the RESEARCHER

IDAHO NSF EPSCoR

Summer 2025

Dr. Nancy Johnston's summer research group at Lewis-Clark State College included students from both the Idaho Established Programs to Stimulate Competitive Research (EPSCoR) program funded by National Science Foundation (NSF), and the Idaho IDeA Network of Biomedical Research Excellence (INBRE) program funded by National Institutes of Health (NIH). EPSCoR and INBRE programs are strong collaborators and work to build research capacity in states that historically receive less federal funding. Each also supports research experiences for undergraduate students. From left to right, Gautam Balakrishnan (EPSCoR), Rayana Shah (INBRE), Sarah McLennan (INBRE), Nancy Johnston (LCSC Faculty), Kaitlynn Butler (EPSCoR), and Erica Stryker (EPSCoR).

Photo credit: Jerome Pollos

Read more about LCSC SARE on page 4

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the RESEARCHER

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LETTER FROM THE DIRECTOR

Andy Kliskey

Welcome to our Summer 2025 edition of the Idaho EPSCoR Newsletter. I am excited to share with you a full issue that is dedicated to the Idaho Community-engaged Resilience for Energy-Water Systems (I-CREWS) Track-1 project's first offering of the Summer Authentic Research Experiences (SARE) program. The SARE program is central to the Workforce Development and Education plan for I-CREWS and is designed to engage Idaho undergraduates in the science, technology, engineering, and mathematics (STEM) fields related to I-CREWS research. Through these myriad undergraduate research and training experiences we hope to increase the number and preparation of skilled scientists and engineers in fields including: geosciences, biological sciences, social sciences, resilience science, computational modeling, machine learning and artificial intelligence.

This summer we have been able to support 27 undergraduate students across Idaho's universities, colleges, and Tribal Nations engaged in research projects with 15 faculty and researchers. The stories that follow represent a selection of the 2025 SARE projects and students along with their mentors. Congratulations to all of the SARE students and mentors for their work this summer.

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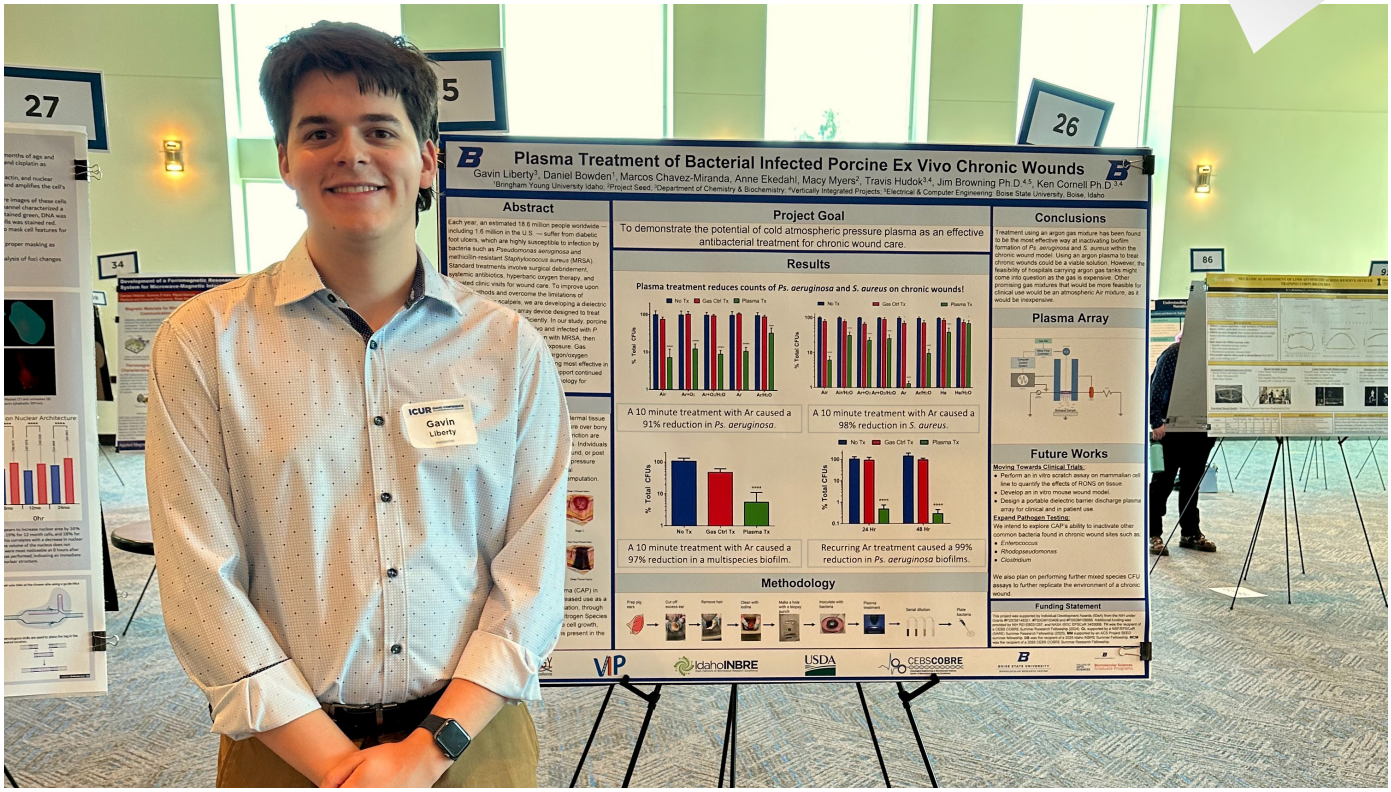
Unless otherwise noted in feature byline, articles and features in this publication are written by Sarah Penney-Jackson with editing and content contributions by EPSCoR administrative team.

