

Teaching STEM Through Astronomy's Lens

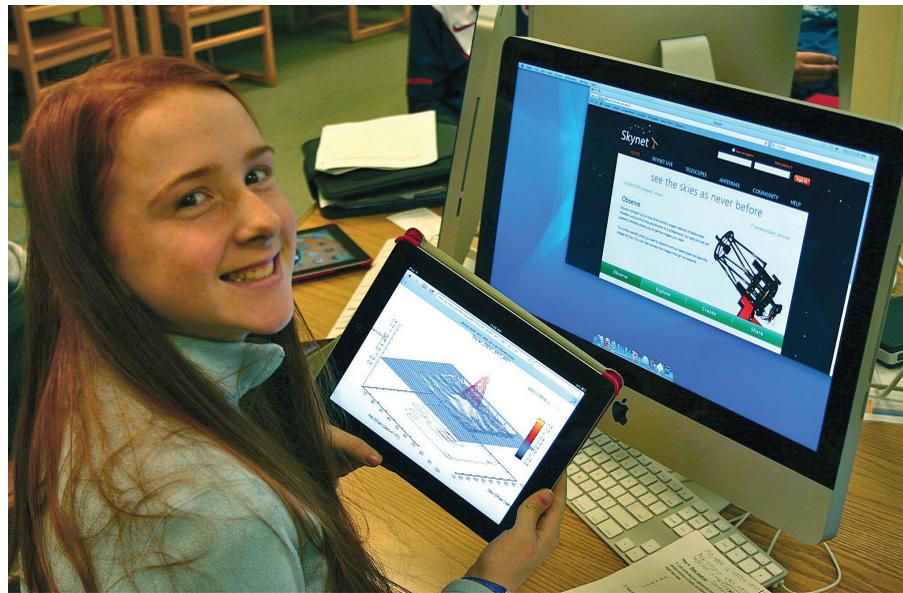
Astronomy programs can provide many advantages to science, technology, engineering, and math (STEM) teachers and students. "Astronomy is a 'gateway' subject among the sciences," asserts Project ASTRO Coordinator Brian Kruse. "It can help teachers encourage more students to take STEM courses and consider careers in STEM."

Project ASTRO (see the website <http://bit.ly/1SQoFDg>), a national program from San Francisco's Astronomical Society of the Pacific (ASP), partners professional and amateur astronomers with educators. Astronomers visit partner classrooms at least four times during the school year to conduct hands-on activities. "Astronomers have to make a commitment to come to classrooms four times; [this isn't] a one-time only [interaction]. We also do follow-up workshops to help support the teachers," explains ASP Director of Education Greg Schultz.

"We're also now focusing on incorporating science and engineering practices and crosscutting concepts, content relating to what teachers are currently teaching," Kruse relates. "Even [in states not adopting] the *Next Generation Science Standards*, students need to engage with disciplinary core ideas so they can meet performance expectations in the Earth and space sciences."

"We've gone beyond just getting teachers to do hands-on activities and engage students in active learning," says ASP Executive Director Linda Shore. "We now have activities for teaching students how to use models to test hypotheses... The emphasis now is on 'What do scientists and engineers do?'" She adds, "It's important to have a real astronomer there who engages with these practices... It's important for kids to see astronomers are a diverse group [so they] see themselves represented."

With *A Framework for K-12 Science Education* in mind, Project ASTRO is redeveloping activities in *The Universe at Your Fingertips (UAYF)*, its signature publication for educators, and adding more multimedia, Shore reports. The ASP manages "the NASA Night Sky Network [of more than] 450 amateur astronomy clubs [nationwide] that do educational outreach for the public and



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in schools. We plan to create videos that show these amateur clubs how to use new UAYF activities to help science teachers engage students in real astronomy," she explains.

The program is also exploring ways to support rural and underserved areas not located near Project ASTRO sites, which are "typically in areas with a lot of astronomers or where planetariums are," Kruse notes. Project ASTRO can reach teachers in these communities via webinars, and amateur astronomers, astronomy graduate students, or retired professional astronomers also can partner with classrooms, he maintains.

Astronomy in Chile

While touring U.S. astronomy observatories in Chile, Tim Spuck says he realized he "didn't know how much the United States has invested in astronomy [there]." After that visit, Spuck—who serves as STEM Education Development Officer for Associated Universities, Inc., in Washington, D.C.—collaborated with others to create the Astronomy in Chile Educator Ambassadors Program (ACEAP; <http://bit.ly/1n1b13B>). ACEAP provides "opportunities for educators to learn firsthand and experience [Chilean astronomy] facilities and help their audiences understand how astronomy is practiced today, the U.S. investment in astronomy in Chile, and the diverse career opportunities at these observatories," says Spuck.

Supported by the National Science Foundation (NSF), ACEAP brings K-16 formal and informal astronomy educators, amateur astronomers, and planetarium staff to U.S. astronomy facilities in Chile and trains them in communicating STEM concepts. "I'm a strong advocate for breaking down barriers between formal and informal educators and creating opportunities for them to interact," Spuck asserts.

"By 2022, it's estimated that 70% of the world's ground-based telescopes will be in Chile," he observes. "There's a growing need for astronomy professionals who can speak Spanish."

Astronomy has become an interdisciplinary science, says Spuck, because "to build telescopes, you need to have incredible engineers and software programmers" to design them to "operate in extreme conditions."

After the trip, "each ambassador has to conduct seven outreach activities," explains Spuck. Last year's ambassadors have conducted planetarium shows, visited schools, written articles and blog posts, and communicated with astronomers via social media. During a summer camp, one informal educator had students build a small telescope, "and he created an activity about the telescopes in Chile," Spuck recalls.

"The world's greatest astronomical research centers are inspiring. They inspire people to want to learn, one

of the greatest gifts we can give [one another]," he maintains.

Young Scholars of the Sky

Middle and high school students can explore the universe using telescopes worldwide as part of Skynet Junior Scholars (SJS; see the website at <https://skynetjuniorscholars.org>), an NSF-funded program for youth in out-of-school programs focused on STEM learning. Vivian Hoette, director of special projects at the University of Chicago's Yerkes Observatory in Williams Bay, Wisconsin, and Sue Ann Heatherly, education program director at the National Radio Astronomy Observatory in Green Bank, West Virginia, founded SJS because "we value kids having authentic experiences in astronomy, such as analyzing data and doing image processing... We want kids to feel like scientists," Hoette contends.

"We put our 41-inch telescope on Skynet (an online program that allows users to interface with telescopes around the world). We could then put in observing requests" from youth programs, she explains.

The SJS web portal connects students with science mentors who can answer their questions, activities, and resources such as an online notebook, a discussion forum, and a gallery where students can post photos. "The kids all have code names, and Sue Ann and I review the notebooks to ensure [online] safety," Hoette relates.

Students can join SJS after their program leaders complete an SJS professional development workshop. They learn how to do investigations with Skynet telescopes, lead hands-on activities with children, and help them make the most of their SJS experience. "We hold face-to-face workshops at Yerkes and Green Bank," Hoette notes, while the ASP offers online workshops. Afterward, educators "have a new network of colleagues, another support system of people interested in science and teaching," she contends.

With SJS membership, "you can learn astronomy with the kids, have access to the telescopes and do your own experiments," she asserts. "Everything is free of charge because we're NSF-funded." ●