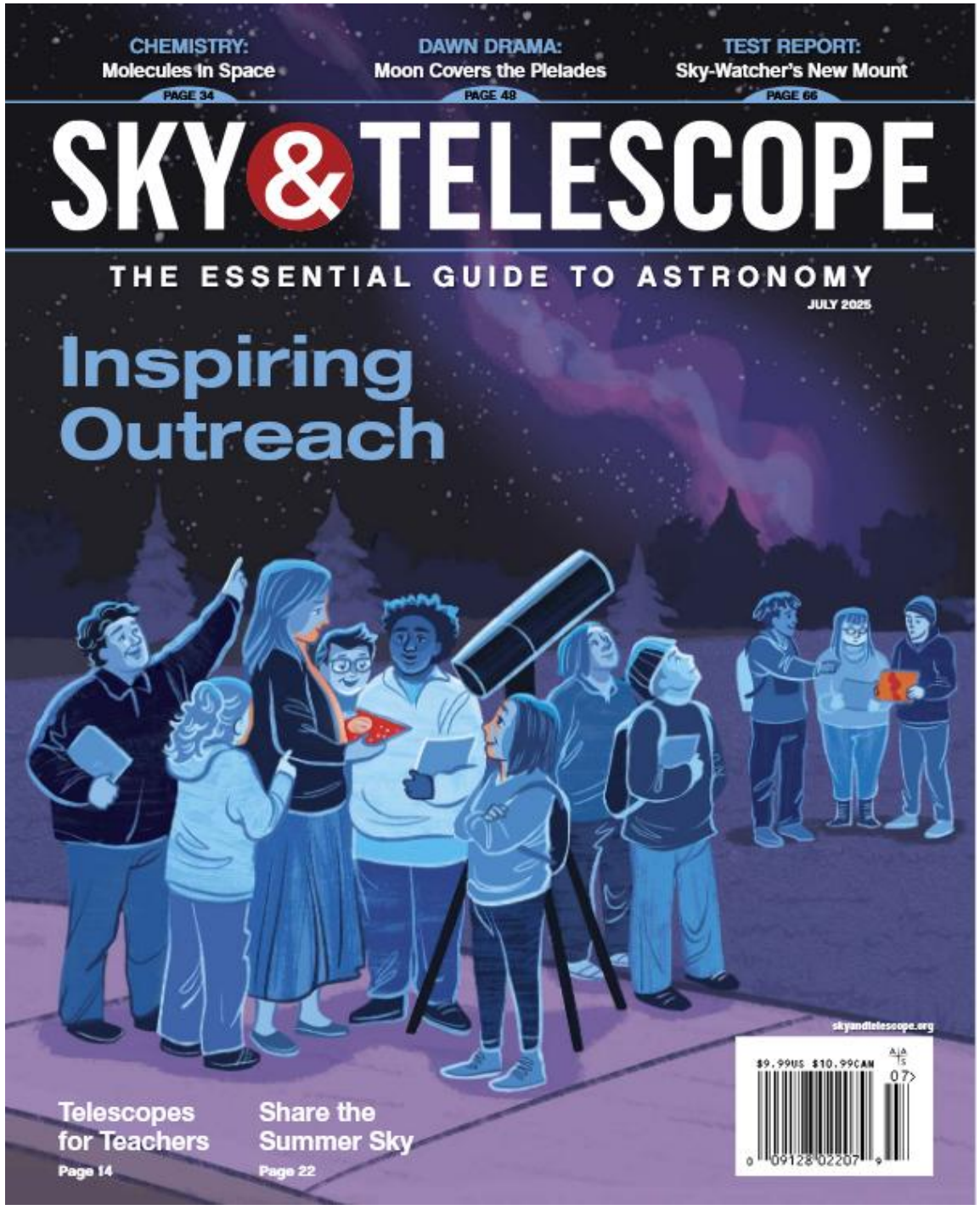


July 2025 issue

 by Rachel M. Huchmala

Telescopes for Teachers

A new program in Idaho is helping kids connect with the universe.

Looking up at the night sky has been a part of human culture for as long as we can remember. For me, being able to see the stars and the Milky Way is a reminder of not only how small but also how special we are. When we lose the sky, we lose both reminders — which is why it's such a gift when someone connects us with the sky.

I used to tell people that, growing up in Las Vegas, I saw different kinds of stars than the ones above our heads. But that isn't entirely true. The sky wasn't dark, but I knew just whom to ask if I wanted to know what was out there. My best friend's dad seemed to have this superpower (some may call it a PhD in astrophysics) for unveiling the universe in our night sky. Taking the 10 or so stars we could see from their backyard, he would weave them into the constellations we would have been able to see if there were less light pollution.