I-CREWS Research

Student Researchers Share Expertise at the 2025 Idaho Conference on Undergraduate Research (ICUR)



Gavin Liberty, a SARE undergraduate student from Boise State University, presented a research poster at the Idaho Conference on Undergraduate Research (ICUR).

The Idaho Conference on Undergraduate Research (ICUR) was recently held on July 16-17 at Boise State University (BSU). Idaho EPSCoR Summer Authentic Research Experience (SARE) students were in attendance and participated in the poster presentation, giving a broad representation of I-CREWS research taking place around the state.

Nearly 600 students, staff, and faculty were in attendance representing over thirty institutions and organizations in Idaho and around the country. Approximately 218 students participated in the poster presentations featuring undergraduate research in all disciplines.

The networking event provided SARE students with a forum to discuss cutting edge resource topics, attend keynotes and lightning talks, and learn about graduate student resources.

In addition to ICUR, SARE students also participated in BSU's Summer Research Community (SRC), a five- to seven-week summer program for all undergraduate researchers affiliated with an Idaho college, university or sponsored program. These opportunities, along with other EPSCoR-related networking events, are all part of the SARE student experience.

To learn more about the students that participated in this summer's SARE program, visit Idaho EPSCoR's research page. Students participating in summer research are featured on the Student Regional Map: **www.idahoepscor.org/student-research-map.**

I-CREWS Education

Monitoring Air Toxics in Wildfire Smoke

Nancy Johnston, SARE Faculty Mentor, Lewis Clark State College

Because energy-water systems are under stress in Idaho due to warmer climates and drought in the summers, an increase in wildfires may result. Wildfire smoke can put communities at risk to air toxics and particulate matter. To address this, a research team at Lewis Clark State College (LCSC) worked to measure air toxic exposures and risk to communities from wildfire smoke in various cities in Idaho.

