



# Radar is advancing at historic speed. How engineers are setting the pace.

*Tool created at Sandia enabling imaginative designs*

By **Troy Rummler**

In a whirling geopolitical landscape of new nuclear weapons, hypersonic weapons, drones and satellites, the U.S. is hustling to test new kinds of radars aimed at detecting evolving threats.

Many of these tests take place in a simulated research environment created at Sandia. Dubbed RAMSES by its developers, the advanced modeling and simulation software is hastening the development of **next-generation radars**.

“We’re hearing from the combatant commands that they need **multimission capabilities**, and RAMSES is able to bring those software simulations to the customer,” senior manager Elaine Martinez said.

RAMSES — short for Radar Analysis, Modeling, Simulation and Emulation Suite — comprises dozens of test scenarios for rapid radar prototyping for a vast number of applications, including

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Innovative Methodologies

**REINVENTING RADAR** — Senior manager Elaine Martinez leads the team that developed RAMSES, Sandia’s go-to tool for helping government agencies improve radar.  
Photo by Craig Fritz

# Sandia collaboration produces improved microneedle technology

*Tiny needles yielding big results*

By **Kenny Vigil**



Innovative Methodologies

**M**icroneedles measure only two to three times the diameter of human hair and about a millimeter long. But their impact is significant, from helping U.S. service members in the field diagnose infections earlier, to helping individuals monitor their own health. Sandia is at the forefront of microneedle research. A microneedle is a minimally invasive way to sample interstitial fluid from under the skin. Interstitial fluid shares many similarities with blood, but there is still much to learn about it.

“When we started work in this field in 2011, our goal was to develop microneedles as a wearable sensor, as an alternate to blood samples,”

**ENHANCED EXTRACTION** — Engineer Adam Bolotsky demonstrates how Sandia, in collaboration with SRI, has enhanced the extraction of interstitial fluid. The improved extraction method gets more fluid in less time.  
Photo by Craig Fritz

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Goal Getters

Five Sandians inspire innovation and resilience at upcoming event

By Katherine Beherec

Since September, Sandia staff have been chasing two big goals: to accelerate innovation and lead in modern engineering. While working toward these goals will certainly lead to excellent outcomes, Labs leadership has emphasized the need to achieve them, saying that if not achieved, Sandia may fail at its mission and put the nation at risk.

"We've got to be more agile to deliver capability faster," Deputy Laboratories

Director for Nuclear Deterrence and Chief Technology Officer Laura McGill told a crowd during a town hall about the goals. "There are going to be new threats that we have to address with diverse and innovative solutions."

On May 7, all staff members are invited to attend an event that features Sandians who have implemented diverse and innovative solutions in their work. They represent different areas of the Labs and each has a lesson to share.

Zak Kreiner: Success is a spectrum

Zak, manager of emerging flight technologies, and his team were tasked with developing a spacecraft payload that carries technology that addresses space situational awareness. A project like this would



typically require years to develop, but they had to deliver the work in 18 months.

Zak and his team identified the minimum set of features they needed to deliver, then intentionally increased scope from there. While it's difficult to prevent scope creep and say "no" to stakeholders who wish for more, his team delivered a prototype for technology that provides a lot of value to partners — and they delivered it on time.



### Julie Thai: Innovation takes time

In late 2020, HR process specialist Julie identified processes in her group that could be dramatically improved by robotic process automation. Julie and her team contracted outside experts and developed their first robot, designed to decrease the time to hire a new person at Sandia. After many months of fine-tuning, they began using it in January 2023, reducing task processing time from seven minutes to two seconds.

Often, innovation doesn't happen overnight. Julie and her team took many small steps in their journey to create a better solution. She emphasizes diving in with the data that is available, staying resilient and recognizing setbacks as opportunities to improve.

Julie's team currently has three active robots and is working on three more that will save more time and transform how they perform work.



### Brooke Harmon: Pivot to meet opportunities

At the beginning of 2020, virologist Brooke was researching antibody engineering to treat diseases of the brain. She and her team developed a platform to characterize efficacy of therapeutics against

many types of viruses. When COVID-19 spread around the world, they pivoted their skillset, expertise, and research to develop nanobody therapeutics for the emerging virus, meeting urgent security needs.

In early 2020, Brooke recruited multidisciplinary experts, from Sandia and externally, to join the effort. In January, her team partnered with a computational team at Lawrence Livermore National Laboratory. By the end of March, Brooke's team submitted proposals and secured funding. Within a few months, the team had identified and tested several promising therapeutic antibodies and nanobodies with efficacy against COVID-19.

By working with an expanded team, on a shortened timeline and with increased funding, Brooke's team rapidly increased their capabilities, which accelerated progress on all their projects. Today, the nanobody pipeline that they developed in 2020 is part of many internal and external projects.



### Carl Rhinehart: Progress through iteration

Design engineering senior manager Carl understands that demanding perfection can hamper excellence. In 2023, Carl and his team rolled out a new design for a manufacturing engineering tool that reduces downstream issues in manufacturing processes. His team could have introduced the tool when it was nearly perfect, but the perfect tool would take three years to develop.

Rather than waiting until 2026, Carl advocated for delivering an early version of the tool to start evaluating conceptual designs, even though it wasn't perfect. The team continues to improve the tool, which is on track to catch nearly all errors after its re-release in 2026.

Carl faced resistance when he suggested delivering the imperfect tool early, but he persisted to meet a national security need. The tool is already correcting many errors that would not have been caught otherwise.



### Rebecca Brock: A fresh perspective

Creative Services manager Rebecca expects her team to take intelligent risks and rewards them for it. When it was time to produce the new corporate video, Creative Services staff proposed their best ideas and voted on them. The ambitious idea was submitted by a new team member, an unconventional choice to lead one of their highest visibility products. He and another new video producer directed the video with a vision for Sandia's future, pulling in expertise from senior members of Creative Services.

When Sandia leadership proposed a Labswide podcast, Rebecca entrusted a writer to develop and launch the show. She knew there would be room for improvement at launch and it would evolve along the way. Since then, the writer has received additional opportunities to lead others in the group.

Innovation is often born from fresh perspectives and hiring staff with new skills for the future. Rebecca seeks those perspectives, supports staff members who take risks and knows this style of leadership reaps benefits. [f](#)

Join the event in-person or virtually on May 7 at 10 a.m. MT to hear more from these speakers about what they learned. Look for location information and a Teams link on Around Sandia.

## RAMSES

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advanced target recognition and target tracking. It has become Sandia's go-to tool for helping government agencies reinvent radar to reaffirm American supremacy in communications, reconnaissance and electronic warfare.

