



S A N D I A

LABNEWS

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Meet Sandia's
first staff
archaeologist
Page 9

Mileposts	8
Gender equity	11
Climate scientist	12
Pandemic pets	15

Safer, more powerful batteries for electric cars, power grid



TESTING BATTERIES — Sandia engineers Alex Bates, left, and John Hewson examine a lithium-ion battery in front of a specially designed battery testing chamber. They compared the heat released by a traditional lithium-ion battery to the heat released by a solid-state battery and a solid-state battery with a little liquid electrolyte. They found in many cases solid-state batteries with a little liquid electrolyte were safer than their lithium-ion counterparts.

Photo by Rebecca Gustaf

Solid-state batteries with little liquid electrolyte are safer than lithium-ion batteries

By Mollie Rappe

Solid-state batteries, currently used in small electronic devices like smart watches, have the potential to be safer and more powerful than lithium-ion batteries for things such as electric cars and storing energy from solar panels for later use. However, several technical challenges remain before solid-state batteries can become widespread.

A [Sandia-led study](#), published on March 7 in the scientific journal *Joule*, tackled one of these challenges — a long-held assumption that adding some liquid

— CONTINUED ON PAGE 5

Neuromorphic computing widely applicable, Sandia researchers show

Brain-based computing chips not just for AI anymore

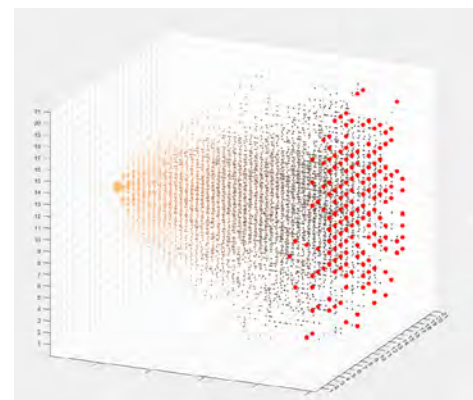
By Neal Singer

With the insertion of a little math, Sandia researchers have shown that neuromorphic computers, which synthetically imitate the brain's logic, can solve more complex problems than those posed by artificial intelligence and may even earn a place in

high-performance computing.

The findings, detailed in a recent article in the journal [Nature Electronics](#), show that neuromorphic simulations, rapidly repeated through the statistical method called random walks, can track disease passing through a population, X-rays passing through bone and soft tissue, information flowing through social networks and the movements of financial markets, among other uses, said Sandia theoretical neuroscientist and lead researcher Brad Aimone.

— CONTINUED ON PAGE 7



SIMULATED WALKS — A [diffusion model](#) on the Intel Loihi platform based on data from Sandia algorithms working. **Graphic by Brad Aimone**

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TABLE of CONTENTS

- 1** | Safer, more powerful batteries for electric cars, power grid
continued on page 5
- 1** | Neuromorphic computing widely applicable, Sandia researchers show
continued on page 7
- 2** | Pivoting toward the pandemic
- 4** | New guidelines for wind energy systems
- 8** | Mileposts and recent retirees
- 9** | Preserving the past
- 11** | Labs joins effort to close gender gap in nuclear security
- 12** | Atmospheric scientist uses statistical approaches to study climate impacts
- 14** | Inspiring local interest in STEM
- 14** | Women's History Month events
- 15** | Pandemic partners

LABNEWS Notes

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Pivoting toward the pandemic

A look back at how Employee Health Services' rapid response has helped keep the workforce safe

By **Meagan Brace**

It has been two years since the World Health Organization declared COVID-19 a pandemic on March 11, 2020. While the pandemic has changed all our lives, it has been especially hard for health care workers nationwide who have had to change the way they provide services, learn how to treat a novel disease and continuously transition through the ebbs and flows of COVID-19 and its variants. As we enter the third year of this reality, we reflect on the Labs' initial response and recognize the resiliency of Sandia's own medical staff.

Around the same time that the United States recorded its first case of COVID-19 in January 2020, Sandia's leadership team was proactively gathering representatives from across the Labs to begin planning for the inevitable.



FUN FITNESS — In the first months of the pandemic, fitness classes went virtual, and attendance nearly doubled. Engagement didn't just increase among the workforce, as children and pets joined in on the fun, too.

Photo by Randy Montoya

Sandia's Pandemic Response Team quickly engaged cross-organizational leaders who monitored the global progression of COVID-19 to ensure Sandia had an effective system in place to remain operational. One important tool in the team's arsenal was a Pandemic Disease Response Plan that had been revised between August and December of 2019. A requirement for DOE within Sandia's Continuity of Operations Plan, this high-level framework provided guidance on how to activate a response to a biological threat — whether a natural disease outbreak or a terrorist attack — to protect the health and wellness of the workforce and ensure mission essential functions could continue.

The plan had been exercised annually during Sandia's flu shot clinics and proved to be helpful in kicking off the COVID-19 pandemic response and engaging the Labs' leadership team before the virus reached Sandia sites. However, it didn't include details on how to manage the pandemic or how to shut down the response afterward, former director of Employee Health Services Renee Holland explained.

"It was great to have so that we could have the communication ready to go and a plan to kick off when we needed to activate for the COVID-19 pandemic, but we're still working through how we need to evolve it and how the Continuity of Operations needs to expand at Sandia because it's a high-level framework," she said in July 2021. "I don't think anything could have had us as prepared as we needed to be to evolve for COVID-19 because it was such a high-level, detailed response that was needed."

Shifting services

A major part of that detailed response was the change in services that Sandia's Medical Clinic provided to the workforce. While some services had to be put on pause, many shifted throughout the pandemic and even more were added.

"We basically changed 100% of our operations in less than 90 days as we were starting to treat people," Renee said. "We had to change every workflow we had to respond to COVID-19."

In-person services like group fitness classes and corporate fitness facilities were paused, and people needing personal health care services and nonemergency care were encouraged to work through their community primary care provider. The clinic still continued a majority of services though, like providing emergency medical services, treating work-related injuries and illnesses, conducting return-to-work and restriction reviews, streaming [preventive health services](#), offering [flu shots](#) and allergy shots by appointment and counseling employees telephonically through the [Employee Assistance Program](#).

On top of continuing many day-to-day operations, Employee Health Services expanded its capabilities to respond specifically to COVID-19 and keep essential workers safe, especially those who remained on-site. Within a few months, they prepared to primarily treat upper respiratory infections, created quarantine guidance, set up [testing](#), managed those who self-identified as high risk for complications, developed a [Health Check app](#) and monitored risk indicators, conducted contact tracing and moved from an in-person service model to a telephonic service model.

In 2020, the team adopted online platforms for telephonic and video visits. This year, Employee Health Services is evaluating a hybrid model of care.

"We are beginning to pivot again to provide more on-site services while still offering services virtually. We want to connect with staff where they prefer," said Kim Pohl, senior manager of Employee Health Services.

On the front lines

The [medical providers](#) in particular had to adapt to COVID-19 quickly, learning how to treat conditions outside their specialties and become experts on new guidance that changed often.