The team, led by Nancy Johnston, professor in chemistry at LCSC, measured the composition of wildfire smoke in various cities in Idaho, including Coeur d'Alene, Boise, New Meadows, Moscow, Julietta, Clayton and Lewiston. While most locations experienced only background levels of air pollutants during the early part of the season, Boise and Coeur d'Alene saw some wildfire smoke. The team's samplers are designed to detect air toxics when smoke from nearby fires is present. Samples were collected throughout the summer and analyzed at LCSC's AIR lab, using thermal desorption-gas chromatography-mass spectrometry. Sites were compared over time with focus on key air pollutants or smoke indicators, such as particulate matter, benzene, furfural, and other hydrocarbons.

This information will help us assess risk to communities of air toxics from smoke. The team will also test correlation of wildfire smoke areas to drought and water shortages. This information will help communities plan and become resilient during these times of environmental change, aligning with I-CREWS mission for Community-engaged Resilience for Energy-Water Systems.

Kaitlynn Butler, an undergraduate in biology at Lewis-Clark State, prepares a calibration standard for air toxics analysis in Dr. Johnston's lab. Photo credit: Jerome Pollos

The team also consisted of five undergrad students including three Summer Authentic Research Experience (SARE) students. They included Kaitlynn Bulter, biology major from Coeur d'Alene, Idaho, Gautam Balakrishnan, exercise science major from Penang, Malaysia, and Erica Stryker, bioinformatics major from Eagle River, Alaska. Two additional students, funded by Idaho's IDeA Network of Biomedical Research Excellence (INBRE) program, included Rayana Shah, biology major from Kathmandu, Nepal and Sarah McLennan, secondary earth science education major from Lewiston, Idaho.

In addition to the SARE project, Dr. Johnston has developed a Vertically Integrated Program (VIP), titled "Environmental Monitoring in Communities", to be launched this fall at LCSC. The VIP will train undergraduate students in the field of environmental chemistry and is part of the larger I-CREWS education and workforce development efforts.

Toward AI Water Sustainability: Indigenous Knowledge, LiDAR, and Art

Luis Benevidas, SARE Faculty Mentor, Idaho State University

How much of an impact does artificial intelligence (AI) infrastructure have on sustainable water management strategies? This was a question that Luis Benevidas and team set out to discover. Benevidas, an assistant professor of digital media at Idaho State University (ISU), led a summer SARE team that took a look at water and energy system resilience in Idaho, focusing on the Snake River Basin in southeastern Idaho, and the people who live there.

With the development of AI Data centers in the northwest and the vast amount of water it takes to operate them, identifying new methods to minimize water usage is imperative in order to create a sustainable future for local communities.

The team, which included three undergraduate SARE students from ISU comprising Andrea Uses Arrow, art major, Jonathon Van Der Horn, digital art major, and Ashlyn Auman, art major, focused on learning about local, Indigenous knowledge to model possible water futures. The team also examined rapid advancements in AI and AI water consumption.

Summer Authentic Research Experience (SARE) students, Jonathon Van Der Horn, Ashlyn Auman, and Andrea Uses Arrow present their research during the Idaho Conference for Undergraduate Research (ICUR) poster session in Boise, Idaho.

The team focused on two research questions to help guide their investigation. 1) What role could adopting Indigenous knowledge and governance dynamics of water systems, especially considering water protection, play in determining resilience strategies or options to climate-driven technological changes with new technologies such as AI? And, 2) How could incorporating diverse ways of knowing by means of artistic interpretation with 3D modeling software and AI create viable pathways for more equitable and resilient futures for our water systems?

The team did a literature review to learn about energy-water systems in the Snake River, learned about Shoshone-Bannock historic water management systems, and explored Shoshone-Bannock cultural and legal history of water preservation.

Using free and open-source 3-D modeling software, students applied the findings to create 3D models through an Art-based research method, using artistic processes to generate, analyze, and interpret data. Students also investigated generative artificial intelligence for 3D modeling software to illustrate scientific concepts and suggested new models, based on local, indigenous knowledge about waterways to imagine and model sustainable futures for all Idahoans.