A few years later, I moved to Flagstaff, Arizona, the world's first International Dark Sky City. Living in a place that prioritized minimizing light pollution was an eye-opening experience for me. I could see the Milky Way from my backyard every night, which only made me more driven to study the science of the universe and more passionate about saving dark skies. I successfully pursued a PhD and worked to support community outreach efforts throughout my education.

Flash forward to 2023, when I joined the Central Idaho Dark Sky Reserve STEM Network as their postdoctoral fellow. The STEM Network is a partnership between a group of astronomers at Boise State University and the Central Idaho Dark Sky Reserve (CIDSR), a stretch of 3,667 square kilometers (1,416 square miles) that holds some of the darkest skies in Idaho. (For aficionados, the area boasts skies ranging from 1 to 3 on the Bortle scale.) The reserve presents a unique resource to the residents of Idaho and is currently one of only two dark-sky reserves in the United States certified by DarkSky International.

Funded by NASA's Science Activation Program since 2021, the main goal of the STEM Network is to support science, technology, engineering, and mathematics (STEM) engagement efforts throughout the state of Idaho. Professor Brian Jackson (Boise State University) directs the program. The network consists of several mutually supporting strands, all working together to provide public astronomy lectures, stargazing, outreach events, and an Astro Adventurers summer program for elementary school students. All this work is made possible by the incredible team that supports the program.

LEAH TISCIONE / ART

SEEING STARS The Milky Way adorns the sky over the Central Idaho Dark Sky Reserve.

I work with an outreach team of undergraduate students, Astronomers in Training Assisting the Community (AstroTAC), preparing and supporting them to host star parties, present astronomy activities at local STEM nights, and use our mobile planetarium to bring the stars closer to the community. The AstroTAC students gain in return not only the joy of serving others but also experience with public speaking and scientific communication, skills that are important as they look toward their futures.

I help the AstroTAC students to design new activities, focused on what the students are most interested in. This makes it easier for the students to teach others and allows the students to share their passion. Some of these activities require no more than beads and string — but paired with imagination, they become exoplanet systems. I am amazed by the impact the network is having on communities in Idaho and its success in "spreading the word" about the effects of light pollution.

By spending time interacting with schools in Boise and the surrounding areas, we saw there was an interest in looking up and a need for more resources to share what was to be seen in the sky. Many of the teachers we talked to were quick to comment that their students have a hard time staying engaged when learning about space-related science, because so much of it is intangible. This is where the idea of Telescopes for Teachers began.

The Beginning

Technological advancements have brought a new era of computerized backyard telescopes. Supported by everything from Go To systems to live-view displays that enable multiple people to see a target at once (without messing with the focus knob between each observer), these devices provide budding enthusiasts with a wide on-ramp to help them climb astronomy's learning curve.

One of the companies paving the way is Unistellar. They offer a range of telescope models, with a variety of bells and whistles, but they all have one thing in common: Instead of being a standard optical backyard telescope, they are equipped with CMOS sensors and read out to a smart device. This means that with a small aperture and their "enhanced vision" technology, these telescopes can create clear, color images of deep-sky objects, even in light-polluted areas.

When we set out to offer telescopes to teachers, we knew that we would need equipment that would be easy to use, learn, and teach with. More than this, we also wanted a telescope that would provide views of the cosmos from places like school basketball courts, in both urban and rural areas. Ultimately, we chose the Unistellar eQuinox 2 telescope for our program. The telescope has a 4.5-inch aperture, hosts its own Wi-Fi network for connection, and fits into a hiking backpack for easy transport.

The next step in creating this program was establishing funding to purchase the telescopes and develop the program. In September of 2023, we asked the NASA Science Activation

MILKY WAY ARIANA JAMALLOO BRACELETS RACHEL M. HUCHVALA

▲ **EXOPLANET BRACELETS** In my favorite activity, participants use beads and string to create their own exoplanet system. We provide them with black beads to represent space, and they choose their own host star (red or yellow bead, to represent a red dwarf or Sun-like star) and exoplanets to complete the system: gas giants, mini-Neptunes, super-Earths, and terrestrial.

Program (which supports the STEM Network) for an additional $125,000, explaining the need for telescopes in classrooms and that providing this resource for teachers would help students maintain engagement in space-science units. We also outlined how the program was an opportunity for something greater: inspiring students with scientists' stories and enabling them to contribute to research. NASA said yes.