"A lot of these providers spent a lot of years in school, and they didn't pick the specialty to respond to a pandemic or pick upper respiratory COVID-19 type work. It wasn't something that was their life's passion and goal, but they all met the challenge, became the experts and pivoted from their normal passions to support the pandemic efforts. That's a hard challenge to face, especially in an environment where health care professionals in the community were highly sought after," Renee said.

Adding and pivoting medical services during a time when health care professionals in the community were in high demand presented challenges of its own. It was a hard market to find enough of the



TESTING, TESTING — Sandia stood up the first testing site at a national lab on April 8, 2020, and began providing appointment-only drive-up screening for Sandia employees and subcontractors who were referred by Sandia Medical.

Photo by Randy Montoya



IMPORTANT IMMUNIZATION — Sandia medical staff worked tirelessly at on-site drive-through clinics from January to May 2021 to vaccinate the Labs' workforce against COVID-19 and ensure no vaccine went to waste. Vaccines and boosters are still being offered by appointment at Sandia's Medical Clinic.

Photo by Randy Montoya


right kind of workers to meet the response. Before the pandemic, the Employee Health Services center included about 90 doctors, nurses and support staff that all contributed to the Labs' COVID-19 response. As infections increased, that number varied upwards toward 105 workers to collect COVID-19 tests, manage the front desk and provide medical services. And as vaccines became available, [on-site drive-through clinics](#) required even more staff.

"There have been many challenges, primarily stretching existing staff resources to cover the pandemic efforts for a much longer period of time than we initially thought," Kim said. "Our people are tired, and it has been a challenge to add more staff as health care everywhere is struggling to recruit and retain resources."

Even with the added challenges, the entire staff has found a way to persevere,

adapt and ultimately keep Sandia's workforce safe amid one of the most unprecedented times in history. Because of them, more than 15,000 employees and contractors across Sandia's sites have had direct access to medical advice and care, timely COVID-19 test results and vaccines.

Sandia's COVID-19 cases have remained below the local and national levels throughout the pandemic and possible on-site transmission has accounted for just 4% of all cases.

"Since the beginning, staff and Employee Health Services have worked together to meaningfully support the mission at Sandia," Kim said. "We know we will look back, down the road, and have great memories of the teamwork, the significant effort expended and the impact the team had made for all Sandians." 

By the numbers March 2020 - February 2022:

58% increase in health and wellness class attendance.

6,200 COVID-19 tests conducted.

5,300 people transitioned through quarantine.

11,700 vaccines administered on-site.

14.1% of the Sandia population in New Mexico contracted the virus, compared to 24.4% of all New Mexicans.

7.5% of the Sandia population in California contracted the virus, compared to 22.7% of all Californians.

New guidelines for wind energy systems

Researchers bridge gap between industry design and US military needs

By Kelly Sullivan

Sandia researchers have devised a new set of design guidelines and procurement specifications that help the wind energy industry and the U.S. military develop and evaluate rapidly deployable wind energy systems for use in defense and disaster-response applications.

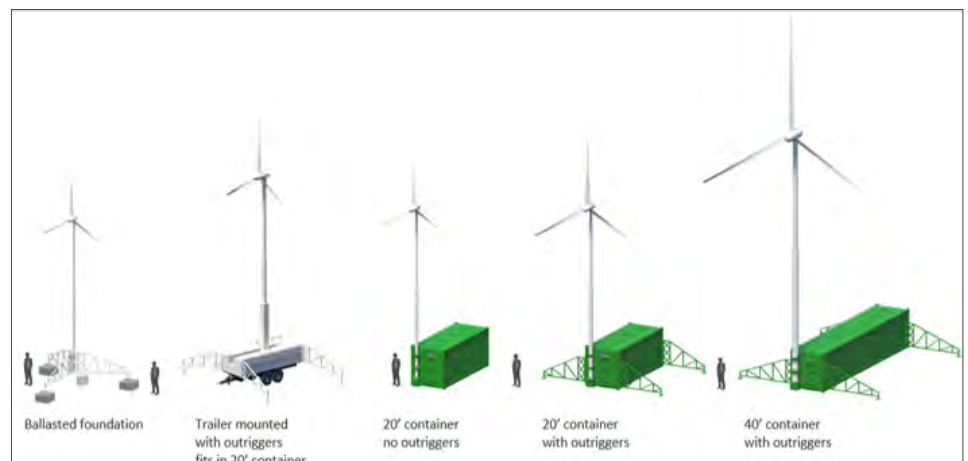
The [Defense and Disaster Deployable Turbine, or D3T](#), project was funded by DOE's [Wind Energy Technologies Office](#) to assess the potential market for deployable wind systems, define the design guidelines for these systems and facilitate engagement between the wind energy industry and the military.

"This project helped fill the gaps within this space," said Brian Naughton, the principal investigator for the project. "Industry always wanted to know if there was interest in the design of such a system — 'What does the military want and need?' — and the military always wanted to know what industry could design and build. It really was a case of the chicken or the egg. This new set of guidelines bridged the gap between the two parties and helped to facilitate informed conversations."

Brian said project work took place in a variety of arenas versus a typical lab or research facility. Content for the guidelines was gleaned through numerous defense and energy conferences. After interviewing

industry and military stakeholders, he shared preliminary findings with the stakeholders and gathered feedback through emails, newsletters, reports and presentations at wind energy associations, like the [Distributed Wind Energy Association](#) and the [Defense TechConnect Innovation Summit & Expo](#).

"Before [the development of] these guidelines, there really were no public resources to study what deployment and application of such a system might look like," Brian said. "Instead of a smaller company investing six months of time and designing a system that the military doesn't need, [the company] can now review three years of distilled data to assist in facilitating and accelerating its product."



WIND INNOVATION — Deployable wind turbine general design concepts from the new guidelines for wind energy systems, drafted by Sandia researchers.

Graphic by Besiki Kazaishvili, National Renewable Energy Laboratory

For instance, Brian said design criteria differ in a deployable wind system from those of commercial wind turbines. Deployable wind systems must be easy to transport, able to operate in nearly any environment worldwide and simple to set up and break down.

“This is the complete reverse of how the wind industry traditionally designs products,” Brian said. “The guidelines recommend [that] both industry and the military consider these key differences.”

The project benefited from deep experience in wind energy and military energy knowledge across the national laboratory enterprise. Within Sandia, researchers Tammy Brown and Sam Gilletly adapted tools and analyses developed by the military and energy systems analysis team, managed by Alan Nanco, to evaluate deployable wind systems in a military operations scenario. Beyond Sandia, project partners at the [National Renewable Energy Laboratory](#) and [Idaho National Laboratory](#) brought expertise in small wind systems, as well as in military microgrid design and testing experience.

Next steps for the Defense and Disaster Deployable Turbine project may include analysis-based work, Brian said, such as research proposals to test hardware. A related project led by Idaho National Laboratory in partnership with [Uprise](#)

[Energy](#) is developing innovative, mobile renewable-energy systems for distributed microgrid applications. This project offers a glimpse at what [portable renewable-energy systems](#) might look like, he said.

Brian is often asked if solar energy would be a better choice than wind energy in deployment and disaster-response situations.

“What we’re finding is that a better question to ask might be, why not both wind and solar?” he said. “Hybrid wind and solar systems have been found to perform better than either type of system on its own.”