"We're determining the feasibility of new radar capabilities to solve the nation's most urgent and complex security needs," Elaine said. "RAMSES allows us to rapidly prototype and find optimal designs before we build anything, saving us a considerable amount of time and resources."

The software is already proving its value to the taxpayer.

"We're able to simulate what happens before the equipment gets flown," Elaine said. "It's a huge cost savings."

### A common design tool for a rapidly changing technology

Recent advances in computing are fueling some of the biggest changes to military-grade radars since the tech was invented nearly 90 years ago. A lot of these changes are happening as engineers increasingly swap analog for digital parts.

A high-resolution image from synthetic aperture radar can require collecting a tremendous amount of data — up to 100 gigabytes, said radar expert Aaron Hallquist. Historically, that meant analog components had to preprocess information

before it could be handled digitally. But now digital components can work with these heavy data streams.


The digital switchover brings an opportunity to use radar signals in new ways, such as changing characteristics of the radar signal on the fly to make it harder to jam, or quickly downloading changes to system configurations for different missions. These are difficult feats with analog tech.

"The things people are trying to do with radar — different domains, different applications, different algorithms — these things have been theorized about for a long time," Aaron said. "Now people are actually exploring and trying to design them."

"That kind of necessitates the existence of this common tool that can meet the simulation and design needs for all those programs," he said.

Elaine said, "Government partners come to us and say, 'We want to provide our warfighters more options. We want to give them more flexibility. We want to give them greater ability to execute an increasingly wide range of missions.' In RAMSES, we learn the types of configurations and designs that exactly allow us to meet their goals."

Simulation software also has benefitted from advances in computing.

"We can actually simulate high-fidelity radar returns now, where we wouldn't have been able to do that 10 years ago, at least in any reasonable amount of time," Aaron said. 

### Curating the authority on algorithms

The Radar Analysis, Modeling, Simulation and Emulation Suite was, like so many inventions, born out of necessity.

"It's a capability that grew out of a space-based system, where we needed to test the radar from end to end," Elaine said. "The algorithms grew into a modular software pipeline that is able to test multiple components. In addition, customers can swap out pieces of that software pipeline and swap in their actual hardware. This is called hardware-in-the loop. It allows customers to test actual hardware before it's put in a hypersonic vehicle or on orbit."

But each component needed its own algorithm to test it. Many of these algorithms had been matured long before the project. They were a struggle to track down.

"After that realization is when RAMSES became a product," Elaine said. The research group started packaging these simulations and software models together. This way, they had all the software they needed in one place. Eventually, a spinoff project formalized the software as a one-stop-shop for the team's radar analysis needs.

Word spread about the software. Other Sandia research groups, mission and industry partners were clamoring to get their hands on it.

The RAMSES team shared their creation. And with each new project, researchers added new tests to the suite. In time, it grew into the comprehensive package it is today.

RAMSES currently includes more than two dozen test modes. And it's still growing. Now a crucial tool for many of Sandia's government projects, RAMSES continues to become more technologically advanced with time.

## Microneedles

CONTINUED FROM PAGE 1

said Ronen Polsky, who has led Sandia's work in microneedles. Microneedles can access interstitial fluid for real-time and continuous measurements of circulating biomarkers.

"People wear continuous glucose monitors for blood sugar measurements. We want to expand this to a whole range of other conditions to take advantage of this minimally invasive sampling using microneedles," Ronen said.

A collaboration between Sandia and an external partner has helped speed up interstitial fluid extractions. That could help get

microneedle sensors to the market quicker for other uses including viral detection and electrolyte levels. Sandia recently received a **patent** for a microneedle sensor that Ronen and his team are trying to commercialize.

"We basically will bring the diagnostic lab to the patient in the form of a wearable device," Ronen said.

Sandia has current partnerships with SRI, Adaptyx Biosciences and the University of California, Berkeley, to expand microneedle work.

### Faster extraction

One of the projects with SRI, an independent nonprofit research institute, has significantly improved the extraction of interstitial fluid. "The previous technique was highly

variable. It took one to two hours to get enough fluid to do the analysis," Ronen said.

That technique involved using four or five arrays of needles, each with five needles.

"Through our new project with SRI, we improved the technique using a single microneedle to get enough fluid for a test in about 10 minutes. The new technique works faster, and we get higher volumes of fluid," Ronen said.

The microneedles penetrate the outer skin layer, but they don't reach nerve endings and are hollow. Engineers made a couple of changes to improve the extraction technique, including modifying the shape of the needle holders, which are 3D-printed by year-round intern Mychal Taylor at Sandia's Advanced Materials Laboratory.



**STRONG PARTNERSHIPS** — Sandia's Brittany Humphrey prepares microneedles in a fume hood. Sandia is working with several partners to expand the use of microneedles.

Photo by Craig Fritz

“With microneedles, we have engineering and comfort concerns, which play into how we design them. We get feedback from participants as we’re updating the design,” said Adam Bolotsky, an engineer in Sandia’s Biological and Chemical Sensors group. “We believe we’ve found the optimal depth for collecting the most fluid with the least discomfort.”

### Viral or bacterial?

Will Brubaker is the principal investigator for SRI on the microneedles project. He said improving the interstitial fluid extraction method helps potentially expand the use of microneedles.

“When we collect more samples in a



**TINY NEEDLES, BIG RESULTS** — Microneedles measure about a millimeter long, as seen here on an extraction device. Sandia researchers have found a way to increase the amount of interstitial fluid extracted with the needles, while saving time.

Photo by Craig Fritz

shorter amount of time, we can recruit more people to these kinds of studies. The improvement in the collection method opens up a lot of doors to other applications,” Will said.

One such application involves using microneedles to distinguish between bacterial and viral infections. It’s another project that Sandia and SRI are collaborating on.

“Making a distinction as to whether an infection is bacterial or viral would help doctors make informed decisions much quicker to get you treated at the earliest possible stage,” Ronen said.

The Defense Threat Reduction Agency is funding the project.

“It’s a potentially useful diagnostic for a service member who is feeling sick and symptomatic,” Will said, adding that the test is a step toward a device that could perform continuous health monitoring using interstitial fluid. He said there’s still a lot of work that needs to be done before seeking Food and Drug Administration approval. “There’s a very clear place where this test could eventually be used for the general public,” Will said.

The current work with SRI is expected to wrap up in October.

## A closer look at the why behind Sandia's microneedle successes

Listening to how the end-user could use microneedles is part of the reason for Sandia’s success in this field – especially in soldier defense.