On March 6, 2024, I walked into work like any other day. However, when the elevator doors opened into the university's physics department, I knew my day was about to take an unusual turn. My eyes fell on a cluttered hallway lined with palettes. As I wiggled my way between the palettes and the students waiting to enter their physics labs to make it down the hallway to my office, I learned that "my" telescopes — or, more specifically, 50 Unistellar eQuinox 2 telescopes, 50 solar filters, and 50 backpacks to store the equipment in — had been delivered (sans warning). It was a bad day to have worn my nicest sweater to work.

Walking down the hallway and seeing all the boxes transformed this crazy idea we had — to provide telescopes to teachers in Idaho — into a real program. But the real work was just starting.

Bringing Hands-On Astronomy to the Classroom

As it turned out, having 50 telescopes delivered to us was the easiest part of the whole operation. The next challenge we faced was finding storage for 50 telescopes, then finding 50 teachers interested in joining the pilot program. Most

importantly, we needed an internal infrastructure to support any participants, meeting them where they were and making sure they all felt comfortable operating the telescope and had access to the appropriate smart device to use it.

We soon received an unexpected windfall. A local news story ran about our program, and overnight almost 100 teachers across Idaho contacted us about participating.

Through a questionnaire we sent to each teacher and a search of school populations, we made our selections. We set forward simple rules: Only one telescope could be loaned to a school, and one teacher had to assume custodianship of it. However, if multiple teachers from a school applied and were selected, we invited all the teachers to the training.

We worked to spread the telescopes across the state, especially to communities our outreach team couldn't easily visit. Ultimately, we were able to reach both rural and urban schools, with varying student populations in every combination of grades, from kindergarten through 12 (see the map on page 19). Because of the range of teachers we selected, we have used the pilot year to learn from the teachers and adapt our programming to best support the concepts and activities that worked in their classrooms.

Once we had our participants assembled, it was time to prepare a training procedure. This took the form of a one-night workshop, designed and led by me, involving four hours of classroom learning and two hours of hands-on observing with the telescope. Our workshop covered four main topics: parts of and how to set up the eQuinox 2, basics of telescopes and how the eQuinox 2 compares to other telescopes, preparing for observing, and the study of exoplanets and how the telescope they were holding could collect real data about exoplanets (more on that later). At the end of the night, the newly trained teachers were sent off with their equipment.

In any given workshop we could have kindergarten teachers or 12th-grade teachers, with experience ranging from those who had just started teaching astronomy to others with experience in astrophotography. So we made sure to design a workshop that was flexible, providing teachers with information, leaving time for discussion, and ultimately allowing the educators the space and freedom to decide how to best present the information to their students. This way, I could teach a workshop geared toward the participants that focused on the tools and resources they might need, instead of providing a rigorous structure for teaching one specific topic.

We held 10 training workshops in all, with a total attendance of 57 teachers who all learned the basics of using the telescope. Hosting these workshops was a chance to meet some of the incredible educators in Idaho, who work so hard for their students. I feel honored that I have been able to meet every participant of our program.

Although we are still only in the first year, we're already hearing from teachers that our telescopes are enabling them to make astronomy more engaging. One of them told me:

> *The Telescopes for Teachers program has given teachers such an amazing opportunity to make science more accessible to students. As an astronomy teacher, I struggle with providing hands-on and tangible experiences for the students, but this program has made that possible!*

Sharing Stories

As a woman in STEM, I have always enjoyed learning the stories of other women in STEM. When presented the opportunity, I decided to name each of our telescopes after a historic woman who has made an influential contribution to physics and astronomy. Thus, the second goal of Telescopes for Teachers was formed: sharing the stories of pioneering women in physics and astronomy.

Our selected individuals span time and geographic location, highlighting women who broke down barriers for the next generation. All of our telescope namesakes can be found on our website (**https://is.gd/cidsr_scientists**), along with a short biography of them and their work.