Learn more about Sandia’s [Wind Energy program](#). [i](#)



HYBRID SOLUTION — Rendering of various deployable wind and solar power concepts at a forward operating base from the Sandia report that sets guidelines for new wind energy systems.

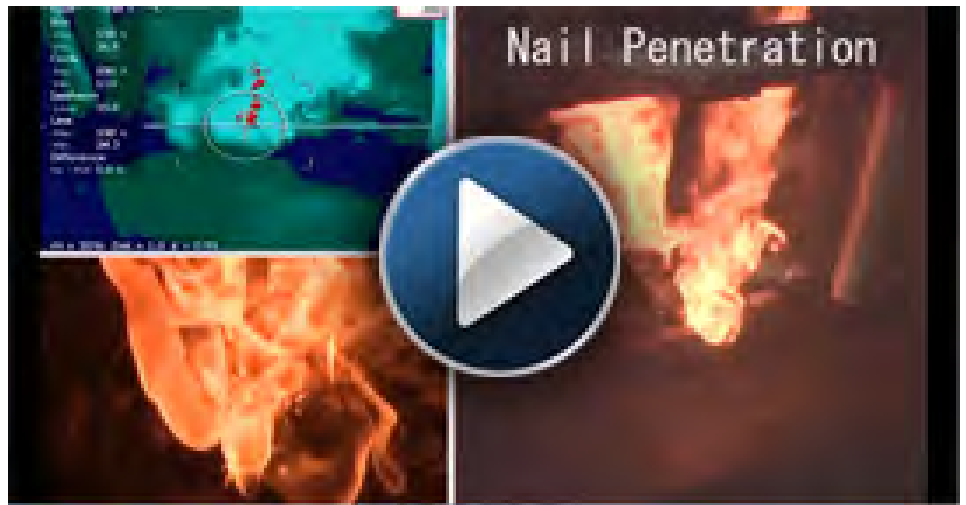
Graphic by Besiki Kazaishvili, National Renewable Energy Laboratory

Powerful batteries

CONTINUED FROM PAGE 1

electrolyte to improve performance would make solid-state batteries unsafe. Instead, the research team found that in many cases solid-state batteries with a little liquid electrolyte were safer than their lithium-ion counterparts. They also found, if the battery were to short-circuit, releasing all its stored energy, the theoretically super-safe, all-solid-state battery could put out a dangerous amount of heat.

“Solid-state batteries have the potential to be safer, and they have the potential for higher energy density,” said Alex Bates, a Sandia postdoctoral researcher who led the study for the paper. “This means, for electric vehicles, you could go farther in between charges, or need fewer batteries for grid-scale energy storage. The addition of liquid electrolyte may help bridge the gap to commercialization, without sacrificing safety.”



BURN, BABY, BURN — A video of different ways batteries can fail, as illustrated by Sandia’s Battery Abuse Testing Laboratory.

Better batteries through chemistry

Solid-state batteries are somewhat like lithium-ion batteries. In both, lithium ions move from one side of the battery to the other, while electrons flow through a circuit to power the device. One big difference is that throughout a lithium-ion

battery, there is a substance that helps the lithium ions move quickly: the liquid electrolyte.

Loraine Torres-Castro, a battery safety expert in Sandia’s [Battery Abuse Testing Laboratory](#) who is involved in the project, compares liquid electrolyte to a fleet of cars pulling into driveways: It shuttles

lithium ions directly where they need to go. However, current liquid electrolytes are flammable and can cause a battery explosion or fire, especially when the battery is damaged.

In a solid-state battery, the liquid electrolyte is replaced by a solid material, called a solid electrolyte, that also helps the lithium ions move quickly. One technical challenge is that while the lithium ions can move quickly within the solid electrolyte, they have a hard time moving from the solid electrolyte to the electrodes and vice versa, Alex said. The solid electrolyte could be compared to a cadre of trains, also quickly shuttling the lithium ions to the station, but then the passengers still have to travel a bit further to get home.

One way scientists have sped up this “direct shuttling” — and thus battery charging speeds and performance — is by adding a little bit of liquid electrolyte to the positive side of the battery.

However, Yuliya Preger, a [Sandia battery reliability expert](#) on the project, said, “There has been a lot of controversy in the solid-state battery research community about the safety of including liquid electrolyte to ‘grease the wheels.’ Some scientists say that any amount of liquid electrolyte is unsafe. So, we did the calculations to see what the impacts of liquid electrolyte could be, instead of just accepting the ‘party line.’”

Steve Harris, a battery scientist at [Lawrence Berkeley National Laboratory](#), and Katie Harrison, a [Sandia battery scientist](#), first questioned the “party line” that led to the study. Both were involved in the study.

How safe are solid-state batteries?

To figure out just how safe a solid-state battery with a little liquid electrolyte would be, the research team started by calculating how much heat could be released in a lithium-ion battery, an all-solid-state battery and solid-state batteries with varying amounts of liquid electrolyte. All batteries tested had equivalent amounts of stored energy. Then, they looked at three different bad things that could happen to the batteries, and the heat that would be released due to each type of failure.

“We started by determining just how much chemical energy is in the three kinds of batteries,” said John Hewson, a Sandia heat-release calculation expert on the project. “There’s only so much energy you can release, which will heat up the battery a certain amount, if a chemical reaction does occur.”

The first bad thing that could happen, Loraine said, is if the batteries caught on fire from either a neighboring battery or a surrounding building. In these cases, the researchers found that the solid-state battery with a little liquid electrolyte in it produced about one-fifth of the heat of a comparable lithium-ion battery, depending on how much liquid electrolyte it had. The solid-state battery without liquid electrolyte didn’t produce any heat under this scenario.

The second bad thing that could happen to the batteries is if repeated charging and discharging caused the lithium metal to form a “spike” called a dendrite. This dendrite can puncture a hole through the separator that keeps the two sides distinct and causes a short-circuit, Yuliya said. This is a known issue with [all batteries that have lithium metal on one side](#). In this case, all three

batteries produced similar amounts of heat, which depended on how much lithium metal was in the batteries.

The third bad thing that could happen to a solid-state battery is the solid electrolyte could break. This could happen if the battery was crushed or punctured or due to built-up pressure during operation, which would allow oxygen from one side of the battery to react with the lithium metal on the other side, Loraine said. In these cases, the solid-state battery without liquid electrolyte could reach temperatures near that of the lithium-ion battery, which the team found surprising.


From safety calculations to laboratory experiments

“One of the promises of solid-state batteries is that they are safe, because the solid electrolyte is firm and unlikely to break. But if it does break, the temperature rise could be about as much as when lithium-ion batteries fail,” Yuliya said. “This study highlighted the importance of engineering the heck out of that separator so that it does not fail.”

The next steps for the project include conducting similar calculations with other solid electrolyte materials and conducting experiments to validate the new and original calculations, Alex said.

“We found if the solid-state battery has lithium metal, it has the potential to be dangerous, regardless of if it has liquid electrolyte or not,” he said. “What we were trying to point out in this paper is that there’s a definite trade-off between performance and safety, but adding a bit of liquid may greatly increase performance while only having a small impact on safety.”