The team hopes to bring awareness of AI's impact on water consumption and investigate avenues of AI environmental sustainability for all Idahoans.

Exploring Language, Meaning, and Perspective concerning Energy-Water Systems

Liz Redd, SARE faculty mentor, Idaho State University

Language is not merely a system of communication, but encodes how we perceive the world and shapes how we share our ideas about the world.

To examine this concept further, an Idaho State University (ISU) team, led by Liz Redd, assistant professor of anthropology, took a look at how language is used across the I-CREWS award activities to frame collaborations, community engagements, and perspectives concerning energy and water connections and human relationships to the environment.

The team also included two ISU SARE students, Jason Johnson, a junior majoring in global studies, and Houston Vanyel, a sophomore majoring in anthropology and philosophy.

The team used AI tools to apply discourse analysis and other linguistic methods to analyze data, including written and verbal texts. The team also analyzed print documents, and learned about discourse analysis methods. Students also learned about coding and data management tools, including AI tools and software.

I-CREWS Education

The project worked to address two main research questions. The first focused on how language concerning water-energy systems and community engagement is used across I-CREWS teams. The second research question focused on whether large language models (LLMs) can perform advanced critical discourse analysis. The purpose of these questions is to support long-term grant success through deeper understanding of the role of language in communication within I-CREWS and with partner communities.

While designing the project, the team consulted with Dr. Leslie Kirby, of I-CREWS, to learn more about how her team used large language models (LLMs) to analyze open-ended survey questions and integrate this type of data into their research. The team also collaborated early on with another SARE project led by Luis Benevides of the Art program at ISU to learn about how their SARE team was utilizing AI in art and science expression.

ISU SARE students, Jason Johnson and Houston Vanyel, at the Idaho Conference for Undergraduate Research (ICUR) poster session in Boise, Idaho.

With this in mind, the team chose to use ChatGPT as their model for further exploration of their research questions. ChatGPT, an artificial intelligence chatbot that performs a wide range of functions, appeared to give results that generally aligned with the team's by-hand analysis, however, Chat GPT was unable to substantiate the theory and data used to perform the analysis.

This finding has implications for researchers, who should be skeptical in assessing LLM analysis results and fact check every assertion it makes, theme it identifies, and data it cites. The finding also has implications for students who are using these LLMs to summarize sets of readings: you can't trust the results.

In addition to learning about how language is used across the I-CREWS project, students were able to delve into how a research project is conducted. Johnson stated, "I learned a lot about the research process. I learned that research is a very time-consuming process. It involves a great deal of diligence and is never quite complete. I learned about critical discourse analysis — the analysis of power dynamics is essential; it isn't simply a media criticism." Vanyel also noted, "My experience in conducting actual research will transfer well into my upper-division classes. I will have a grounding in how to do independent research. I think it is also important that I gained confidence in my results."

The team hopes that their work will help the I-CREWS members use these techniques to better understand the language used across the project in order to support improved communication, community-partnership building, and overall grant success.

Application of GPS and Photogrammetric Methods for Stream Flow Monitoring

Jeff Cooper, SARE Faculty Mentor, College of Southern Idaho

Water is a major resource in the State of Idaho and plays a major role in its economy. Being able to have abundant, accurate data on water flow is critical to decision making when it comes to this resource.

A research team from College of Southern Idaho (CSI), led by Jeff Cooper, professor in Natural Resource Management, came together with the goal of improving existing methods for measuring flow rate in open

channel systems. Efforts were focused in the Rock Creek and Salmon Falls Creek Drainages tributary to the Snake River Basin.

According to Cooper, water managers in the arid and semi-arid west have relied on tried-and-true methods for measuring water flow to create water budgets and determine allocations. Many of these methods are time consuming while others require alterations to the channel.