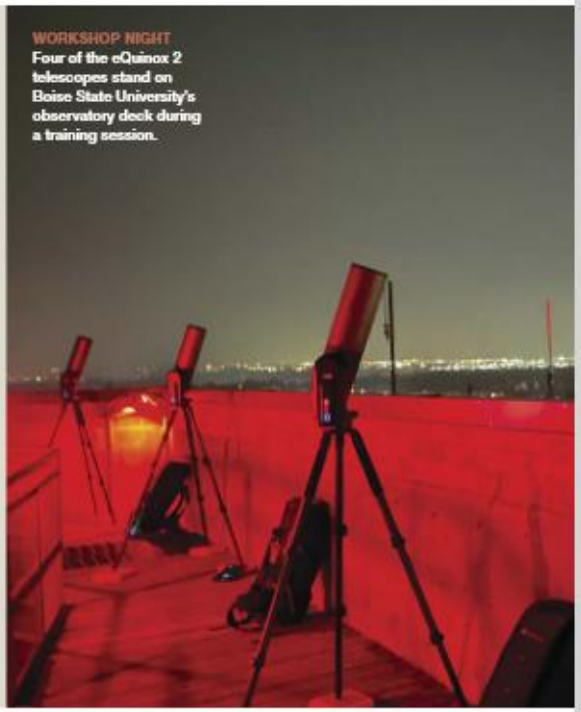
This recognition is an important aspect of our program: It both provides visibility to scientists whose stories are often overlooked and gives students examples of scientists they might more easily see as role models for themselves. This visibility is important to all students, not just girls, because it shows that with the right amount of perseverance, anyone can gain access to education and become a scientist.

Contributing to Citizen Science

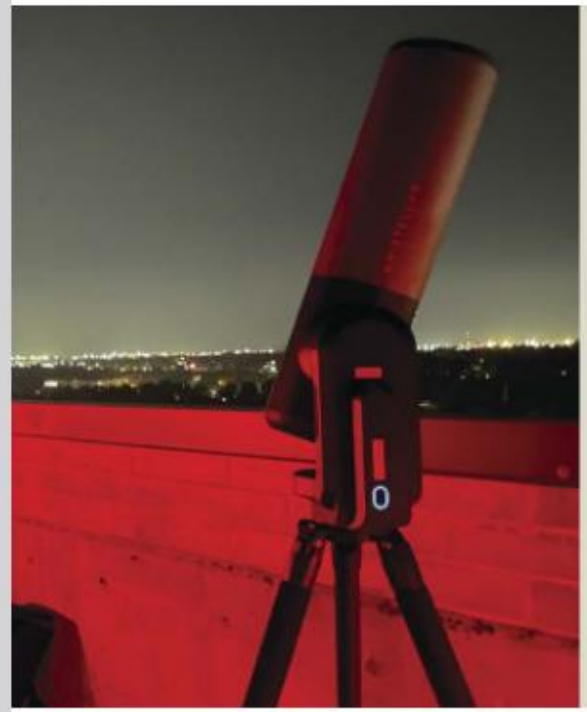
For my postdoctoral research, I study transits of *short-period exoplanets* — worlds that make a quick orbit around their host stars. I do this work as a member of an international scientific collaboration called the Short Period Planets Group, or SUPERPIG for short. Within SUPERPIG, my work has focused on *ultra-hot Jupiters*. This is a class of exoplanets that are Jupiter-size or larger and lie so close to their host star that they complete a full orbit in less than 4 days.

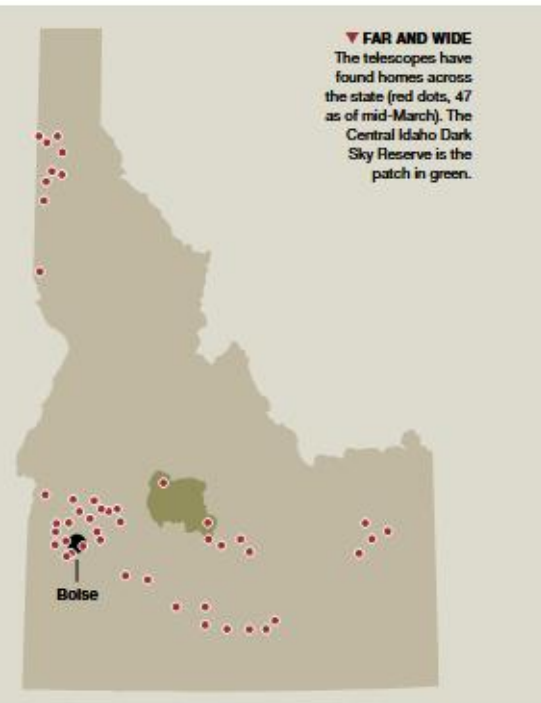
Because of the planets' size and proximity to their stars, when they pass between us and their host star they block

READY TO GO Each telescope comes in a backpack adorned with a Boise State University luggage tag. Inside we also pack a laminated informational page on the telescope's namesake, for the teacher to share with students.



WORKSHOP NIGHT Four of the eQuinox 2 telescopes stand on Boise State University's observatory deck during a training session.





FAR AND WIDE The telescopes have found homes across the state (red dots, 47 as of mid-March). The Central Idaho Dark Sky Reserve is the patch in green.