“We’ve had amazing interactions with customers and sponsors,” said Ronen Polsky, who leads Sandia’s microneedle work. “We have traveled to special operation commands of the military. A Navy Seal Medic explained what kind of medical response equipment they have available, and what they need. We learned directly how the Sandia technology had to be adapted for military use in the field, as opposed to making a sensor for commercial use.”

Ronen said management has been key to those interactions and helping guide research for use-case scenarios.

Adam Bolotsky, an engineer who works closely with Ronen, said another key to success is collaboration among Sandians.

“We had quick turnarounds on printing needle fixtures so we could work on optimizing extractions of interstitial fluid,” Adam said. “Brittany Humphrey was getting volunteers and performing extractions. Then she was providing extraction output data that helped us come up with the final design of the microneedle holders. A great team effort helped us get tangible results.”

Ronen said the interdisciplinary effort, which is often hard to find in academia and private industry, stands out to him. “This really is a cross section of chemistry, engineering and biology. Interdisciplinary collaboration is promoted within Sandia’s culture,” he said.

He added that Laboratory Directed Research and Development is another reason for innovation and optimization of microneedles.

“There’s a huge sense of satisfaction when the work we do is taken out of Sandia. You can see it in research reports around the world and when people contact us that they want to work together. We’re helping expand this work to the broader science community. It makes us extremely happy with what we’re doing,” he said.



Illustration by Eric Lundin

## Adaptyx Biosciences

Sandia is also working with Adaptyx Biosciences under a Cooperative Research and Development Agreement. Adaptyx is hoping to get a better understanding of what biomarkers are in interstitial fluid.

“We want to broadly understand the components in interstitial fluid and how those components correlate to blood measurements. We’re leveraging Sandia’s existing technology for foundational physiological studies,” Alex Yoshikawa, co-founder of Adaptyx, said.

As part of this collaboration, Sandia is extracting interstitial fluid on-site from volunteers using the improved method developed with SRI.

“It’s much easier to recruit volunteers who only need to dedicate 15 minutes of their time versus two hours,” said Sandia’s Brittany Humphrey, who coordinates and oversees the extractions. “The extraction basically requires little to no work on their part.”


Adaptyx is analyzing the fluid collected with the goal of developing continuous monitoring devices for public use, Alex said.

## Electrolyte sensors

Sandia also has a partnership with the University of California, Berkeley, to develop microneedle electrolyte sensors with professor Ana Arias and graduate

student Carolyn Schwendeman.

“In this case, we are functionalizing the microneedle to be sensitive to electrolytes such as sodium, potassium or calcium,” Ronen said. Work just started on the second year of the three-year-long project. Continuous electrolyte monitoring, like a wearable glucose meter, could help manage cardiovascular functions, hydration levels and electrolyte imbalances for a variety of conditions.

“Studying interstitial fluid is not easy. Sandia has made a mark in this area, and we are known as world leaders for this work. It’s turned into this interdepartmental collaborative effort with a lot of other people,” Ronen said. 

# Former Sandian added to Entrepreneurial Wall of Fame

*Leaving his mark on the world*

By **Kim Vallez Quintana**

**C**harles Rath had no connection to the state of New Mexico before moving here in 2011. But today, his actions, both personal and professional, are rooted in making it a better place.

“A big part of what drives me on a daily basis is my two sons, ages six and seven,” Rath said.

As president and CEO of Resilient Solutions 21, a leader in data science and artificial intelligence, Rath is the latest to be honored with a place on Sandia’s Entrepreneurial Wall of Fame.

“It’s honoring innovation and entrepreneurship,” said Mary Monson, senior manager of Technology Partnerships and Business Development.

Located in Building 800, where Sandia’s top leaders work, the Wall of Fame highlights former Sandians who have led the way in taking Sandia’s technology into the world.

Rath’s picture and story now sit among photos of people like:

Dan Neal, who was instrumental in

advancing LASIK surgery using wave-front sensing metrology technologies crafted at Sandia; Todd Christenson, who transformed Sandia research into a company specializing in the world’s smallest electromechanical switches; and Hong Hou, an electrical engineer pivotal in turning EMCORE Corp. into a leading manufacturer of high-efficiency solar cells.

“To think that my portrait is on the walls of arguably one of the most prestigious science and engineering organizations in the world is one of the greatest honors of my life,” Rath said. “It makes me very proud to be associated with an organization that is doing so much good for our country and the world.”

## Charles Rath's story

Rath grew up in southern Illinois. He moved around frequently before eventually finding a home in Washington, D.C., in



**HELPING NM THRIVE** — Charles Rath, a former employee of the Labs and a 2023 Sandia Entrepreneurial Wall of Fame inductee is president and CEO of Resilient Solutions 21, a thriving data analytics company in Albuquerque. **Photo courtesy of Resilient Solutions 21**

2001. One month later, the tragic events of Sept. 11 unfolded.

“I lost a couple of neighbors from my apartment complex,” Rath said. “One was a flight attendant; the other worked in the Pentagon. It shaped the next 15 years of my career.”

Rath went on to work for the Department of Homeland Security as a consultant, then after several years was hired on full time.

In December 2011, Rath decided to bring his expertise in national security to Sandia. He was far from the conventional hire.

“I had a background in analytics but didn’t have a Ph.D. in science or engineering. Sandia thought outside the box to bring a person like me into the organization,” Rath said.

Rath soon became the lead of the Resilient Cities Program, which helps cities better solve problems through data analytics and artificial intelligence.

“One morning while watching the news, I heard a representative from the Rockefeller Foundation talking about a billion-dollar initiative to help cities around the world become more resilient and address the stresses of the 21st century. I was like, ‘Wow, how cool is that; I wonder if they have access to world-class scientists and engineers to help advise them? Wouldn’t it be cool if Sandia was a technical adviser?’ So, I cold-called Rockefeller and asked if they had heard of Sandia National Labs,” he said. “They said, ‘Where?’ It was clear they had no idea what we were. I told them we have world-class experts in water systems, energy grids, supply chains and counterterrorism. It wasn’t long before we partnered. Sandia leadership supported me in the endeavor, and we became part of this global initiative.”

Over the next three years, Rath traveled the world helping cities, states and countries. In New Orleans, for example, the program helped the city develop a more resilient energy grid.

In 2015, Rath decided to take advantage of the opportunity provided by Sandia’s Entrepreneurial Separation Program to start his own business in downtown Albuquerque, named **Resilient Solutions 21 Inc.** The company’s mission is harnessing the power of data to help people make better, faster and smarter decisions.

Since its founding, RS21 has grown to 80 employees from diverse professional backgrounds. The team provides advanced analytics supporting efforts in health care, defense, safety, urban planning, energy, cybersecurity, land use, climate, disaster preparedness, disaster recovery, space and social equity.



