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Authentic Astronomy Research Experiences for Teachers: The NASA/IPAC Teacher Archive Research Program (NITARP)

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Abstract. How many times have you gotten a question from the general public, or read a news story, and concluded that “they just don’t understand how real science works?” One really good way to get the word out about how science works is to have more people experience the process of scientific research. Since 2004, the way we have chosen to do this is to provide authentic research experiences for teachers using real data (the program used to be called the Spitzer Teacher Program for Teachers and Students, which in 2009 was rechristened the NASA/IPAC Teacher Archive Research Program, or NITARP). We partner small groups of teachers with a mentor astronomer, they do research as a team, write up a poster, and present it at an American Astronomical Society (AAS) meeting. The teachers incorporate this experience into their classroom, and their experiences color their teaching for years to come, influencing hundreds of students per teacher. This program differs from other similar programs in several important ways. First, each team works on an original, unique project. There are no canned labs here! Second, each team presents their results in posters at the AAS, in science sessions (not outreach sessions). The posters are distributed throughout the meeting, in amongst other researchers’ work; the participants are not “given a free pass” because they are teachers. Finally, the “product” of this project is the scientific result, not any sort of curriculum packet. The teachers adapt their project to their classroom environment, and we change the way they think about science and scientists.

1. What is NITARP?

The NASA/IPAC Teacher Archive Research Program (NITARP) partners small groups of teachers with a mentor astronomer, they do original research as a team, write up a poster, and present it at an American Astronomical Society (AAS) meeting. The teachers incorporate this experience into their classroom, and their experiences color their teaching for years to come, influencing hundreds of students per teacher. This program was originally operated as the Spitzer Teacher Program for Teachers and Students, and in 2009 was rechristened NITARP.

Our goal is to give teachers an authentic research experience, using real astronomical data on a current astronomical topic. We use real astronomical data from archives housed at the Infrared Processing and Analysis Center (IPAC), which includes (but is not limited to) Spitzer, WISE, other Infrared Science Archive (IRSA) holdings,

the NASA Extragalactic Database (NED), the NASA Stars and Exoplanets Database (NStED), etc. Each team does a new, original project.

We select teachers from a national competitive application process; teachers must already be familiar with the basics of astronomy (e.g., what magnitude means) and astronomical data (e.g., what a FITS file is). Most of the educators are high school teachers, but 8th grade and community college, as well as non-classroom educators, may also participate.

2. How Does NITARP Work?

The nucleus of each team is the mentor astronomer. Each team usually includes four educators, one of whom has been through the program before and acts as a mentor teacher—essentially the scientist's deputy.

The educators who have been through the program have typically been high school teachers, but we have also had 8th grade and community college educators participate and benefit. Very recently, we have started to expand to more non-traditional educators—people who are not currently in the classroom, but who are still doing education, e.g., observatory education coordinators, regional coordinators, museum educators, or amateur astronomers doing public outreach.

The program runs roughly January to January—it starts at an American Astronomical Society (AAS) meeting with a kickoff workshop for the new NITARP participants on the Sunday before the meeting. The AAS meetings are the largest astronomy meetings in the world, and often represent a significant fraction of the professional astronomy community in the U.S. Part of the NITARP experience is immersion in the culture of professional astronomy. In addition to starting to learn the culture of astronomy, and in addition to their kickoff workshop, the teams start work on their project at the meeting. They learn about how to present science and education posters, what makes a good or bad poster, etc. After the AAS meeting, the teams go home and work remotely. They write a proposal, due in February or March, and it is reviewed. They do reviews of the published astronomical literature in the spring. They come out to visit the scientist at Caltech in Pasadena for three to four days in the summer to get started in earnest on their project; most teams save intensive data work for the summer visit. They go home and continue to work through the fall. As a team, they write two AAS poster abstracts by the appropriate deadlines (one science, one education), and then go to the AAS and present their results. The program pays for all (reasonable) travel expenses. Most of the work is conducted remotely.

After the AAS meeting (and in some cases, even beforehand), the teacher participants conduct at least 30 hours of professional development in their schools, districts, counties, regions, and states; many have conducted workshops on the national level. The teachers involve students in their classes during their intensive NITARP year, and then emerge with tools that can continue to be used in future years for future projects. The alumni, who have gone through the program serve as mentors (formal or informal) to the rest of the NITARP community of teachers and students. Almost without exception, teachers who have been through the program don't want to stop after just a year; they want to do more!