Cooper's team examined other methods of monitoring stream flow that could prove to be more efficient. In addition to using drones, also known as small Unmanned Aircraft Systems (sUAS), to collect data, the team also utilized other methods to lay groundwork for more rapid flow rate determination. One method was photogrammetry, which includes making measurements of real-world objects and terrain features from images. Another method was Real-Time Kinematic (RTK) GPS, a technique that enhances the accuracy of standard GPS positioning by providing corrections in real-time.

Three CSI undergraduate students were also part of the research team and each brought their own expertise to the project. Abigail Cluff, a Geology and Geospatial Technology major, had previously participated in SARE and came to the project with remote sensing experience. Caleb Burke, Health and Human Sciences major, was new to undergraduate research and quickly assumed a leadership role within the project. Finally, Brigham Kimball, Natural Resource Management major, brought his love of the outdoors and geospatial expertise to the team. The students participated in field data collection, data processing, and protocol development.

Preliminary results indicated that utilizing sUAS (drones) in a controlled section of a stream can help to determine flow rate in that section within a certain degree of confidence. The team's research method techniques could also potentially help water managers rapidly monitor flow rates at a low labor and equipment cost. With an increased ability to more quickly determine flow rates, more data can be utilized in critical decision making.

The method, with further refinement, could be used to ensure the long-term sustainability of water, not only in Idaho but in many other states.

CSI SARE Research team members (Abigail Cluff, Caleb Burke, and Brigham Kimball) taking flow measurements. Photo credit: Jeff Cooper

Brigham Kimball collecting drone data

Abigail Cluff extracting data from the drone imagery to be compared against measured data.

Photo credit: Jeff Cooper

Energization Game brings Competitive Environment to Resource Planning Education

Terence Soule, SARE Faculty Mentor, University of Idaho

A team at University of Idaho (U of I), led by Terence Soule, professor in the Computer Science Department, recently developed a multiplayer, educational resource management video game focused on utility systems. The game was designed to promote Energy-Water systems literacy and informed decision making.

The project goals include integrating the game into U of I courses such as, 'Energy in the Modern World,' which will support a new Energy Literacy Undergraduate Academic Certificate presently under development. The team also hopes to adapt the game for use in secondary education to support STEM learning across Idaho and also make the game accessible to the general public and policymakers to promote energy literacy and informed decision-making.

Additional members of the research team consisted of SARE undergraduate students, Carson Gustavel and Daniel Stevenson, both seniors at U of I. Gustavel, the programmer for the project, is from Boise, Idaho, and is passionate about the creation of video games and other educational software. In addition to majoring in computer science, Gustavel is minoring in creative writing and history, bringing extra depth to the project.

Stevenson, the main visual designer for the project, took on the responsibility for the game's user interface design system, user experience, and other artistic assets. Originally from Libby, Montana, Stevenson came to U of I to pursue a BFA in Studio Art and Design with an emphasis in Experiential Design. He is passionate about creating unforgettable user experiences and unique designs for a myriad of digital tools and users.

In the game, players take on the roles of regional electric utility managers and make decisions about resource development, sustainability, infrastructure investment, system interconnection, and policy trade-offs. The game world is modeled after the western United States, reflecting its diverse geography, energy intensity, water resources, and urban-rural dynamics.

The team also collaborated closely with John Kumm, Executive Director of the College of Engineering Energy Institute, to ensure the game accurately reflects the technical and policy challenges faced by energy utilities in Idaho and similar regions.

By simulating the complexity of energy and water systems, the game helps players understand the interconnectedness of infrastructure, policy, economic, and environmental constraints. This understanding leads to more informed public discourse and better resource management across the state and region. This project represents a novel and engaging way to bridge the gap between technical knowledge and public understanding — empowering students, educators, and citizens to think critically about the future of energy.