**WALL OF FAME** — Theodore Rath views a display of about his father Charles, who is the latest inductee into the Entrepreneurial Wall of Fame. In the background, Charles, left, speaks with Mary Manson, senior manager of Technology Partnerships and Business Development. **Photo by Craig Fritz**

## Entrepreneurial Separation to Transfer Technology Program

Each honoree on the Entrepreneurial Wall of Fame participated in Sandia’s Entrepreneurial Separation to Transfer Technology Program.

“This is why it is important to have the Wall of Fame,” Mary said. “The recognition celebrates commercialization of Sandia technology and highlights the opportunity available to the Labs’ workforce.”

Under the program, anyone at Sandia can try their hand at being an entrepreneur. If it doesn’t work out within two years, they are guaranteed a job to return to at Sandia.

“It’s a great source of innovation and helps Sandia attract more brilliant people,” Rath said. “Part of Sandia’s mission is to create and help commercialize new technology. I also hope that my story makes others aware this path exists and inspires them to take a similar one.”

While that path does mean the departure of some brilliant minds, the enduring impact is that of the work that is cultivated at Sandia and continues the Labs’ remarkable 75-year legacy of innovation.

## Helping the world


“These Sandians have made very impactful contributions that not only

advance our mission but help the world,” Mary said.

Rath, who refers to Sandia as a national treasure, is humbled by the distinction. “It makes me very proud to be associated with an organization that is doing so much good. We’ve helped create hundreds of jobs in the community where Sandians and their families live and thrive. I want to be part of a changing narrative about Albuquerque and our economy. I want to prove that great tech companies can be born and thrive in our city.”

Rath, who moved around a lot while he was younger, now considers New Mexico his home.

“I care deeply about the state of New Mexico and the city of Albuquerque. My wife’s family has been here for hundreds of years.” And that influences some of his company’s projects.

“Part of what we do is work on issues related to early childhood education, crime, cancer, the environment, water issues,” Rath said. “We are able to take some of the know-how from Sandia and help our own state, which we are really proud of.” 

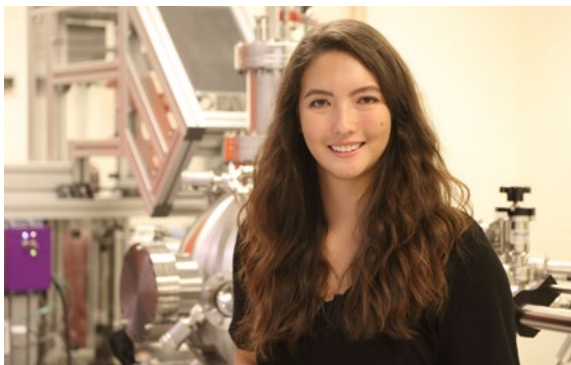
# Exceptional mission work achieved through Sandia postdoc program

## Meet the 2024 Truman and Hruby Fellows

By **Sophia Horowitz**

**D**istinguished Level Fellowships are autonomous three-year appointments offered to individuals who want to further Sandia's national security mission. Fellows are granted opportunities to delve deep into their research areas at state-of-the-art facilities and the ability to learn from recognized engineers and scientists.

The 2024 Hruby Fellows are Samantha Jaszewski and Hannah Stroud, and the 2024 Truman Fellows are Matthew Barry and Jonathan Paras.



**MATERIALS MAVEN** — Hruby Fellow Samantha Jaszewski is researching memory that is based on ferroelectric materials.

Photo by Tom Cogil

### Samantha Jaszewski: Harnessing ferroelectric materials in extreme environments

During her fellowship, Samantha Jaszewski is researching computer memory that is based on ferroelectric materials, specifically focusing on hafnium oxide.

Hafnium oxide is a material that is present in computer chips; in its ferroelectric form, it can be used as a memory material that can enable further miniaturization of computer components.

"The material increases the efficiencies

and lowers the energy needed for computing, which is important because the energy needs from computing are constantly increasing," Samantha said.

Hafnium oxide also has the potential to withstand harsh radiation environments, which is important for several national security applications.

"I'm interested in seeing how this material performs under those radiation conditions and to understand the fundamental limits of this material, which will set the application space that it can be used in," Samantha said.

Samantha graduated from Boston College in 2017 with a bachelor's degree in chemistry. In 2023, she completed her doctorate in materials science and engineering at the University of Virginia, where she authored her dissertation "Processing and Field

Cycling Impacts on the Properties and Performance of Ferroelectric Hafnium Oxide Thin Films."

Samantha's adviser at the University of Virginia, Jon Ihlefeld, was a Sandian for nearly 10 years before entering academia. He inspired Samantha to apply for a fellowship at the Labs.

"I got to hear my adviser's experience working at Sandia, and he had a lot of positive things to say about his time here. And, from early on, I was really interested in working at a national lab. So

it was a perfect opportunity to learn what it was like to work at Sandia," Samantha said.

### Hannah Stroud: Enhancing reentry vehicle models with roughness features

Seeking the ability to choose her own research path and learn from the best and brightest, Hannah Stroud applied for the Jill Hruby Fellowship.

"I began my path at Sandia as a year-round intern before applying for a fellowship. Before beginning my internship, I did not know very much about Sandia at all, but



**ROUGH SURFACES** — Hruby Fellow Hannah Stroud is researching incorporating roughness features into fluid and ablation models.

Photo by Lonnie Anderson

the internship process was helpful for me to get a feel for what the Lab does and learn about the type of work I would be doing as a postdoc," Hannah said.

Hannah earned bachelor's and master's degrees in aerospace engineering from Texas A&M University. Her research focuses on proposing methods for surrogate modeling for roughness on reentry vehicles.

"My project specifically looks at incorporating roughness features into fluid models and ablation models. We are looking at the geometry that is produced and determining whether the surface is rough or not," Hannah said.

Incorporating roughness features into fluid and ablation models helps researchers understand how irregularities of a surface affect how the fluid flows over it. When a vehicle reaches hypersonic speeds, the vehicle increases in temperature. Understanding how a surface responds to heated conditions enables design of better equipped systems.

"I am lucky enough to have a project that is of interest to a lot of individuals who are eager to know the outcome of my research like I am. Since that is the case, I am very well-supported and have a lot of people that I can ask specific questions to," Hannah said.





**BIG DATA** — Truman Fellow Matthew Barry is researching and developing machine-learning models for multiscale materials modeling.