Understanding this trade-off may help speed up commercialization, Loraine added. “Having the clarity and the confidence that knowing a small amount of liquid electrolyte will not create huge safety issues may help the development of commercial solid-state batteries. The adding liquid electrolyte could fix one of their main problems, the solid electrolyte interface.”

This safety study was supported by DOE’s [Office of Electricity Energy Storage Program](#). 



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Sandia Labs has official social media accounts on several online communities to engage in conversations about our work, update followers about the latest Labs news, share opportunities, and support the open government principles of transparency, participation and collaboration.

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Brain-based computing

CONTINUED FROM PAGE 1

“Basically, we have shown that neuromorphic hardware can yield computational advantages relevant to many applications, not just artificial intelligence to which it’s obviously kin,” said Brad. “Newly discovered applications range from radiation transport and molecular simulations to things like computational finance, biology modeling and particle physics.”

In optimal cases, neuromorphic computers will solve problems faster and use less energy than conventional computing, he said.

The bold assertions should be of interest to the high-performance computing community because finding capabilities to extract solutions from statistically solvable problems is of increasing concern, Brad said.

“These problems aren’t really well-suited for GPUs [graphics processing units], which is what future exascale systems are likely going to rely on,” Brad said. “What’s exciting is that no one really has looked at neuromorphic computing for these types of applications before.”

Said Sandia engineer and paper author Brian Franke, “The natural randomness of the processes you list will make them inefficient when directly mapped onto vector processors like GPUs on next-generation computational efforts. Meanwhile, neuromorphic architectures are an intriguing and radically different alternative for particle simulation that may lead to a scalable and energy-efficient approach for solving problems of interest to us.” Brian models photon and electron radiation to understand their effects on components.

The team successfully applied neuromorphic-computing algorithms to model random walks of gaseous molecules diffusing through a barrier, a basic chemistry problem, using the 50-million-chip Loihi platform Sandia received approximately a year and a half ago from Intel Corp., said Brad. “Then we showed that our algorithm can be extended to more sophisticated diffusion processes useful in a range of applications.”

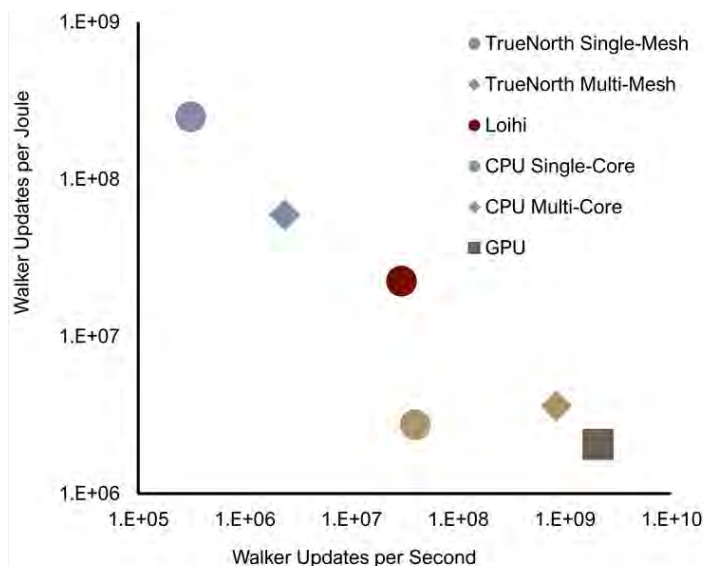
The claims are not meant to challenge the primacy of standard computing methods used to run utilities, desktops and phones. “There are, however, areas in which the

combination of computing speed and lower energy costs may make neuromorphic computing the ultimately desirable choice,” he said.

Unlike the difficulties posed by adding qubits to quantum computers — another interesting method of moving beyond the limitations of conventional computing — chips containing artificial neurons are cheap and easy to install, Brad said.

There can still be a high cost for moving data on or off the neurochip processor. “As you collect more, it slows down the system, and eventually it won’t run at all,” said Sandia mathematician and paper author William Severa. “But we overcame this by configuring a small group of neurons that effectively computed summary statistics, and we output those summaries instead of the raw data.” William wrote several of the experiment’s algorithms.

Like the brain, neuromorphic computing works by electrifying small pin-like structures, adding tiny charges emitted from surrounding sensors until a certain electrical level is reached. Then the pin, like a biological neuron, flashes a tiny electrical burst, an action known as spiking. Unlike the metrological regularity with which information is passed along in conventional computers, said Brad, the artificial neurons of neuromorphic computing flash irregularly, as biological ones do in the brain, and so may take longer to transmit information. But because the process only depletes energies from sensors and neurons if they contribute data, it requires less energy than formal computing, which must poll every processor whether contributing or not. The conceptually bio-based process has another advantage: Its computing and memory components exist in the same structure, while conventional computing uses up energy by



THE NEUROMORPHIC ADVANTAGE — Both the IBM TrueNorth and Intel Loihi neuromorphic chips observed by Sandia researchers were significantly more energy-efficient than conventional computing hardware. The graph shows Loihi can perform about 10 times more calculations per unit energy than a conventional processor. Energy is the limiting factor — more chips can be inserted to run things in parallel, thus faster, but the same electric bill occurs whether it is one computer doing everything or 10,000 computers doing the work.

Graph by Brad Aimone

distant transfer between these two functions. The slow reaction time of the artificial neurons initially may slow down its solutions, but this factor disappears as the number of neurons is increased so more information is available in the same time period to be totaled, said Brad.

The process begins by using a Markov chain — a mathematical construct where, like a Monopoly gameboard, the next outcome depends only on the current state and not the history of all previous states. That randomness contrasts, said Sandia mathematician and paper author Darby Smith, with most linked events. For example, he said, the number of days a patient must remain in the hospital are at least partially determined by the preceding length of stay.

Beginning with the Markov random basis, the researchers used Monte Carlo simulations, a fundamental computational tool, to run a series of random walks, which attempt to cover as many routes as possible.


“Monte Carlo algorithms are a natural solution method for radiation transport problems,” said Brian. “Particles are simulated in a process that mirrors the physical process.”

The energy of each walk was recorded as a single energy spike by an artificial neuron reading the result of each walk in turn.

“This neural net is more energy efficient in sum than recording each moment of each walk, as ordinary computing must do. This partially accounts for the speed and efficiency of the neuromorphic process,” said Brad. More chips will help the process move faster, using the same amount of energy, he said.

The next version of Loihi, said Sandia researcher Craig Vineyard, will increase its current chip scale from 128,000 neurons per chip to up to one million. Larger-scale systems then combine multiple chips to a board.

“Perhaps it makes sense that a technology like Loihi may find its way into a future high-performance computing platform,” said Brad. “This could help make HPC much more energy efficient, climate-friendly and just all around more affordable.”

The work was funded under the [NNSA Advanced Simulation and Computing](#) program (the Beyond Moore’s Law portfolio) and Sandia’s [Laboratory Directed Research and Development](#) program. 