University of Idaho SARE Students, Carson Gustavel and Daniel Stevenson, working on the Energization game, a game designed to increase energy literacy across the region. Photo credit: Terence Soule

Helping Idaho Communities Live More Safely and Sustainably Alongside Their Rivers

Angel Monsalve, SARE Faculty Mentor, University of Idaho

A Summer Authentic Research Experience (SARE) team at University of Idaho (U of I) recently did a study to determine how riverbed forces actually behave across different geomorphological settings. The U of I team, led by Angel Monsalve, assistant professor in the Department of Civil & Environmental Engineering, and Ranjit Mainali, SARE student and civil engineering major, worked to challenge a fundamental assumption in river engineering: that bed-shear stress, or the force exerted by water flowing over a riverbed, can be adequately represented by a single average value across an entire river reach. In reality, the forces acting on riverbeds vary dramatically in both space and time, creating critical knowledge gaps in design that can lead to infrastructure failures and costly emergency repairs.

Understanding the variability of forces in riverbeds requires local measurements of flow and bed properties, which are then complemented and expanded using numerical simulations. Identifying a method of measuring riverbed forces that uses local data, combined with state-of-the-art technology, could have a big impact on Idaho communities.

For Idaho's agricultural communities along rivers like the Kootenai, this research could potentially help farmers and ranchers protect valuable farmland from erosion while identifying areas where rivers naturally rebuild themselves. A greater understanding of these patterns could also support habitat restoration efforts, helping maintain healthy fish populations that are vital to Idaho's outdoor recreation economy.

The team used the Kootenai River in Idaho as a study site. Using advanced computational modeling methods combined with existing digital elevation models of the riverbed, the team worked to quantify the true spatial variability of bed-shear stress within this complex, gravel-bedded river system. They also tested how far the classical reach-average formula departs from reality and identified specific conditions where it fails.

The finding demonstrates that current reach-average approaches significantly underestimate the complexity of real river systems, with direct implications for infrastructure design and protection strategies.

Ranjit Mainali, SARE student and Civil Engineering major at University of Idaho, collects sediment samples to characterize the bed grain size distribution and identify which particles are likely to be mobile under current flow conditions. Photo credit: Angel Monsalve Supulveda

To address this, the team is producing practical tools such as detailed maps, simple curvature metrics, and reusable workflows, that engineers and agencies can immediately apply to identify scour "hot spots" before designing piers or bank protection. This tool provides a cost-effective preliminary assessment method that can guide where detailed analysis is most needed, optimizing both time and resources in project planning phases.

The team's vision extends beyond the Kootenai River as their goal is to formalize these findings and apply the same analytical approach to other Idaho river systems, building a comprehensive understanding of how riverbed forces actually behave across different geomorphological settings.

This research directly benefits Idaho communities by making infrastructure protection smarter and more

Helping Idaho Communities cont.

cost-effective. Instead of using outdated techniques to identify where rivers might cause problems, our work shows in a more reliable manner where the water hits hardest and where it flows gently.

The broader impact extends to emergency preparedness: by predicting where flood damage is most likely, communities can plan better responses and avoid costly emergency repairs. This research also trains the next generation of Idaho engineers with cutting-edge skills, keeping talent in-state and building local expertise to tackle future water infrastructure challenges.

Ultimately, this work helps Idaho communities live more safely and sustainably alongside their rivers, protecting both human infrastructure and natural ecosystems while making the most of limited public resources.

SARE Student Profiles

Morgan McCully

Building Big Meadow: An Environmental History of an Experimental Forest

Morgan McCully, a junior majoring in archaeology and history at the University of Idaho (U of I), served as a SARE student this summer, under the mentorship of Alyssa Kreikemeier, assistant professor in the Department of History at U of I, on a project designed to help environmental scholars to better understand the role of governance in water resource management.

McCully was born and raised in Troy, ID, where their family continues to ranch. After being awarded a summer SARE research award, McCully set out to understand how the Civilian Conservation Corps (CCC) camp at Big Meadow — which built the reservoir providing water to the town of Troy, ID — affected the community and landscape of the town. The Big Meadow camp created the dam that provided a water supply to Troy, but McCully discovered it did much more than that.

