

## A Research Adventure for Tucson Educators

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Ever watch a science show on television and think, "Wow, I'd like to do that!"—whether it's about space flight, dolphins, or volcanoes? Now imagine non-astronomers thinking the same about our field. While the public may enjoy many illuminating astronomy talks and striking web pages, opportunities to actively engage in research at any level are rare, and can be challenging to execute in a meaningful way. Hence, we all jumped at a good opportunity to involve Tucson educators in a WIYN research observing project.

Three Girl Scouts of the USA (GSUSA) leaders and Tucson (TUSD) teachers with a strong bent for science education joined astronomers for two nights of observing on the WIYN 0.9-meter telescope. Carolyn Hollis (GSUSA, TUSD), Susan Hollis (GSUSA, TUSD), and Samantha Sims (TUSD), dove into all aspects of observing a set of quasars with the S2KB imager, working closely with me. Simultaneously, University of Wisconsin astronomer, Marsha Wolf, observed the same objects using Sparsepak and the Bench Spectrograph on the WIYN 3.5-meter.

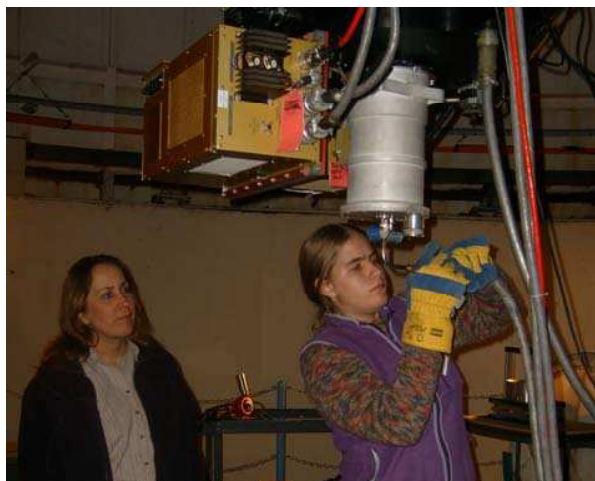


**Figure 1:** Tucson teacher Samantha Sims filling in the log book. Credit: E. Hooper.

Helping to fill the dewar, typing in coordinates, taking images, keeping a log, watching the weather, observing calibrators, collecting flats and biases, even starting to analyze the data, and talking about the rationale for each step, kept everyone busy. However, once the science targets were in the bag, we had a little time to exercise the instrument's 20 arcmin field of view on a few targets more visually compelling than point sources. These included nearby galaxies and nebulae—images which will find their way into classrooms and Girl Scout activities. Even minor glitches proved useful as group problem-solving exercises that can be turned into lessons.

Wolf and Kitt Peak Observing Associate, Karen Butler, greeted the educators at the WIYN 3.5-meter during their afternoon calibrations and explained the other part of the science project. "We're studying quasars and the galax-

ies in which they live using a spectrograph that can look at the various parts of the system simultaneously," explained Wolf. However, she pointed out that given the way she has to use the instrument, she can't calibrate the brightness of the variable quasar component. The educators and I had the job of making this calibration with the other telescope.



**Figure 2:** Marsha Wolf (l) and Susan Hollis (r) filling the dewar with LN2. Credit: S. Sims

"To be immersed in this setting, and having time to talk about the educational issues and the kids and getting it across ... I am so charged up!" exclaimed Carolyn Hollis. We started discussing educational applications with the natural inclination of astronomers to explore data quantitatively, from altering display parameters, to measuring the sky background, and even some simple photometry of the target quasars. We used the Yale Observatory iMAge Manipulation Application (Yomama), a simple but powerful image display and analysis program written expressly for educational applications by David Goldberg (now at Drexel).



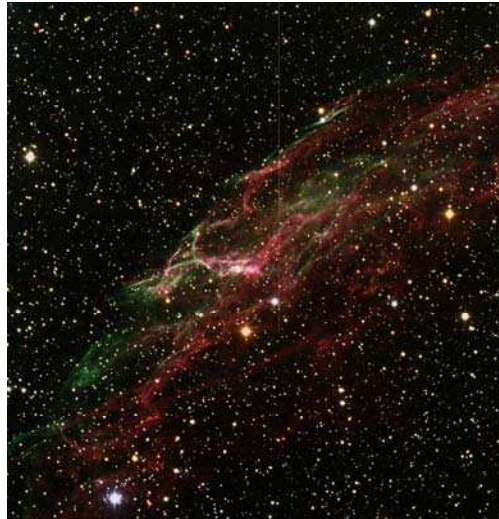
**Figure 3:** Carolyn Hollis (l), in the driver's seat at the WIYN 0.9-m, as Eric Hooper (r) looks on. Credit: S. Sims

The educators divided these activities by level for their varied students, from third graders through high school Girl Scouts. All three educators also converged on the

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use of our images to convey ideas about color, from the meaning of intensity values in images of different colors, how to make a true color image, to the need for false color images to represent non-visible radiation. As nascent lessons began to take shape, Susan Hollis pointed out that “we can work with these images on our own also using Gimp, clean them up, combine them.”

Manipulating digital images of stunning natural objects provides a segue into art education. Samantha Sims explained that “some of the students come in with a real fear of artistic expression, but if you give them some parameters and a platform to ease them into their creative expression, sometimes it works a lot better.” To complete the loop, beautiful celestial images created by students can catalyze an interest in astronomy. Many of these ideas may find expression not only in the classroom but also in a planned national Girl Scout astronomy-themed “Destinations” program for older girls.



**Figure 4:** Color composite of images of the Veil nebula taken with the WIYN 0.9-m telescope, using Yomama software. Credit: E. Hooper.

Several elements contributed to the success of the venture. First, the project was relatively modest in scope and straightforward in execution, which afforded an

opportunity to explore and discuss in a relaxed environment, while still retaining some research urgency.

It also benefited from active and enthusiastic participants, scientists interested and experienced in education and outreach, and the help and support of KPNO and WIYN staff and administration, plus the NOAO Office of Public Affairs and Educational Outreach.

Finally, we would not have gotten off the ground without the financial and logistical support of University of Arizona astronomer Don McCarthy and his NIRCam/JWST education and outreach program for Girl Scouts, plus our University of

Wisconsin-Madison collaborator and overall Principal Investigator of the project, Andy Sheinis.~