*Musa Paradisiaca*) and bioplastic from bananas (*Musa acuminata*).

Tactics and Results: Plantains and bananas are very closely related, but plantains have thicker skin and more starch. Rye decided to compare plantain and banana amyloplasts, cells in the plants that make and store starch. She extracted individual cells from bananas and plantains and counted the amyloplasts from 100 cells each. Then, she extracted the starch from bananas and plantains and measured the amount of starch per gram. Finally, she made bioplastic from both fruits and compared it to plastic parafilm. Rye found that plantains had the highest number of amyloplasts and the most starch. She also tested the bioplastics for strength and stretch. The plantain bioplastic had higher tensile strength and breaking distance, making it a stronger plastic than the banana.

Other interests: Rye is a member of 4-H, and has shown a cow, goat, cat, pig and poultry at the fair. She takes care of 14 goats and has helped train both cows and pigs. Rye has high-frequency hearing loss, and wears hearing aids. “Everyone was worried that I would do badly in school, but I have gotten straight As my whole life,” she says. She wants to be a materials scientist. “My dream is to make better bioplastics,” she says. “I want to make the perfect recipe for different types of single-use plastics.”



OLYMPIA STERNSEN

Encinitas, California

The Role of Language Specificity in Sparking Controversy on Social Media

Project Background: Olympia has always been interested in how the language people use makes others feel. She also noticed that politicians didn't speak like the people around her. "This difference was that politicians tended to use more general language, and non-political speakers tended to use more specific language," she says. "I wondered if this was a strategy to increase positive reactions to their statements." She decided to study how people used general and specific language to convey positive feelings without inciting controversy.

Tactics and Results: Olympia looked at the sentiments associated with words in 20 lexical hierarchies, which are relationships between words, ranging from general to specific. For example, "transportation" would be a very general topic, and more specific words in the transportation hierarchy would be "car" or "train." She collected 10 hierarchies per topic. Olympia then took 11,725 posts from the social media platform X (formerly Twitter) and used an AI sentiment model to measure the feeling of each post, where high sentiment would mean strong feelings. She found that sentiment increased for political topics when the words were more general, but for non-political topics, the sentiment increased when words were more specific. The highest sentiment also had the biggest range — meaning people had strong negative and positive reactions. Olympia concluded that general political language is associated with positive feelings, even though it's also more controversial, while specific language was best for non-political topics.

Other interests: Olympia competes in Botball — which is not a sport for humans. Teams of students build robots that complete tasks to win. When their robot broke on the plane to a competition, "we rebuilt and re-programmed the robot to score points in an entirely different way." The competition taught her how to start over and adapt on the fly. Olympia also likes horseback riding and competes in showjumping. She would like to become a psychologist and is fascinated by the way the mind takes in the world around it, and how interpretations of the world differ from person to person.



ANDREW SUN-ZHUANG

Shoreline, Washington

VisionStrike: Portable AI-Powered Baseball Pitching Machine

Project Background: Andrew plays baseball, and he's constantly trying to improve his batting performance. But he's been less than impressed with pitching machines. "Because they cannot vary pitch location to simulate real-game conditions, batters can anticipate pitch placement and achieve unrealistically high contact rates," he explains. His hit rate is 95 percent against a batting machine, but only 35 percent in real life. And most batters, Andrew included, can't practice against a real pitcher every day. He decided to train an AI to produce a better pitching machine.

Tactics and Results: Andrew first built his own pitching machine, using a microcontroller, a Raspberry Pi, a camera, servos and motors. He then trained an AI model on 200 different pictures of a batter — himself. Andrew had the model detect six key points on every image: The end of the bat, the wrist, elbow, shoulder, hip and knee. The model used these points to determine where the bat strike zone should be. When loaded into the Raspberry Pi, the model calculates the right angle once a batter has stood still for two seconds. Then it launches the ball. Using Andrew's AI model, the machine pitched with 86 percent accuracy within a strike zone for front-toss pitching. For fastball pitching, it "threw" strikes with 94 percent accuracy and balls with 97 percent accuracy. Andrew's final prototype cost only \$260, a major improvement over pitching machines which usually cost much more.

