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Contents

- 5 Editor's Page by Ron Laugen
- 6 President's Message by Karen Pikula
- 7 Talent Development in STEM Disciplines: Sparking Innovators by Julia Link Roberts
- 10 Siemens Foundation and the STEM Challenge by Jeniffer Harper-Taylor
- 12 Negotiating the Path: The NCSSSMST Pre-Conference Symposium – A Milestone on Our Journey by Letita Mason
- 14 The Sky is Not the Limit: CVGS Students Reach for the Stars and So Can You! by Shannon Beasley
- 17 Assessing Differences in Students' Experiences in Traditional versus Scientific Teaching-Based Biology Course by Sarah O'Leary and Susan C. Styer
- 21 Technology Focus: Enhancing Learning of Limits of Functions with Dynamic Sketches by Beth Cory and Joe Garofalo
- 23 Arts Corner by Arthur S. Williams
- 24 Affiliate Spotlight: Nashville Reflections by Jill Sifuentes
- 25 Solar Hydrogen Fuel Cell Projects at Brooklyn Tech by Alumni and Students at Brooklyn Technical High School
- 27 Student Research Across NCSSSMST
- 36 Member Schools
- 38 About NCSSSMST

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The Sky is Not the Limit: CVGS Students Reach for the Stars and So Can You!

By Shannon Beasley, Central Virginia Governor's School for Science and Technology

Editor's Note: If you are currently participating in an astronomy collaboration, or are interested in starting one, the author would like to discuss research possibilities with you. Please contact her at sbeasley@cvgs.k12.va.us.

As I began my teaching career at CVGS, it became apparent that many of my students were interested in doing research projects in astronomy and the number seemed to increase every year. At first I did not think that I had the tools to do a good job accommodating these interests. But what seemed impossible then was not going to remain that way for long. All it would take was collaboration.

Two years ago, my female students and I traveled to the University of Virginia's Astronomy Observatory for the annual graduate student series hosted by Women in Math and Science (WIMS). Some very enthusiastic astronomy graduate students presented their research using a wonderful array of slides. They discussed fields I'd not heard of, like astrobiology and astrochemistry, and I learned that one could study an area far removed from our solar system.

I also found out that Rachael Beaton, an alumna of CVGS, was a grad student in the UVA Astronomy Department and had actually discovered a galaxy! The combination of the WIMS group and having a contact helped start our collaboration the UVA Astronomy Department.

But you don't need to have a special event or an

alumni connection to begin this kind of collaboration in your school. In fact, several UVA astronomers told my students that there is so much data literally "sitting on shelves" that many labs would love for high school students to work with them.

For example, one UVA astronomy lab has a large collection of images from their Spitzer Space Telescope Survey of the Vela-Carina Galaxy study. So they invited two of my juniors to help them analyze data. A third junior, intensely interested in black holes, was also connected with data from a lab.

There are many ways that students can to analyze astronomy images and data sets. One of the most user-friendly ways is to use DS9 - open source software available for free download on the Smithsonian Astrophysical Observatory (SAO) website (Table 1). Once you find an institution willing to collaborate, they need to provide you with images that can be transformed into the type that are used with this software.

The raw telescope file images we obtained from the Vela-Carina study had to be converted to Flexible Image Transport System (FITS) images in order to work with the DS9 program. The grad



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Astronomy Website	URL
Astrobiology	http://astrobiology.nasa.gov/
Astrophysics and Astrochemistry lab at NASA Ames Research Center	http://www.astrochem.org
Harvard-Smithsonian Center for Astrophysics	http://www.cfa.harvard.edu/education/
Lunar Institute for Educators	http://education.gsfc.nasa.gov/lunarinstitute/
NASA Education	http://www.nasa.gov/offices/education/about/index.html
SAO Image DS9: Astronomical Data Visualization Application	http://hea-www.harvard.edu/RD/ds9

Table 1

students brought hard drives with these images on them so that our students could hook them up to any computer that had DS9 installed on it in order to analyze the images. Students were then trained by the graduate students on how to look for items of interest.

One way to spark an astronomy research collaboration is to knock on doors, virtually of course. Send e-mails to the university and/or college astronomy departments in your area. One of the graduate students that we worked with noted that graduate students desire collaborations because the experience "looks good when applying for fellowships or for jobs."

UVA post-doc researcher Amanda Kepley provided the following advice about asking post-docs to work you into their National Science Foundation (NSF) or other fellowship grants: "Post-docs are generally short-term positions (2 to 3 year) with specific outcomes tied to grants, so I would advise people looking to work with post-docs to reach out to the departments that they are interested in working with and have a good web-presence....All NSF grants must specifically address the 'broader impacts' of the grant work, which can include mentoring students. See the NSF Grant proposals guide or a similar guide for the main funding agency for your research area (NASA, NIH, DOE, etc)."