Mileposts



Charles Barbour 35



Vincente Romero 35



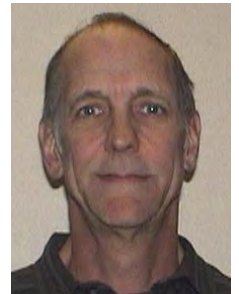
Michael Skroch 35



Biu So 35



Diane Gaylord 30



Ron Meyer-Hagen 30



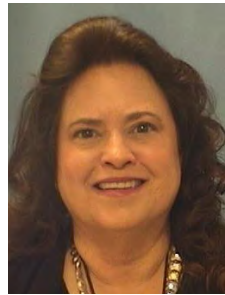
Joe Castro 25



Prabal Nandy 20



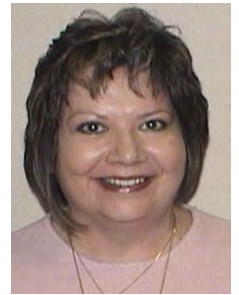
Jeanette Brionez 20



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Craig Carmignani 20



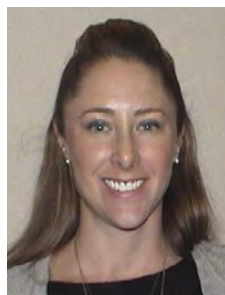
Cheryl Post 20



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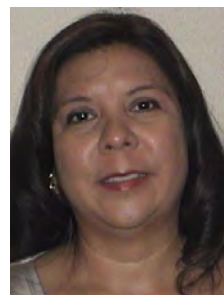
Eddie Silva 20



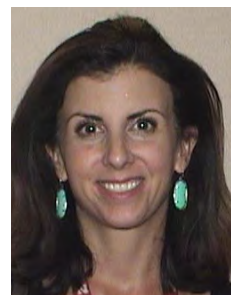
Jennifer Gonzales 20



Darleine Barboa 15



Angela Calabaza 15



Lisa Gribble 15



Andrew McCourt 15



Chuck Skeens 15

Recent Retirees



Martin Aragon 30



David Skousen 28

Preserving the past

First staff archaeologist at Sandia brings 'cool factor' to protecting land's history

By **Manette Newbold Fisher**

When archaeologist Christina Chavez surveys Sandia land and finds rusted tobacco tins, ceramic fragments, glass shards or rocks resting in deliberate formations, she documents and determines who at the Labs needs to know.

"Archaeological resources are all around us, and even if most people don't see them, there's still a potential that they're there," Christina said.

Christina, the Labs' first full-time archaeologist, works with teams throughout Sandia to ensure DOE remains in compliance with [Section 106](#) of the National Historic Preservation Act. Established in 1966, the act requires federal agencies to consider the effects on historic properties when carrying out or funding projects. For Sandia, projects can mean anything from construction to an experiment or explosion taking place in remote areas.

"Together, we stay in compliance and protect and preserve cultural resources.

That's huge," Christina said. "When I meet with groups and organizations, they learn we have a responsibility. I enjoy seeing when they take pleasure in knowing about cultural resources and recognize that they are some of the keepers of the past."

Cultural sites Christina surveys by foot are recorded and submitted to state historic databases that archeologists use. Sandia has sites in New Mexico spanning four major cultural temporal periods dating between 10000 B.C. and the mid-1900s, Christina said. More recent historic sites are likely associated with military use.

Pick it up, put it back

Christina works in the cultural resource program she established within Sandia's Environment, Safety and Health group that ensures safety and environmental compliance and stewardship while supporting the success of the Labs and community. She also works closely with the Labs' historian, Rebecca Ullrich, who said Christina's impact has made a big difference.

"I can tell you all kinds of things about Sandia's history and how it's represented in the built environment and what is signif-

icant about that, but I cannot look at a site and tell you anything about it archaeologically," Rebecca said.

Christina significantly expanded cultural resources investigations and the opportunity for preservation at Sandia, and she does it in a way that makes others interested, Rebecca said.

"She brings the cool factor," Rebecca said. "Her work is so interesting and that



PAVING THE WAY — Christina Chavez is Sandia's first full-time archaeologist. She established the Labs' cultural resources program within the Environment, Safety and Health group.

Photo by Bret Latter

overcomes a lot of the resistance to any kind of compliance that might delay a project. Her ability to explain what's going on, why it matters and what she finds fascinates people."

After she was hired in 2018, one of Christina's first big land surveys took place on Sandia's Robotics Vehicle Range, which spans more than 300 acres. After documenting what she found, she worked with Robotics Manager Jake Deuel, so he could better understand areas the team should avoid during field work.

"Christina and I came back and started talking," Jake said. "I hadn't fully appreciated the significance of what was on this site before us."

In the past, there had been frustration when the team was told to avoid certain areas, but they weren't told why or where they were. While Christina is firm that some sites and artifacts need to remain on a need-to-know basis, she also works hard to bridge understanding between her job and the work of Sandia engineers.

"I want organizations across the Labs to understand that it's doable. We can work together and come up with a really cool reputation together and enhance the reputation of Sandia," Christina said. "It's a huge responsibility, but I think it's quite flattering at the same time to be able to say we're doing our best. We're doing our due diligence to protect cultural resources and lands."

Jake worked with Christina to set up



EARLY 1900s — During a tour with a group of Sandia employees, archaeologist Christina Chavez shared that a site dates to the early 1900s due to purple glass found in the area. During the early 20th century, glass was tempered using the element Manganese which turns purple after many years of being exposed to the sun. This color of the glass reveals the estimated timeframe when the glass was produced and left in the area.

Photo by Bret Latter



PROJECT PREPARATION — Christina Chavez, third from right, works with teams throughout Sandia to consider effects on historic properties when carrying out or funding projects.

Photo by Bret Latter

a short field trip, and she was able to educate the robotics team about the archaeological sites in the area. They drove to remote areas, parked cars on dirt roads and walked to locations where Christina previously noted pottery, glass and other artifacts. Team members picked up pieces, enthusiastically showed them to each other, turned them between their fingers, admired the colors and shapes, then placed them back on the ground.

“I’m all for education and teaching people about all of these things,” Christina said. “You can pick up pieces of pottery and glass and look at them, but make sure you put them back because once these things get picked up and not returned, we lose that context of where they came from and what they’re associated with. Once you pick them up and take them out, they lose meaning in a lot of ways.”

As the team examined a rusty tobacco tin, pieces of a Mason jar and part of a teacup at a historic homestead Christina showed them, she explained that people probably lived there around 1920. When asked how she estimates time periods, she said certain items reveal time periods based on how they were made and changed.

“I associate time periods with artifacts,” she said. “For example, in the early 1900s, glass was tempered using a chemical reaction and over time as the glass sits in the sun, it turns purple. When we find purple glass, we can date the site to that time period.”

For prehistoric and archaic sites, pottery and arrowheads are diagnostic, Christina said, and Sandia has many sites from those time periods, too.

“The land we’re on — Sandia’s been here since 1945 but a whole lot of other people were here before that doing very different kinds of things,” Rebecca said. “Having an


understanding of the place that we’re in and its overall history is very important.”

‘I’ve never looked back’

Always interested in science, Christina started college wanting to be a doctor but changed paths after taking an introduction to anthropology course her freshman year at New Mexico State University. The following summer, she participated in an archaeological field school offered by the university and spent months camping with other students and instructors near the Mexican border where they excavated a 300-room pueblo.