Other interests: Obviously, Andrew likes baseball, and started in Little League when he was five. Last summer, he played both All-Star Majors baseball and water polo. "I love baseball because of the connections I build with my teammates and the challenges I face during games," he says. "The pressure of competition pushes me to stay focused, build resilience, and constantly strive to become a better player." Andrew also enjoys robotics and has participated in several robotics programs. "I have a deep passion for robotics because it is an active, hands-on blend of STEM that can solve real-world problems," he says.



LILLY SWIGERT

Los Angeles, California

Fly Away From Addiction: Testing
Dibenzazepine's Effect on Ethanol Preference
in *Drosophila melanogaster*

Project Background: "Although I have not experienced or known anyone with Alcohol Use Disorder, I have observed the destructive effects it has on families, self-worth, and health through media and literature," Lilly says. While she knows that many people seek treatment for alcohol addiction with Alcoholics Anonymous or through behavioral therapy, Lilly wanted to develop a medication that might help. She decided to test dibenzazepine, which is a chemical that serves as the base for drugs to treat conditions like epilepsy and schizophrenia.

Tactics and Results: Lilly tested how fruit flies (*Drosophila melanogaster*) responded to dibenzazepine after exposure to alcohol. First, she had her flies feed freely on 15 percent ethanol for two days. She then separated her flies into three groups, and treated the first group with no dibenzazepine, the second with 0.11 mg/mL dibenzazepine and the third with 0.14 mg/mL dibenzazepine. She then offered all the flies 15 percent ethanol and normal food to see which they preferred. Flies that did not receive dibenzazepine drank 0.52 μ L/mg ethanol, and flies that got the highest dose of the drug drank 0.42 μ L/mg. But those who received the middle dose drank less, only 0.38 μ L/mg. Her results show that dipenzazepine helped reduce that amount of alcohol the flies consumed.

Other interests: Lilly loves singing, drama and musical theater. "Becoming a character gives me space to explore deep emotional connections with others and situations so unlike my life," she says. She and her family also volunteer at Our Big Kitchen LA, making and handing out meals for the elderly and homeless. Lilly would like to go to medical school. "Through TV shows, real-life experiences, and research, I learned about surgery, anatomy and the impact medical workers have on their communities," she says. "I find medicine to be particularly interesting because it not only focuses on science but also on personal interaction."



BOWEN WANG

San Carlos, California

Machine Learning-Based Aftershock Risk
Forecasting for Earthquake Safety

Project Background: Bowen is no stranger to earthquakes. “My house is only a few miles away from the San Andreas Fault,” he says. “Over the past year, there have been several earthquakes that woke me up at night.” The main earthquake is the one that makes headlines, but it’s usually followed by aftershocks, smaller quakes that diminish over time. Bowen knew that the aftershocks are also incredibly dangerous. He wanted to use machine learning to try to better predict the magnitude, frequency and location of aftershocks.

Tactics and Results: Earthquakes are very difficult to predict. But aftershocks after that quake are another matter. “They follow distinct, predictable patterns that correlate to the mainshock, making them possible to study and predict,” Bowen says. He compared three machine learning models — XGBoost, Logistic Regression and Random Forest — training them on locations of tectonic plates and all the earthquake data between 1950 and 2025 from the United States Geological Survey. He separated out the mainshocks and the aftershocks, and asked each model to predict aftershock risk. All the models predicted aftershocks well, but Bowen found that XGBoost performed best. Using it, he created a tool called Aftershock Oracle, that allows users to put in information about the main earthquake, and get predictions about the location, frequency, and strength of the aftershocks.