Photo courtesy of Matthew Barry

## Matthew Barry: Multiscale materials modeling with machine learning

Matthew is spending his fellowship developing a machine-learning framework for multiscale modeling of atomic systems. This framework will enable development of reduced-order material structure-property relationships that can be used to speed up expensive physics simulations or even bypass them completely. Matthew plans to deploy this framework to design and discover novel multifunctional materials for next-generation national energy and defense missions.

“Part of this project is building on some of the tools I developed during my Ph.D. The team and I here at Sandia are working to improve and expand the capabilities of these tools and apply them to study specific materials,” Matthew said.

Matthew is no stranger to fellowships. Prior to joining Sandia, he was a fellow through the [National Science Foundation: Integrative Graduate Education and Research Traineeship](#), as well as a [NASA Space Technology Research Fellow](#).

“Being able to participate in fellowships prior to coming to Sandia has given me invaluable experience and the freedom to explore interesting research

topics. I am excited to have the opportunity to continue exploring such interesting research and to apply that research to Sandia’s missions,” Matthew said.

Matthew received his master’s in mathematics from the Georgia Institute of Technology in 2022 and a doctorate in mechanical engineering from Georgia Tech in 2023.



**METAL MANIA** — Truman Fellow Jonathan Paras is making breakthroughs in metal manufacturing.

Photo by Lonnie Anderson

## Jonathan Paras: Revolutionizing metal manufacturing

Jonathan became fascinated with metals when he joined his high school robotics team.

“I remember working on these little robotic-type mechanisms and being more interested in the metal that we made the robots out of than the mechanical design of the machines themselves. Why could I bend the aluminum alloys with my hands? Why was steel so much heavier?” Jonathan said.

His curiosity about metal alloy properties inspired him to write his undergraduate college applications about wanting to study materials science, with a focus on the subfield of metallurgy.

Jonathan attended Massachusetts Institute of Technology, where he

completed his bachelor’s and doctoral degrees in the department of materials science and engineering. His dissertation focused on the thermodynamic behavior of electrons around the melting point in pure metals and their alloys.

But he has bigger plans than focusing on pure scientific research.

“My goal is to work on conventional manufacturing. And, when I say conventional, I don’t mean boring or old, but the kind of work that used to occur at Sandia’s Melt-Lab,” Jonathan said.

Part of Jonathan’s research is to look at the fundamental thermodynamic behavior of metal alloys at high temperature to better predict how they respond under extreme conditions, which can emerge during certain manufacturing processes. Jonathan’s goal is to design new processes to manufacture metal alloys that Sandia previously could not.

The metallurgical research that took place during the Manhattan Project is what initially drew Jonathan to Sandia.

“When it was time to consider a postdoc position, I began reading about the history of nuclear deterrence work in the United States. I was interested in all the fathers of high-temperature metallurgical research, like Leo Brewer and Cyril Stanley-Smith, who worked on the Manhattan Project,” Jonathan said. “There was this interesting confluence of people who worked on aspects of the Manhattan Project that were either associated with nuclear programs or affiliated with Sandia.”

Jonathan is the grandson of immigrants hailing from the Pindus Mountains in Epirus, Greece. His grandfather, Christos G. Pappas, came through Ellis Island in 1951 and settled with his family in Philadelphia, where Jonathan grew up.

Sandia’s postdoctoral fellows are integral to the success of the Labs, as they bring fresh and innovative perspectives to critical mission areas and new approaches to projects. These four accomplished individuals contribute to Sandia’s mission by promoting scientific excellence and sustaining a thriving research environment. [i](#)

# Sandia helps Las Positas College manufacture the future

*Labs donates machines to new advanced manufacturing program*

By **Michael Ellis Langley**

**S**andia has donated more than \$30,000 in machinery and attachments to Las Positas College in Livermore as it launches a new program aimed at training generations of California students in the once-widespread trade of fabricating new things from raw materials.

According to manufacturing operations engineer Chris Bergh, when Sandia California upgraded two Haas VF-2 computerized numeric controls, staff contacted local schools to find a new home for the retiring milling machines. He learned that Las Positas was gearing up to launch a robust manufacturing program.

“If you’re going to be teaching, you want to teach what’s happening in the real world,” Chris said. “This is going to give them the ability there, especially with such a well-known U.S. brand, to learn this machine and then translate into the real world much easier using those technologies.”

Each of these Haas machines is what is known as a vertical machining center, which works in three axes. The donation of the machines — if new — would exceed \$220,000. In addition to the Haas machines, Sandia donated tool holders, power transformers and attachments called trunnions, which allow the machine to become a five-axis mill that can facilitate simultaneous axis milling. The attachments are worth at least \$70,000 new.

“Students will learn three-axes machining in the X-Y-Z axes and then

learn about A and C axis and B axis later in their careers,” Chris said.

Chris said he was inspired by his manager Brian Cass, who donated machines to Livermore high schools some years ago. In fact, both were part of a recent effort to keep Livermore High School’s machine program active. The donation to help start the program at Las Positas includes another key piece of industrial-grade equipment.

“The **Sandia Machine Shop** will also donate a coordinate measuring machine able to check parts to tens of thousandths of an inch in measurement,” Chris said. “Inspectors who can use a CMM and other aspects of metrology equipment are a huge need in the manufacturing industry. There are more machinists than there are inspectors, and a good inspector is very important to a machine shop.”

Chris was excited to support Las Positas once he heard about their facility.

“Las Positas is not only one of the best junior colleges in California, it’s one of the best in the nation,” he said. “I think their program is going to be well-received. It’s a great facility, and they have a good curriculum. They’ve thought about the layout and the equipment coming in. I think they’re really motivated to have this work for the school and are seeing strong interest about the courses.”

For Chris, this donation is both an



**THE BUILDING BUILDING** — The Advanced Manufacturing program building at Las Positas College will house dozens of machines designed to teach students how to create shapes and geometries to specific measurements..

Photo by Chris Bergh

extension of how he views his responsibility as a Sandian and about recapturing something he believes has been lost.

“As a country, we used to be innovators and producers. We don’t repair things anymore. It’s cheaper to buy the widget because it’s completely made than take it out and fix it,” he said. “We were the industrial drivers of the world, and we’ve really gotten away from that, and other countries have seized that. Take an electric



**DELIVERY DAY** — One of two coordinate measuring machines donated by Sandia to Las Positas College is loaded onto a truck for delivery in October 2023.

Photo by Chris Bergh

vehicle: the motor was made on a CNC machine, and the components in there were made by a machinist. Even the computer gets put together on an automated system that was made by a machinist.”

Now some of those machinists will have been educated at Las Positas College.

“We are very grateful for our partnership with Sandia National Laboratories and their generous donation of CNC machines, which not only provides valuable cutting-edge equipment to our college, but also aligns perfectly with our mission to equip students with the skills needed to succeed in today’s manufacturing industry,” said college president Dyrell Foster.