“I fell in love with everything we did,” she said. “I was outside learning and excavating, and I’ve never looked back since.”

Christina completed a master’s degree immediately after completing an undergraduate program, then worked at Fort Bliss Military Installation in El Paso and later worked on White Sands Missile Range. Christina also worked as a consultant and contractor for several years prior to coming to Sandia. Her passion for history and archeology extends far beyond work, and if she had any advice for the public when they come across artifacts in the wild, her advice would be to leave those traces of history behind.

“Look at it, take pictures of it and then leave it,” she said. “Then we can better know our lands and their histories.” 

To learn more about Sandia’s New Mexico cultural resources, visit the [Coyote Canyon page](#) on the history website. Viewers can also learn more about historic Sandia buildings and test areas.

Women's History Month

Sandia joins effort to close gender gap in nuclear security

By Janeen Miller

In June, Sandia joined Gender Champions in Nuclear Policy, a leadership network of more than 70 U.S. and international organizations dedicated to breaking down gender barriers in the field of nuclear security.

"At Sandia, we believe that women's voices and diverse perspectives are critical to our continued work in global security," said Labs Director James Peery, who serves as the executive champion for the effort. "Through GCNP, Sandia has committed to a series of goals that will track ongoing diversity and inclusion efforts and help us build on our successes."

This year is the first year of Sandia's stated one- to three-year goals, which include:

- Encouraging gender balance in internal and external nuclear policy expert forums, including panels where James

is invited to participate.

- Supporting awareness of and participation in awards that recognize women for their technical and leadership excellence.
- Increasing participation in internal diversity and inclusion educational courses by 5% over the 2021 baseline.
- Fostering gender equity in hiring panels and applicant pools and continuing to use inclusive language in job postings and interview questions.

GCNP goals for 2023 and 2024 include adding peer discussion groups to share ideas and best practices, further increasing inclusive educational offerings and participation, and increasing representation of women in senior technical and management roles.

"Through GCNP, Sandia is engaging at a leadership level in the policy, behavioral and cultural changes needed to achieve effective gender balance in the nuclear

GCNP

GENDER CHAMPIONS IN NUCLEAR POLICY

GENDER EQUITY — Labs Director James Peery has joined a network that brings together leaders who work in nuclear policy and are committed to gender equity in their organizations. Research indicates that women's contributions to peace and security discussions add sustainability to nuclear policies and their impact, according to GCNP.

field," said David Sandison, director of global security and lead of the GCNP Sandia taskforce. "I want to personally encourage all Sandians to get involved in GCNP. A diverse and equitable workforce benefits us all."

For more information about GCNP or upcoming events, contact David or GCNP Sandia contacts Sondra Spence and Anelisa Simons. [f](#)

Sandia's GCNP commitments at a glance

Commitments:

- Conscious panel participation
- Education on inclusion and diversity
- Gender equity in HR processes

2022

Commitments:

- Conscious panel participation
- Education on inclusion and diversity
- Gender equity in HR processes
- Culture change strategies

2023

Commitments:

- Conscious panel participation
- Education on inclusion and diversity
- Gender equity in HR processes
- Culture change strategies
- Increase representation of women in management and senior leadership roles

2024

Sandia taskforce: James Peery, Sandia Labs director; David Sandison, director, R&D; Esther Hernandez, chief diversity officer; Sondra Spence, engineering program/project lead; Anelisa Simons, I&D specialist

Women's History Month

Atmospheric scientist uses statistical approaches to study climate impacts

By Sarah Jewel Johnson

Diana Bull, a researcher in Sandia's atmospheric sciences group, is not afraid to try new things. Her research has taken her from private industry pursuing ocean wave energy research, to research at the University of Pennsylvania, to exploring innovative ideas supporting climate security at Sandia. Though her applied research background is diverse, Diana has remained steadfast in her passion for climate.

She began her career at Sandia 10 years ago while working on ocean wave energy conversion research. Six years ago, she began focusing her research on changes in the Arctic and Arctic security, examining Arctic coastal erosion. "From there my work began to move to more of a strategic position working

"Climate change touches just about every single aspect of life, and so finding the aspect that is important to any person is possible."

—Diana Bull, Sandia atmospheric sciences researcher

in the Strategic Futures and Policy Analysis group. It was there that I started to think about the Arctic and climate change from a strategic position, endeavoring to really understand where impact could be made," Diana said.

In 2021, Diana, along with peers across the national laboratories, launched the CLDERA, or CLimate impact: Determining Etiology thRough pAthways, project to develop new statistical approaches to attribute climate impacts to and from their sources. The novel analytic tools will be demonstrated on simulations and observations of the 1991 eruption of Mt. Pinatubo in the Philippines — the 20th century's second-largest volcanic eruption — with the goal of elucidating the dominant connective relationships between that event and its climate impacts. These relationships will serve as crucial constraints helping to cull the possibilities in attribution. These tools could go on to inform new climate agreements, for instance, by tying climate impacts back to their causes and establishing the needed systems for detection and attribution of future impacts.

Diana received a bachelor's degree from Vassar College with a focus on physics, math and chemistry. She obtained a master's degree from Cornell University in physics.

Read Diana's interview to better understand how her work addresses climate security awareness, climate intervention and adaptations driven by the changing climate, as well as her approach to educating others about climate change.

Why are you passionate about climate change?

I've always loved nature, and I was a tree-hugger when I was a kid. One of my favorite shirts that I still have from when I was 12 is a "Save the Whales" T-shirt. I grew up camping. I grew up in the mountains. I have always been inspired by the diversity and complexity of nature's solutions to specific challenges, which has engendered a real passion to preserve it. Anthropogenically driven changes are too fast for natural adaptation and truly threaten flora and fauna.

What does "climate security" mean to you?

I adhere to a much broader definition of security; it's not just about borders and military force. For me security is about human security, it's about biodiversity security, it's about natural resource security. So, when I think about climate security, I think about all of the things that allow different aspects of nature to survive and to thrive.

What climate-related challenge are you most excited to work on?

The thing that I am most excited about in climate right now is trying to deepen the understanding of the connective relationships that result in changes to expected climate behavior. The climate is incredibly complex and nonlinear, and to understand how an outcome arises may be intractable, but it is exactly the task a team and I have taken on.

We recently launched a new project at Sandia called CLDERA, which is named after the Valles Caldera National Preserve here in New Mexico, the site where a volcano erupted more than 1 million years ago because the exemplar in the project is the 1991 eruption of Mount Pinatubo in the Philippines. Working with a cross-disciplinary team, we are focused on developing novel tools to elucidate connective relationships between the eruption and its impacts in both simulations and observational data. We believe identifying and representing these relationships will enable scientific attribution of a variety of impacts to the eruption. This new set of methods and tools offers a framework that can be translated to other exemplars like wildfires, the disappearance of Arctic sea ice or changes to the currents in the Atlantic Ocean, like Atlantic Meridional Overturning Circulation.