▲ **DUMBBELL NEBULA** Teacher Sally Pham from Eagle High School used the telescope's "enhanced vision" feature to capture this image of Messier 27 in a Bortle Class 6 area (bright suburbia).

▲ **WHIRLPOOL GALAXY** The author captured this image of Messier 51 and its smaller companion, NGC 5195.

a significant amount of the star's light. This feature makes them good candidates for observations with small ground-based telescopes — even those as small as the ones we're giving out to teachers.

Back in March, after the dust had settled and the palettes were cleared from the hallway, Brian Jackson and I looked at the stack of telescope boxes that now decorated my office. In a moment that could only be described as a light bulb turning on, we found a new way to connect my love of exoplanet science and my passion for community outreach: We realized that we could involve teachers and their students in real science. In turn, their observations could also directly contribute to my own research.

With this realization, we were able to develop the third goal of Telescopes for Teachers: empower teachers and their students to confidently contribute to exoplanet science.

One of the most exciting things about the Unistellar telescopes is the partnership between Unistellar and the SETI Institute, a nonprofit research organization dedicated to understanding the origins and prevalence of life in the universe. Thanks to this partnership, the telescopes are equipped with a special "science mode" that an observer can use to contribute to active research projects being done in astronomy. There are currently six observation campaigns: asteroid occultations, exoplanet transits, planetary defense, cometary activity, cosmic cataclysms, and satellite surveillance.

"The goal is to make anyone a part of the scientific process," Franck Marchis, chief science officer and cofounder of Unistellar, told me when we sat down to chat at the 245th American Astronomical Society meeting this past January. "They don't only record observations, but they also learn about why we care about observing this exoplanet, this comet, or whatever else."

Starting the science mode is simple. When a user decides to conduct an astronomical observation, with the click of four buttons they can take and share their data. They first press a button to accept the target, then a second button moves the telescope. The third button starts the observation, at a given exposure and cadence predetermined by the specific observing campaign. With the click of a fourth button, the data are sent to Unistellar/SETI Institute for analysis. For most projects, a user is notified of their results within 48 hours.

For our program with teachers, we are most interested in Unistellar's exoplanet-transit campaign. We've designed a citizen science program, the SUPERPIG Observing Grid, specifically for participants of Telescopes for Teachers. Its goal is to conduct follow-up observations of ultra-hot Jupiters in search of signs of *tidal decay*. This phenomenon occurs when the gravitational interaction between the planet and the host star causes the planet to slowly spiral in closer to the star. It ultimately leads to the planet's demise (*S&T*: Jan. 2023, p. 14). We call these exoplanets "doomed worlds," and the most popular one is an exoplanet by the name of WASP-12b.

But the change to a doomed world's orbital period happens slowly: It took a decade of observations to confirm signs of tidal decay in WASP-12b's orbit. This means that in order to detect tidal decay in more exoplanets' orbits, we need to establish long-term follow-up observing programs. We intend for the SUPERPIG Observing Grid to be one of these programs.

As this article goes to press, the SUPERPIG Observing Grid is preparing for its first observations in the spring and summer of 2025. We do not require the teachers to join the citizen-science program, but we hope they will be excited to do so. The teachers that do join will be presented with a number of exoplanet transits that will be visible from their location and invited to collect *light curves* of the events with their students using the telescope and Unistellar's data-reduction tools. We are only just starting out, but ultimately I hope to be able to combine observations taken in my own research with observations from teachers and their students to further our understanding of tidal decay.

In just one year we created a program, distributed telescopes to nearly 50 teachers, and are now working to prepare them for scientific observations. All in all, I hope that this program creates excitement amongst the teachers, fosters a community of science teachers throughout Idaho, and exposes students to the many wonders of astronomy. I am excited to see how our first observing season goes and to learn about all the unique ways the telescopes are being used in the classroom. More than anything, I hope the opportunity to use a telescope gives the students an appreciation for the wonders of the night sky.

▲ **TRIANGULUM GALAXY** Teacher Benjamin Satterwhite took this image of Messier 33 from the Julius Jeker Planetarium in Boise. He says that the program "has allowed students to step out of the classroom and become active citizen scientists." It even inspired the planetarium to build its own telescope library for the local school district.

▼ **A TROOP OF TELESCOPES** The author poses with all 50 telescopes, prior to their distribution.

■ RACHEL HUCHMALA is a postdoctoral fellow at Boise State University. Her research interests include exoplanets, citizen science, and community engagement in space science.

Learn more about the Telescopes for Teachers project: https://is.gd/idaho_tft.