Chris says he is excited to help students enter a profession he loves, where someone like him gets to manufacture things that protect a nation and usher in the future.

“I have parts in orbit around the world. It’s exciting,” he said. “We see the need in manufacturing, and Las Positas can help train the next generation. Manufacturing helped put a man on the moon and beyond.” [IT](#)



**MEASURE TWICE** — The coordinate measuring machine donated by Sandia can check parts that measure tens of thousandths of an inch.

Photo by Chris Bergh

## American Chemical Society honors Sandia scientist for outstanding promise

*Prolific researcher first from Labs to garner award*

By **Luke Frank**

**S**andia materials scientist Dorina Sava Gallis has been honored by the American Chemical Society with a 2024 Women Chemists Committee Rising Star Award, recognizing her excellence in the scientific enterprise demonstrating outstanding promise for contributions to her respective field.

In her 14 years at Sandia, Dorina has accumulated more than a dozen U.S. patents, authored or co-authored more than 60 technical publications and is recognized as a world expert in nanoporous materials, particularly in metal-organic frameworks.

Generating big ideas with the smallest of particles, Dorina has found successful materials solutions in various applications, including environmental remediation, gas storage and separations, energy storage, degradation of toxic chemicals, viral detection, advanced therapeutic countermeasures and photoluminescent materials



**START HERE** — Dorina says the hard work is convincing others that your idea is worth pursuing.

Photo by Craig Fritz

for solid-state lighting, bioimaging and anticounterfeiting.

“I’m fortunate to be involved in a lot of interesting work with MOFs — for example, bridging biology with material science,” she said. Last year, Dorina led a team that invented a transparent material capable of marking authentic goods with

a special pattern or signature visible only under certain kinds of light, effectively thwarting counterfeiters.

Among her many talents and successes, Dorina particularly enjoys assembling research teams. “I’m really passionate about building multidisciplinary teams to solve cutting-edge national security



Innovative Methodologies



**SHINING BRIGHT** — Sandia materials scientist Dorina Sava Gallis was recently recognized by the American Chemical Society Women Chemists Committee with a Rising Star Award.

Photo by Lonnie Anderson

challenges,” she said. “I enjoy thinking about which people I can collaborate with — material scientists, chemists, engineers, biologists, physicists, modelers — to create the best solutions for specific needs.”

Dorina quickly acknowledged her colleagues and mentors who have contributed to these successful projects.

She has also become adept at technology transfer and commercialization, developing comprehensive business plans and identifying market pathways for her research programs.

“Much of our work has national security relevance, but it also holds significance for the broader material science community, and commercial potential,” Dorina said.

### Materials engineer, chemist or materials scientist?

From her earliest years, Dorina was a voracious reader and found math enjoyable. “In my younger days, math was like a game to me,” she said. “I was self-driven, solving as many math problems as I could. They were riddles for me that I had to find

the answers to.”

Her interests and skills in math eventually led to a bachelor’s degree in materials science and engineering. At that point, she faced a crossroads.

“I didn’t originally plan on earning a doctorate, especially in chemistry,” she said. “I didn’t really understand what that

## The case for divergent thinking

Sandia rising star Dorina Sava Gallis reflects on the challenges of transitioning academically from a materials engineer in undergrad to a chemistry major for her doctoral work. However, she also has come to realize the value of her unconventional academic journey.

“I’m a materials scientist, but I have this complementary training in chemistry,” Dorina said. “It has been very beneficial for my career to possess and apply both backgrounds. I’m able to combine them in a way that allows me to see the big picture, as well as the nitty-gritty details.”

Dorina emphasizes the power of assembling diverse research teams. “I don’t know if innovation can be drawn out of certain individuals, but I have seen how it thrives within a team,” she said.

“This is something that makes Sandia Labs truly special,” she said. “Sandia provides the infrastructure for building multidisciplinary teams of scientists, technologists, postdoctoral appointees, and graduate and undergraduate students.

“I try to surround myself with innovators: chemists, engineers, biologists, physicists, modelers and others who can contribute their expertise to a project. Additionally, we use advanced engineering tools, such as artificial intelligence and machine learning.”

For Dorina, innovation can strike at any moment.

“Sometimes ideas come to me in the middle of the night. It’s like a constant enterprise in my brain,” Dorina said.

“Because I love what I do, it doesn’t feel like hard work. The real challenge is convincing others that your idea is worth pursuing.”

**ASIAN AMERICAN  
PACIFIC ISLANDER  
HERITAGE FESTIVAL**

**SAT. MAY 4, 2024**  
10 AM - 3 PM MDT

The NATIONAL MUSEUM OF  
**NUCLEAR**  
SCIENCE & HISTORY

ASIAN LEADERSHIP & OUTREACH  
COMMITTEE

entailed. But a professor of mine in undergrad saw my potential and encouraged me to pursue graduate school.”

Studying chemistry at a higher level was one of her biggest life decisions because it took her in a completely different direction.

“Graduate school was tough,” Dorina said. “In science, we think very differently than in engineering. In engineering, we have a macroscopic, applied view. In science, we dig down to the elemental atomic level. It’s a very different mindset.”

Dorina describes herself as an engineer and a scientist. “Overall, the best


description of what I do is a materials scientist, but I have this interesting interdisciplinary training,” she said. “I now realize how important graduate school was in shaping me as a scientific researcher.”

### A first for Sandia

Dorina has received numerous professional and academic awards throughout her meteoric career, but this one is special.

“I’m really proud of this award,” she said. “This organization and committee have been around for a long time, and this is the first time a Sandia scientist has received this honor.”

In fact, the Women Chemists Committee of the American Chemical Society was established in 1927 to encourage women chemists to take an active interest in society activities. The committee serves as a forum for women chemists, develops guidance for women’s issues in the field and recognizes and promotes women in the chemical sciences.

The Women Chemists Committee Rising Star Award is open to American Chemical Society members in chemistry and chemical engineering working in academic, industrial, government, nonprofit or other employment sectors. 

# A culture evolution

**TEAM EFFORT** — Labs Director James Peery addresses staff during a Labswide event titled We Are Sandia: Together Igniting Culture Evolution. The event, held on April 23, was focused on embracing innovation, trust and belonging to help Sandia meet challenges, retain exceptional talent and support strategic goals.

Photo by Lonnie Anderson



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# Sandia's road to Tonopah Test Range

## Weapons testing leads Sandians to Nevada

By **Kenny Vigil**

Located in the desolate Nevada desert, the Tonopah Test Range serves an important national security mission. Since 1957, Sandians have helped ensure the reliability and safety of designs for current and future weapons and their delivery systems through their work at the test range.