Another extension of these tools is to use them to understand climate interventions, like stratospheric aerosol injections, specifically designed to cool the planet. As identified in a recent National Academies of Sciences, Engineering and



FOCUS ON CLIMATE — Diana Bull examines a coastal permafrost bluff along the North Slope of Alaska.

Photo by Jennifer Frederick

Medicine report, an outstanding and critical research topic to be addressed for governance and equity around climate intervention techniques is the attribution of specific climate outcomes back to the stratospheric aerosol injection event.

What does the nation or world look like in the future if we are successful in addressing climate change?

Climate change will cause a myriad of impacts that will require technical innovations to address, and so there are rich opportunities in front of us, as bizarre as that may seem. The need to understand and proactively or retroactively adapt to these impacts also opens the landscape into thinking about equity and justice in ways that perhaps we previously wouldn't have thought about. So, by addressing climate change there is a real opportunity to ensure that diverse communities are incorporated in meaningful ways and see technical innovation in areas where it previously wasn't seen. In an ideal world, we could envision a bright and inclusive future.

However, on the darker side, climate change is going to result in a lot of loss and that's going to be very difficult to deal with. As areas become uninhabitable, with the coupled loss of people's heritage and biodiversity, we will be faced with mass migration and strained resources. We should expect societies to be under significant strain, and this will temper any visions of an ideal future.


If you were trying to recruit somebody to work on the problem of climate change at Sandia, what would you say to them?

Sandia is one of the few places that has depth of capability

and breadth of expertise that allows you to draw upon needed areas and then specialize it to things and problems that exist in climate change. When you think about modeling and simulation, high-reliability engineering, detection and attribution, and risk analysis, you see expertise at Sandia that can be reoriented to address problems in climate. Sandia has also been able to work with policymakers to develop scientific solutions and risk analyses that ensure delivered products have well-quantified operational envelopes and controls to account for uncertainties. It is one of the few places that runs the gamut from deep expertise to policy integration in really large-scale programs.

I have also found passion and excitement around the climate crisis at Sandia. The people I work with are inspiring for many reasons, and I learn so much through transdisciplinary pursuits here. If I continue to ask questions, I will never become bored and there will always be someone here — often in an unexpected group — to work toward answers with.

How can we educate and involve more people in addressing the climate crisis?

I think you have to engage people where their passion lies. Climate change touches just about every single aspect of life, and so finding the aspect that is important to any person is possible. Their interest is the open door to talk about the changing climate and widening the aperture to aspects they may not know about. Unfortunately, climate and climate change have become politicized issues, and that's partly because it can touch every aspect of people's lives. So, in educating people, I think the best thing you can do is make sure you have sound facts, make sure you have a narrative that will appeal to them but also accept that it may not always work. 

Women's History Month

Inspiring local interest in STEM



STEM LOVE — The Society of Women Engineers hosted a Women Engineers Local Expo in Albuquerque last month. SWE invited women from all stages of their collegiate and professional journeys and connected them through professional development, guest speakers and networking. Sandia postdoctoral appointee Qi Quo participates in the expo with a hands-on activity to teach young women about the science of hydrogen powered cars.

Photo by Debra Menke



HANDS-ON FUN — Community Relations specialist Debra Menke taught a participant about ultraviolet light by making a bracelet of ultraviolet beads that change color when exposed to light.

Photo by Jennifer Dugan

Celebrate with SWAN

The Sandia Women's Action Network and Sandia Women's Connection are hosting events all month in celebration of Women's History Month. The theme this year is "Providing healing, promoting hope." All events will be virtual, and all staff are invited to attend. Links to register or view the presentations are available on SWAN's Women's History Month page.

MAR
16

SWAN Leadership Panel

The SWAN Leadership Panel will emphasize the spirit of lead-from-where-you-are.

Join Laura Biederman, Chris LaFleur, Elizabeth Roll and Associate Labs Director Nancy Davis to hear a variety of perspectives on "Providing healing, promoting hope."

Wednesday, March 16, 1 p.m. MDT

MAR
24

50 ways to fight bias

Discussions will be facilitated using the "Lean In" card decks from leanin.org.

Thursday, March 24, 3 p.m. MDT

MAR
29

Thriving in stressful environments: Breaking the cycle of burnout

Diversity Cinema

Join us for SWAN's capstone event in celebration of our monthly theme. Our Inclusion, Diversity, EEO and AA team; SWAN; and Employee Health Services will come together to provide an exceptional panel discussion and TED-style talk on resources and perspective of the book "Burnout" by Emily and Amelia Nagoski.

The book aims to address one of the most relatable experiences when in prolonged stressful situations: emotional exhaustion associated with burnout. Employee Health Services will discuss content from the Thrive Health Action Plan, designed to teach individuals how to cope with stress while still doing meaningful work. SWAN will provide a free book upon request.

Tuesday, March 29, 1 p.m. MDT

MAR
31

Women in research: Mentoring talk

The Women in Research series seeks to encourage the professional development of women on the technical ladder. The event will include mentoring talks from successful women researchers with time for Q&A and open discussion. SWAN supports the careers of women in research as they seek advancement, and this session is open to all staff interested in technical advancement. Senior scientist Michelle Griffith will discuss her career path and share success stories.

Thursday, March 31, 11 a.m. MDT

Pandemic partners

Sandia pets offer comfort and companionship amidst challenge

By **Andrea Sanny**

The last two years have been challenging both in our personal and work lives. One bright light for many has been the welcoming love and companionship of furry friends who are happy to become the most popular coworkers in the office and champion keyboard stompers. No matter how big or small, each Sandian pet has filled our homes with antics and affection, giving us something to look forward to throughout the day.

Whether alone and isolated or taking care of a family, many Sandians have found comfort and support in their furry friends who brighten up the day. These pets have become constant companions and new family members to staff in need. 🐾



NELLIE — Nellie is a large Labrador retriever-shepherd mix. She is about two years old and was adopted from Argos Shelter Dog Rescue in October 2020. She was originally a foster dog for Katie and her husband, but they consider themselves “foster-failures” because they fell in love with her immediately and opted for adoption. She is big and loving, and she gives nibbles on a person’s neck when hugged. Nellie enjoys watching TV, such as Olympic badminton with Katie’s husband.

Photo courtesy of Katie Snapp



ZUKO — Zuko, a.k.a. Baby Firelord, was born July 4, 2020, and was brought to his “forever” home in late September that year. After a rough start that included upper respiratory issues and a nasty case of ringworm, which resulted in a 1980s Gremlin appearance, Zuko has grown into a big, beautiful, fluffy monster. His hobbies include following his mom everywhere, biting toes and bothering his brother Leeroy.

Photo courtesy of Miranda Mundt



LADY LEXI — Lady Lexi Axl Rose Marshall is a three-year-old retired breeding Frenchie. Tiffany has spent a lot of time retraining her to be a “pet” and not a “tool to make money.” Lady Lexi loves to run in the backyard and play with other animals. She is a “momma bear” and is very protective of her people. Tiffany rescued her in May 2021 but in reality, she was a pet Tiffany didn’t even know how much she needed. As of July 2021, she is a certified emotional support animal.