It is important to consider what kind of student should do astronomy research. Each needs to have a very strong work ethic and have the time to spend analyzing data. All three of my juniors that collaborated with UVA were hard workers and very meticulous. They agree that any student who is interested in an astronomy project "definitely has to be willing to trudge through hours and hours of procedure in looking at star charts" and so needs "to have patience and hope."

Each student also needs to be "willing to do a lot of outside work on their own." The initial enthusiasm of the CVGS was essential in keeping them focused and committed. Working with professional astronomers provided the students with a great deal of confidence and brought their passion to a new level.

It is necessary for a student doing this research to

have good communication and teamwork skills, since they have to work together to troubleshoot and bounce ideas off of one another. It is also important that the students you choose to work on these projects should be prepared to see the project through, even if, half way through the project, they lose some interest. This will keep the collaborative environment a stellar one.

Actually, today's technologies make it possible to communicate and collaborate with astronomy departments all over the globe with ease since astronomy software can be accessed in your classroom. However, long distance collaborations are not free from difficulties in communication, especially when students have deadlines to meet for grades and astronomers keep late hours and busy schedules. In the astronomy world, graduate students, post-docs and principal investigators can often be called to have telescope time in a certain location, and potentially have to leave with little or no notice.

My students were able to communicate with their researchers via a shared online document hosted through the university's server. The communication provided was "a great source for background research, communication, and investigation" said one student. Other communication methods such as Google Docs or Skype were not explored by the CVGS students, but would also be useful ways to communicate over long distances.

At the end of their projects, I asked my students what they thought about the opportunity that they were given. One student said that it was an "incredible experience, especially being able to work with actual astronomy researchers, even though I'm just a junior in high school."

Another agreed, saying that it was "a pretty big deal to play a part in studying real astronomical data," and that "being able to say that I participated in the Vela-Carina survey with UVA astronomers and having that kind of background will definitely help me if I want to do an internship in the future." The third junior found that working on a study of black holes in high school was possible because she was able to work with "specialists in the field."

The graduate students were equally excited to work with the students. One of the graduate students I spoke with knew she was working with gifted students, but was extremely surprised at how “brilliant they are,” and noted that these students will have a leg above the rest in the future in this field because “they can demonstrate that they are familiar with the overall research process, and that they can work with people with various levels of expertise.”

Finally, if you are able to collaborate with a local astronomy department, create a venue to celebrate your students’ work. For example, the UVA Astronomy Department invited our students to present their results at their annual Astronomy Symposium.

The students gave short PowerPoint presentations summarizing their research questions, hypotheses, concepts, methodologies, results, and conclusions.

The students were very excited to present in a professional environment. The astronomers were impressed with each student’s ability to analyze and scrutinize the images and data that they were given. After the presentations it became clear that future collaboration between UVA graduate students and CVGS students would continue.



CVGS students present at the 2010 UVA Astronomy Symposium. Left to Right: CVGS student Rebecca Millard, UVA astronomy doctoral student Rachael Beaton, UVA astronomy student Gail Zakowski, CVGS students Paul Zvick and Morgan Lupton.

Dr. Stephen Majewski, UVA astronomy professor, told our students that high school helped fuel his passion for the sky by “providing him access to enter the school at night to wheel the big telescope out. I convinced my family to take me on a tour of the famous Yerkes Observatory in Williams Bay, Wisconsin while in high school. This is the home of the world’s largest refracting telescope, run by the University of Chicago. During the tour I turned to my mother, pointed to the tour guide and said ‘someday I’ll be up there doing that.’ Sure enough, about 10 years later, I was a graduate student at U of C and giving tours of the Observatory.”

Dr. Majewski also said that with all of the data out there, high school students could potentially make any number of large astronomical finds. Your students should therefore be told that their research in astronomy could potentially contribute to the big picture. Ours were really impressed that they were also able to consult with professors and thought that, despite their youth, they were very supportive.

In conclusion, collaborating with an astronomy department is an excellent way to promote STEM based experiences to our students. It is quite evident that the CVGS students gained so much

more than just research experience from their collaboration. One of the students noted that he had been interested in being an astronomer for a long time, but that it made him “realize that there is A LOT of data that still needs to be combed through.”

The students that did this work might become astronomers one day, discovering new galaxies and challenging current theories. I’m thankful that their passion to explore astronomy was fueled and I know that this experience will open more doors for them.