Other interests: Bowen plays competitive ice hockey and has been attending multiple hockey camps to improve at his sport. “Hockey helps build mental discipline and trains me to stay focused under pressure,” he says. He also loves to read. “Reading has redefined the way that I look at myself, and I think of it as not just a hobby, but a part of who I am,” he says. Bowen would like to be a civil engineer. “One day, I will start my own firm and prove that practical, modern design and ecological responsibility can coexist,” he says.



LOCKLYN RAE WARD

Grove, Oklahoma

A Study of Open Field Plants, Native and Non-Native, and Their Antimicrobial Properties Against *Escherichia coli* and *Staphylococcus epidermidis*

Project Background: Locklyn's family has a farm in Oklahoma. "As we were feeding cows one evening we drove by what I thought were weeds, and my Dad said it was pokeweed growing wild," she says. "He said he had always heard it was healthy in many ways." Locklyn is worried about overuse of antibiotics and began to wonder if some of the plants growing wild on the farm might have antibiotic properties, and how the antibiotic properties in the plants compared to antibiotics used in medicine.

Tactics and Results: Locklyn picked 24 different plants, 12 of which were native to Oklahoma. She weighed and cut the plants into one gram pieces, and boiled them in distilled water to extract potential chemicals in the plants. She then grew *Escherichia coli* and *Staphylococcus epidermidis* on agar plates. Locklyn soaked small paper disks in her plant extracts, and dropped them on her bacterial plates. If the plant extracts contained antibiotic compounds, then the bacteria around the paper disks would die. She also got disks covered in commercial antibiotics, and tested them for comparison, measuring how much bacteria each plant extract or antibiotic could kill. After 24 hours of incubation, she found that 56 percent of the plants she collected showed some antibacterial properties. Of the native plants, seven of them showed antibiotic activity. But none of them were as effective as commercial antibiotics.

Other interests: Locklyn is active in her church and enjoys church activities the most. "I attend a very old church in the country. Walking into this building gives me an instant peaceful feeling," she says. "I can gather my thoughts and fears in peace and quiet. After Sunday, I am ready to tackle the problems and issues of the upcoming week." She attends church camps and basketball camps in the summer and has volunteered at basketball camps with elementary school kids to pass on her skills. Locklyn also helps on her family's farm.



ALEC ZELENVIC

Arlington, Virginia

A Multivariable Math Model for Predicting Win Probability in 12U Travel Baseball

Project Background: Alec has been playing baseball for seven years. While older players use runs scored and runs allowed to predict a win, Alec plays for a 12U team, where everyone is under 12. “I have been in many games where one inning, one walk, or one strikeout changed everything,” he says. “I wondered what really drives a 12U team to win.” Alec was also learning about linear regression in his math class. He decided to create a mathematical model that could tell him what factors mattered most for players 12 and under.

Tactics and Results: Alec started with public data from the GameChanger app, collecting data from 82 12U games played by various teams. For each game, he collected hitting data, including at-bats, runs, hits, walks, strikeouts, doubles or triples and home runs. He also collected pitching data, including strikeouts, total pitches and total strikes. He checked this data for correlations, relationships between different pitching and hitting characteristics and wins. Then, Alec built a mathematical model to test different combinations and find out which patterns were most likely to win a game. His model showed that in 12U, winning a game isn’t really about batting average. Instead, winning teams earned more free bases, avoided strikeouts, added extra-base hits, and pitched with good control. Alec hopes that his model can help players and coaches better analyze their games and put ideas into practice.

Other interests: Baseball is a very big part of Alec’s life. He has played travel baseball for years, and represented Virginia in baseball tournaments for the last two summers. He also really enjoys playing chess and designing and engineering things. “My favorite example was designing and building a gravity car big enough to hold a person,” he says. He would like to become an environmental engineer. “Environmental engineering interests me because I could use similar problem-solving skills for bigger issues rather than baseball, like pollution, clean water, climate and protecting nature,” he says.



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