Photo courtesy of Tiffany Marshall

KEEP UP WITH THE LABS

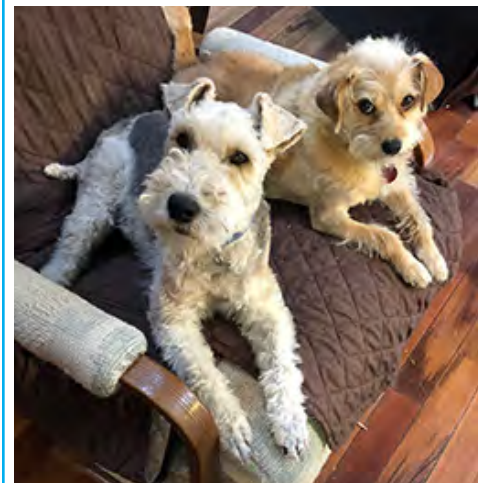
anytime, anywhere

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to get Lab News in your Inbox every two weeks

— 🐾 —

sandia.gov/LabNews



BOLT AND PEANUT — Bolt, left, a wirehair fox terrier, and Peanut, a cairn terrier mix with the attitude of a queen, have been an extra source of companionship during the pandemic as Elizabeth has continued to work on-site throughout the pandemic. Early on, her building was like a ghost town, which meant she worked in isolation all day, but she drew comfort from knowing that when she got home, her pups would be jumping for joy, ready to get out and hike.

Photo courtesy of Elizabeth Huffman



DOTTIE AND PENNY — Dottie and Penny were Lisa's beautiful fur babies until November 2021 when they both passed away the same weekend due to different forms of cancer. Dottie was a 17.5 years old, goofy, high-energy, high-jumping Dalmatian-pointer mix, and Penny was a sweet, loving, long-legged, 8-year-old dachshund mix. Despite such a huge age gap, difference in energy and personality, they quickly bonded and became "sisters." Lisa believed that when Penny went over the rainbow bridge, Dottie missed her too much and decided to leave to join her sister only three days later. They were such special creatures, and they will be in her and her family's hearts forever.

Photo Courtesy of Lisa Dong



BETTY — Danielle's father passed away last September, which left his beloved Betty in need of a new home. She meant so much to him, and Danielle was so glad to give her the absolute best home possible. Here, Betty is enjoying the scenery at Big Sur in the summer 2021. Her favorite pastimes include sleeping, begging for pets and watching "The Office."

Photo courtesy of Danielle Martin

PIPER — Piper came to the Shoemaker family in April 2020 at just over two years old. She is special for many reasons, one of which is that she is deaf. Especially in her early days in their home, she exhibited unbounded levels of energy and, at first, they didn't have a name for her. In introducing the dog to their neighbor, Paul explained that she was deaf and that they were considering naming her "hyper" because of her energy level. Paul's wife corrected him saying, "No, we're probably going to call her 'Piper.'" The neighbor laughed and responded, "Apparently the dog isn't the only one in the family who's hard of hearing!" For the Shoemaker family, Piper is love on four legs.

Photo courtesy of Paul Shoemaker



SYDNEY — Sydney was adopted on Halloween 2020. The first part of her life was in a backyard breeder and hoarder situation of 20 dogs in Bernalillo County. Animal rescue confiscated the dogs, but it took almost a year to get the owner to surrender the dogs through the courts. Sydney spent the year at the shelter. She never really knew what being a part of a family was all about, but as you can see here, she is learning fast.

Photo courtesy of David Ostgulen

PEPPER — Emmeline's family adopted their pandemic pet, Pepper, from a chinchilla rescue in August 2020. They had never had a furry pet before and their only experiences with chinchillas were from visiting the Sulphur Creek Nature Center in Hayward, California. During a visit in December 2019, both of Emmeline's daughters were entranced as they watched the chinchilla popcorn around the room and take a whirlwind dust bath. Eight months later, the girls were thrilled when they visited the rescue and brought Pepper home. Pepper lives in a large, double-level cage in the Chens' breakfast nook and kept Emmeline's older daughter company during her year of remote high school from the kitchen table. Emmeline credits Pepper for lifting the girls' spirits up during the pandemic and is thankful that they finally took the plunge to adopt a pet.

Photo courtesy of Emmeline Chen

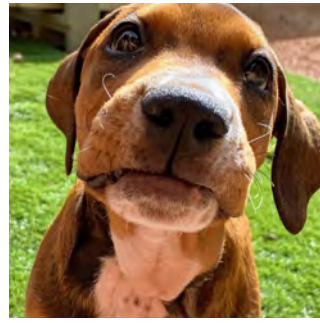


KATIE — Katie is a 3-year-old English cream golden retriever and certified service dog from Honor Service Dogs in North Carolina. She joined her new family in September 2020 and enjoys the beach. She is now an Orange County dog who is loved by everyone.

Photo courtesy of Thomas Clark

PANCAKE — Aundre and his fiancée recently adopted the latest addition to their family, Pancake, a baby Morkie poo, who is currently three months old and weighs three pounds. Pancake's spirit animal is half squirrel, half teddy bear. She has a fascination with strings and socks. Pancake sleeps for about 20 hours out of the day, but the few hours that she is awake are eventful — often running laps around the house and loving to play tug of war with everyone she meets. Pancake is also extremely friendly and has never barked at a stranger.

Photo courtesy of Aundre Huynh



GUS — Gus is half Doberman pinscher and half English bulldog. He is a quarantine pup who now looks like an 85-pound bratwurst on four sticks. He's got a loving disposition, lives for treats and can't get enough snuggles. He's also very "talkative" and likes to wish everyone on Teams' meetings "good morning."

Photo courtesy of Ashley Fate



MILLIE — By the end of March 2020, both of Monica's kids were asking for a puppy so their other dog could "have a friend." It took them over six weeks to find an available puppy at that time, but Millie was found on the streets of Clovis and taken in by Lap Dog Rescue. They

adopted her in May 2020, and every day since has been awesome because of her. She's snuggly, playful, happy and sociable, and she truly has helped all of Monica's family get through this tough time with her little Chiweenie face equating to pure joy.

Photo courtesy of Monica Bigney



JONI — Meet Joni, a.k.a. Joni Mitchell Snoozle Doozle Dog. Joni was adopted from Española Humane in March 2020 and brought her fluffy ears and floofy tail to Albuquerque, where she has settled into a life of long walks, camping, being carried in a backpack when her paws get tired, and snoozing on the couch, bed or really any moderately plush surface. She's made lots of human and animal friends along the way and been a ray of light during tough years of remote work and limited social interactions.

Photo courtesy of Michelle Pang



2022 CHILDREN'S BOOK DRIVE

MARCH 7-26

Donate New or Gently Used

English, Spanish or Bilingual Children's Books

★ **Collection Boxes**
at all Central New Mexico SLFCU branches

★ **Contact-Free Drive-up**
on Saturday, March 26th, 9am-1pm
at SLFCU Cottonwood, Juan Tabo and Paseo branches

★ **Donate Online**
at www.aps.edu/education-foundation/giving Note "Sandia Labs Read to Me" in additional info

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P.O. Box 25704, Albuquerque, NM 87125
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Memo: "Sandia Labs Read to Me"

Contact: rjriver@sandia.gov