McCully engaged with archaeologists, historians, community members, and interviewed a fisheries biologist at Idaho's Department of Fish and Game. After locating the original site and identifying opportunities for archaeological survey research in the future, they photographed the location of the CCC camp.

McCully's major takeaways include identifying and mapping the site and retrieving the social history of Troy in the 1930s through extensive archival research. Contextualizing the environmental history among changing social, political, and environmental conditions from the 1930s through the time of the site's acquisition by the U of I will shed light on one rural community's perceptions of changing natural resources--specifically water--over time and help environmental scholars to better understand the role of governance in water resource management.

Morgan McCully

Aerial photograph of Big Meadow Civilian Conservation Corps (CCC) camp

Kent Merrill

The Role of Persistent Springs in Ensuring Reliable Water Flows During Dry Summers and Droughts

SARE student, Kent Merrill, an Earth and Environmental Science major at Idaho State University (ISU), was part of a research team that focused on something that fish and hikers both care about: reliable cold water in streams. Reliable cold water is usually thought to come from springs that flow year-round, otherwise known as perennial springs. Although some Idahoans might think first about hot springs as a place to relax and warm up in winter, cold perennial springs are more common across Idaho and are critical for maintaining healthy streams.

Mountain springs create a refugia for organisms throughout Southern Idaho's semi-arid climate and its dry summers. By understanding water sources, we can better predict areas that will contain a larger amount of biodiversity in both plants and animals. We can also predict how springs will be affected by the ever-changing climate.

The research team was led by Sarah Godsey, associate professor in the Department of Geosciences at Idaho State University. The team also hosted two short-term visitors from Japan, Kenta Iwasaki and Shodai "Sho" Iwagami, who are also studying springs across Japan. ISU Geosciences Masters' student, Anna Sniadach, helped host our guests. Together we were curious whether a new method they developed in Japan to find springs throughout a stream network could be applied in the US. During a short visit, our collaborative team identified more than 20 springs that had never been mapped, hiked through a recent burn scar near Pocatello, and visited Hooper Springs and Formation Springs Cave near Soda Springs, Idaho.

The team's findings indicated that some cold perennial springs are more sensitive to changes in air temperature than previously thought. Even though the team tried to predict which springs had the most stable temperatures, they determined that those predictions are currently very difficult. With the help of further testing, it might be that spring temperatures can help tell us how old the water is because we hypothesize that older water might have more stable temperatures.

This research allows for a better understanding of mountain springs, the ecosystem they provide for, and the variability in water quality throughout the year.

A research team studying cold water streams in Idaho, included two short-term visitors from Japan, who are doing similar research across Japan. From L-R: Shodai "Sho" Iwagami and Kenta Iwasaki (visiting students), Anna Sniadach (ISU graduate student), and Kent Merrill (ISU SARE student), conduct field work at Gibson Jack watershed near Pocatello, Idaho. Credit: S. Godsey

Kent Merrill

"I look forward to continuing my learning to become a multifaceted expert in many of the layers of what constitutes our natural environment. I have an affection for water quality and how the organic and inorganic processes contribute to the health of water which ultimately impacts the ecosystem it provides for. By studying mountain springs, I am able to study both the water quality and its effects on the ecosystem."

— Kent Merrill

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(L-R) Summer Authentic Research Experience (SARE) undergraduate students, Carson Gustavel, computer science major, and Daniel Stevenson, studio art & design major, working on the Energization game, a game designed to increase energy literacy across the region. Photo credit: Terence Soule

Gautam Balakrishnan, a Summer Authentic Research Experience (SARE) undergraduate student in exercise science at Lewis-Clark State, prepares a sample for analysis in Dr. Nancy Johnston's lab. Photo credit: Jerome Pollos