3. How does NITARP pick participants?

The educators are selected from an annual nation-wide application process. The applications are available annually in May and due in September.

Since one of the purposes of this program is to spread the word about how science works and expose more people to the process of science, it explicitly spells out in the application that if an applicant already has a Ph.D. in the physical sciences, that applicant probably already knows how science works, and thus is at a competitive disadvantage compared to people who don't already know how science works. We have had a few participants with doctorate degrees in other fields who are now teaching full time. Generally, we don't accept educators who already have astronomy Ph.D.s, because evidently they already know how astronomy research works.

The astronomy mentors are largely volunteers, and most have some affiliation with IPAC and/or Caltech. They are all active researchers, and represent a wide variety of sub-fields within astronomy.

4. What has NITARP Accomplished?

The list below includes those participants in the previous Spitzer program (starting in 2004) and NITARP, and are current as of July 2011:

- 56 educators trained (or training) in real astronomy research,
- 47 science or education posters presented,
- 4 research articles published in major refereed astronomical journals,
- 117 students (high school, middle school, college) visited IPAC and/or attended AAS meetings,
- more than 1200 students used data through the program,
- more than 100 students report that the program has influenced them to pursue careers in science or related fields,
- teachers and students have delivered at least 200 presentations, reaching over 14,000 people,
- at least 100 newspaper, radio, and TV reports (plus numerous Internet articles) discussing various aspects of teacher and student involvement,
- at least 43 high school students using their experiences in this program have received regional and international science awards.

Here are some selected quotes from recent participants (teachers and students); many more are on our website.¹

¹<http://nitarp.ipac.caltech.edu>

“...it invigorated me to become part of the greater message, which is the story of space and ground based observatories. Never in the history of this great science has so much data...been available to not just the scientific community but the general public as well. All one has to do is just ask!”

“I always thought just from programs on TV and in the classroom that astronomy was, more or less, completely figured out. Learning that it isn’t is pretty exciting.”

“Being there with my students was the most amazingly cool experience. I saw [them] explode in their willingness to ask questions and express an opinion. I was totally amazed by how their attendance made them reflective about the year and enthusiastic about science.”

“EVERYTHING had a different flavor this year. I experienced everything through the lens of the research project of the past year. The entire experience was in context. When I look at how the intellectual process changed over the last year, I imagine it going from a diffuse look at research and the entire conference experience to the extreme focus on our own project during the year, and finally reaching outward again in Seattle to incorporate new information and understandings. Returning to AAS made the experience complete.”

“I cannot say enough positives about the NITARP experience for the participating students. They have had the opportunity to learn and grow and see science applied in authentic research projects, while working with some of the coolest scientists around! It has allowed me to grow as a teacher and researcher, and be able to share my insight and newfound knowledge with students and peers.”

“The best thing about the trip was the real world experience. Just like a real scientist, we worked with others to accomplish our goal by using the data and making graphs and calculations to find what we needed. We helped each other out, compared our answers, and learned from our findings and mistakes.”

“This experience definitely changed the way I thought about astronomy and astronomers. I didn’t realize that some of the calculations and applications were as accessible as they were. I also didn’t realize how collaborative of a job it is...[and it’s made up of many components].”

“[Real astronomy is] handling huge chunks of data and learning how to mine this information from sets so large that it is simply mind boggling. Many people are not aware of this, notably teachers in the trenches. They are teaching the science not as a process, but as a set of background material that acts as a starting point for conversation. The actual DOING of the science is a foreign thing to most teachers. This project is exactly why we are doing what we are doing! We want to convey what science is...”

“[The best thing about the trip was that] there are only a handful of people at home that I can speak to about astronomy, physics, and the like, so I was absolutely thrilled by the people I got to meet. Being surrounded by people at least as intelligent and, oftentimes, far more so is quite the exhilarating experience.”

5. Come Play With Us!

Applications for NITARP educators are available annually in the spring and due in September. Scientists interested in mentoring a team (or subsidizing a team or teams) should contact us. The program runs from January to January. Please see our website¹ for more information, or email nitarp@ipac.caltech.edu with any questions.

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