Today, about 60 people — 25 Sandians and about 35 employees from Navarro Research and Engineering — work at Tonopah, where the mission has remained steady through the years. “The primary mission out here has always been to do flight testing in support of the nuclear deterrence mission,” range manager Brian Adkins said. “Tonopah remains relevant today because it’s the only test range where we do full end-to-end testing on air-delivered mock weapons and their components. Without our team, the president would have no idea whether his nuclear weapons stockpile for the air-delivered weapons is reliable.”

### End-to-end testing

Brian calls end-to-end testing an orchestrated assessment. It starts with getting the weapon out of storage, removing the



**TESTING MISSION** — A Joint Task Force 2 fighter plane makes a low-level test run in 1965 at Tonopah Test Range.

Photo from the Sandia archives

nuclear physics package from the unit and then replacing it with a telemetry package. A telemetry package is a digital instrumentation component that gathers and transmits performance and functionality data from the test unit.

The test unit is then loaded onto the aircraft that will drop it at the Tonopah Test Range. Once dropped on a specific target at the range, Tonopah crews recover the unit and ship it to another site for forensic analysis. The test site also gathers real-time data from test flights that is fed into the control tower and shared with the flight systems engineer.

The data help shape the Labs director’s annual letter to the president about the status of the nuclear stockpile. “If we don’t get the mission done here, we won’t have data to make it into the report for the president and Congress,” Brian said.

### Before Tonopah

In late 1945, weapons assembly and test teams that worked on the Manhattan Project at Los Alamos National Laboratory and Wendover Army Air Force Base in Utah transferred to what is now Kirtland Air Force Base. These teams were adamant that weapons needed to be 100% reliable, meaning that the weapon would release from the aircraft properly, fall directly toward the target and detonate at the precise elevation and timing. Field testing was key to determining whether the weapons designs would work.

Area III was created south of Kirtland Air Force Base for environmental testing of nonnuclear components and subassemblies. Area III had centrifuges, sled tracks and other facilities. But to do full-up field testing, a wide-open range, free of urban development and commercial air traffic was needed.

Before Tonopah, Sandia used sites at Los Lunas, New Mexico; Salton Sea,



**A LONG HISTORY** — A sign to the Tonopah Test Range shortly after the range was established. A rocket is still there today, marking the road to the test range. Photo from the Sandia archives

California; and Yucca Flat, Nevada, for conducting tests.

### Los Lunas

Between 1945 and 1946, scientists used a practice bombing range near Los Lunas, south of Albuquerque, for testing. While no test facilities were built, camera and target station markers were installed, and equipment was brought in for each test. Scientists used Los Lunas for ballistics testing, controlling nonnuclear bomb trajectory and accuracy.

### Salton Sea

In 1946, most testing stopped in Los Lunas because Salton Sea in Southern California was selected as Sandia’s test range. The Navy had operated Salton Sea Test Base, which served various military testing operations during World War II.

Under the agreement with Sandia, the Army operated the base, while Sandia managed technical and testing operations. Sandia rebuilt old Navy targets and installed

camera pads. The Atomic Energy Commission invested \$3.5 million into improvements at Salton Sea Test Base in 1947.

Sandia's first test drop at Salton Sea was completed March 12, 1947. About 150 tests were conducted each year. In 1950, Sandia took over full operations of Salton Sea. Initially, most of the tests were to check weapons ballistics.

Scientists were also interested in how existing weapons in the stockpile would respond to a variety of environmental conditions. Weapons from the stockpile were disassembled, inspected and then tested without fissionable material.

## Outgrowing Salton Sea

As fighter aircraft equipment advanced, it became more difficult for Sandia's scientists to track higher and faster planes at Salton Sea. More people living near the base, more commercial air traffic and the Los Angeles haze started impacting testing operations.

By 1954, Sandia found a new test location: Yucca Flat at the Nevada Test Site. For a couple of years, Sandia crews from Salton Sea traveled to Yucca Flat for testing. Yucca was adequate for high-altitude test drops, but mountains on three sides did not make it ideal for low-altitude drops. The Nevada Test Site served primarily as a test site for nuclear weapons, which was receiving priority over Sandia's testing.

## Tonopah Ballistic Range

In 1956, the search began for a new test site that could serve Sandia and the DOD. The Navy expressed interest in an area called Cactus Flats, on the Nellis Air Force Base Range in Nevada. The open, dry and barren site allowed for excellent visual coverage of nonnuclear bomb drops.

Construction started on the Tonopah Ballistic Range in August 1956. Six months later, in February 1957, the first test was conducted at the Tonopah range. Crews from the Salton Sea site traveled to Tonopah for testing as needed.

The Tonopah Ballistic Range was initially intended to be a temporary test

site, while Sandia and the Air Force worked to acquire a joint test site in Arizona. Those plans eventually fell through. Testing at the range was so successful that in February 1959, Sandia management announced Tonopah would be Sandia's permanent test site.

"Today Tonopah remains Sandia's premier off-site test range," Brian said.

## Today's capabilities

While the mission has remained unchanged, the same cannot be said about the capabilities and equipment at the test range. The range covers about 200 square miles. Some of the equipment for testing includes: a test operations center, radars, neutron detectors, optical tracking systems, telemetry stations and weather stations.

## Life at the test range today

The Tonopah Test Range has other types of equipment that you would find in a small city. "We have excavators, road graders, trash trucks and snow removers," Brian said.

Many Sandians who work at Tonopah live in Las Vegas, which is about a four-hour drive one-way. Employees who live in Las Vegas work 40 hours over a three-day period, Tuesday through Thursday. They make the four-hour drive to work Tuesday mornings and then stay on-site at a large complex of motel-styled buildings known as the Mancamp.

"We have permanent assigned rooms. We go to the same room every week," Brian said.

The rooms were recently upgraded with new furniture. Each room has a flat-screen TV with cable, a refrigerator and a landline telephone since cellphones are not allowed at the test range. There's also



**TEST TIME** — Navarro Engineering and Research contractors recover a mock B61-4 for analysis, following a drop by an F-15 in 2022.

Photo by Craig Fritz

a cafeteria nearby that serves hot food three times a day.

The employees who live in Tonopah, which is about 45 minutes away from the test range, typically work ten hours a day, four days a week.

Brian says his small but mighty team has built a strong camaraderie, including



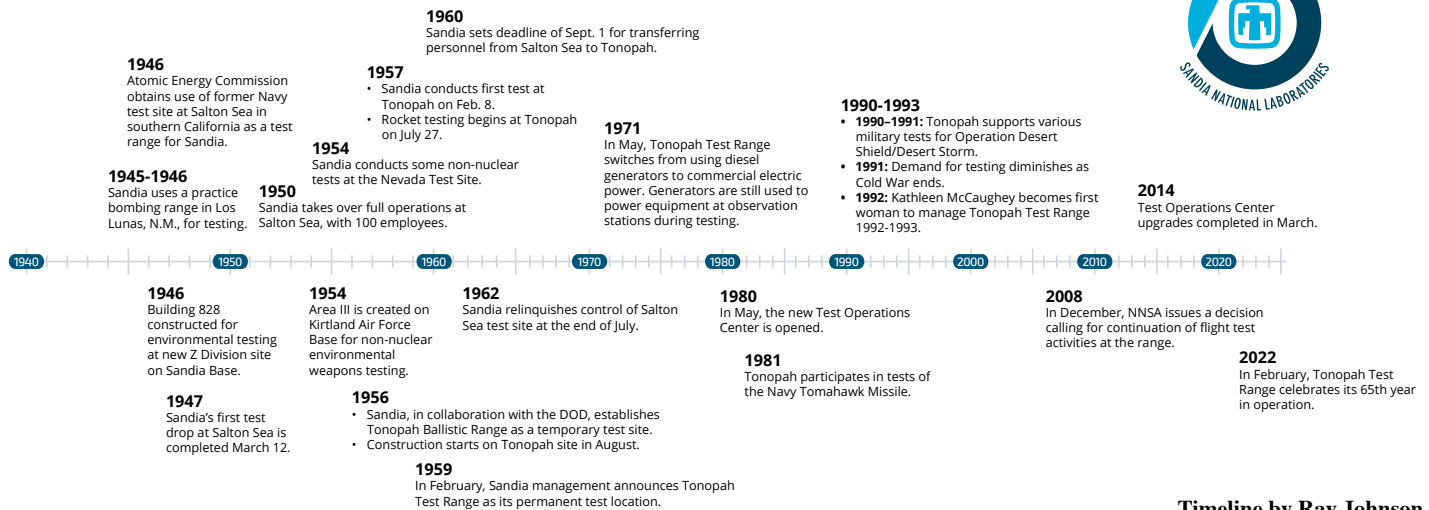
Video by Craig Fritz

the 35 to 40 employees from Navarro Engineering and Research, whom he considers part of the Sandia family.

"We all work well together as a team and for the same goal. It's a family atmosphere out here. We look out for each other like family to make sure everyone stays safe. We factor safety into everything we do out here," Brian said. [📺](#)

**Editor's note:** Historical information in this article was compiled from Sandia Report: Tonopah Test Range Outpost of Sandia National Laboratories SAND96-0375.

# The road to Tonopah



Timeline by Ray Johnson

## Want to work at Sandia? Become a welder.

High schoolers get a look at the trades within Sandia

By Kim Vallez Quintana

Federico Rael isn't what some would consider a "typical" Sandia job candidate. He isn't a math, science or engineering wiz, but he is a great welder.

"One of the reasons I love welding is because it's hands on," said Rael, a sophomore at Sue V. Cleveland High School. "It's more my style of learning, and it's something I'm passionate about."

Rael was one of 10 students from Rio Rancho Public Schools who recently visited Sandia as part of a job shadowing event organized by the Community Involvement team.

"Career exploration opportunities help students chart their futures," Community Involvement Manager Amy Tapia said. "Sandia's mission is achieved by people working in a variety of professions, including technologists and trade positions. This opportunity was a great way to connect students with potential career paths at Sandia."

The students who attended are part of a three-year dual credit program at Central New Mexico Community College as part of the Rio Rancho schools' Career Technical Education program. The students aim to graduate from high school with a certificate or associate degree in welding from CNM.

### Welding supports Sandia's mission

Welding plays a crucial role in supporting Sandia's mission.

"At Sandia there are so many different welding processes and so many skill levels you have to meet to accomplish the things we do," said technologist James Scott, who guided the students during the tour.

James showed them what a day on the job looks like, for him.

"We perform TIG, MIG, furnace braze/torch braze and orbital welding. We also tried to teach them some metallurgy, so they can understand what happens to the base metal and the heat affected zone during and after welding," James said.

James and his team also showed the students the many ways welding is incorporated throughout Sandia, from vacuum



**EXPLORING OPPORTUNITIES** — Ed Arata shows welding students from Rio Rancho Public Schools the brazing lab during a visit on April 12.

Photo by Craig Fritz

chambers used in experiments to the Ion Beam Lab, the Z Pulsed Power Facility and the solar tower.

"This is not just about sitting at a bench and welding. You have to be multifaceted and proficient in multiple processes to succeed," James said.

### Trades vs. college

While college has traditionally been emphasized as the next step for high school graduates, there has been a recent shift toward promoting trades. The Career Technical Education program, in its first year in Rio Rancho Schools, is one way to do that.



“The demand for skilled trades workers in New Mexico is growing due to the aging workforce,” Rio Rancho Career and Technical Education High School Principal Kristopher D. Johnson said. “It is important to introduce students to trades because not all students are ready for a four-year university.”

Sandia aims to show these students that there’s a place for them at the Labs.

### James' journey

James is living proof of this.

James was once one of those students.

“My welding journey began when I was 17 or 18 years old,” he said. “I graduated high school knowing college wasn’t for me, so I moved to Colorado to work on a horse ranch.”

Soon after, James was tasked with building a two-story barn and bunkhouse out of metal, despite having no welding experience. “A welder took me aside and showed me how it worked. After about two weeks, I was welding faster and better than the other welders. It became a passion to get better each time I laid down a bead, and I just loved doing it.”



**LEADING THE WAY** — Sandia technologist James Scott, center, leads Rio Rancho Career and Technical Education High School welding students on a tour of the Labs.

Photo by Craig Fritz

Five years later, James returned to New Mexico to work for one of Sandia’s suppliers. Thirteen years later, his journey has brought him to where he is today, a place he never envisioned.

“Never in a million years did I think I could work at Sandia. I always thought

you had to have the college credentials,” James said. “I figured I had no chance.”

Today he shares his story, hoping these students can see their future in his past.

“I am very proud and grateful to be a Sandian,” James said. “We need skilled welders, and we will need them forever.”

## Mileposts



Mark Martin

35



Becky Krauss

30



Amy Leyba-Essary

30



MaryAnn Monia-Archibeque

25



Margaret Jaramillo

20



Tiffany Pierce

20

## Recent Retirees



Jann Smith

20



Michael Kent

32