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Impact of and Lessons Learned from NITARP, the NASA/IPAC Teacher Archive Research Program

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Abstract. NITARP, the NASA/IPAC Teacher Archive Research Program, gets teachers involved in authentic astronomical research. We partner small groups of educators with a mentor professional astronomer for a year-long original research project. The teams echo the entire research process, from writing a proposal, to doing the research, to presenting the results at an American Astronomical Society (AAS) meeting. The program runs January through January. Applications are available annually in May and due in September. The educators' experiences color their teaching for years to come, influencing 100s of students per teacher. This program differs from other programs that we know of that get real astronomy data into the classroom in that: (a) Each team works on an original, unique project. There are no canned labs here! (b) Each team presents their results in posters at the AAS, in science sessions (not just 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 educators and students. (c) The 'product' is the scientific result, not any sort of curriculum packet. The teachers adapt their project and their experiences to fit in their classroom environment, and we change the way they think about science and scientists. For more information, see: http://nitarp.ipac.caltech.edu/

1. NITARP Overview

NITARP, the NASA/IPAC Teacher Archive Research Program, was started in 2009, but it has built heavily on the model established by (and lessons learned from) the Spitzer Space Telescope Research Program for Teachers and Students, started in 2005. We partner small groups of educators with a mentor professional astronomer for a year-long original research project. The teams echo the entire research process, from writing a proposal, to doing the research, to presenting the results at an American Astronomical Society (AAS) meeting.

Our goal is to give teachers an authentic research experience such that they understand more about how science really works. We use real astronomical data from archives housed at the Infrared Processing and Analysis Center (IPAC), which includes ground- and space-based missions and surveys, and which is primarily but not only infrared. Each team does a new project, and this can vary widely; we have had teams study objects ranging from relatively nearby young stars to far-flung galaxies from the early universe, at wavelengths from the ultraviolet to the sub-millimeter.

We select teachers from a national competitive application process; 4 times as many people applied as we had advertised spots for 2012, and 5 times as many applied for 2013. Ideal applicants are already familiar with the basics of astronomy (e.g., what is a magnitude) and quantitative measures of astronomical data (e.g., what is a FITS file), but have not yet done research. Most of our educators are high school teachers, but also 8th grade, community college, and informal educators participate.

No school would hire a football coach who had never played the game, and yet most science teachers have never done real scientific research. Our model works, and should be extendable to other sciences.

2. Main Program Components

Each team consists of 3-4 educators plus a mentor teacher (who has been through the program before), plus a scientist mentor. They work to develop a science research project, do it, write it up, and present it – all within 13 months! Educators (and their scientist mentors) attend a start-up workshop at a winter AAS (most recently Jan 2013). They learn about their science, their tools, how AAS meetings work, and how astronomers present results. (We pay for teacher travel.) The team works remotely to write a proposal. (most recently due March 2013.) The teams must use some of the wealth of data housed at IPAC: Spitzer, WISE, Kepler data and more are housed at IRSA, NED, and/or NExScI. To collaborate, the teams use telecons, and internet-based resources such as our wiki, etc. The proposal is reviewed by a committee of astronomers and educators! The teams receive comments, and rewrite their proposal, if necessary, in response. The proposals are posted on our website. The teams meet for 3-4 days at IPAC to work on the data (most recently Summer 2013). Funding permitting, each teacher brings ≤2 students to this visit; students must be heavily involved in the project. (We pay for teacher/student travel; they may bring up to 2 more on their own money.) They work remotely before and after the trip, using online resources. They present results of the project in AAS posters (next: Jan 2014). Each team presents at least 2 posters, 1 Science and 1 Education; these are also posted on our website. Funding permitting, each teacher brings ≤2 students we pay for; they may also bring up to 2 more students. Thereafter, educators serve as NASA and NITARP ambassadors, providing 12 hours' worth of professional development workshops, talks, etc. Some serve as mentors to the rest of the NITARP community of teachers and students. Now, we have 80 teachers who have been through the program, and they want to do more!

3. Challenges (a.k.a. lessons learned the hard way)

Finding the right teachers. They have to be savvy educators, and reasonably savvy in astronomy, but have not yet done research. **Finding the right scientists.** They need to be patient! They need to see this work as a partnership of equals. They need to come up with a project that can be done within 13 months by people who largely do not program; there need to be multiple "exit points" such that something substantial can be presented at the AAS no matter what happens. **Getting all the travel logistics sorted out.** Teachers are bringing kids who are not biologically their own, on long trips. Government travel rules require some outlay of cash, creating stress on teachers! **Working remotely across time zones.** Scientists do this all the time; teachers do not. The teams use email, NITARP wiki, etc.. School email systems are often broken in one way or another, necessitating workarounds. NITARP teams need regular (weekly or biweekly) telecons to succeed. **Software installation.** We use common or free software; some schools put severe limitations on software installation. **Keeping it all together.** The program is long. Between the summer visit, through the start of year chaos in September, there is often brain-drain. The teams just review things again in the Fall – then it sticks better. **Finding funding!** We are often too science-y for outreach proposal calls and too outreach-y for science proposal calls. We are currently funded largely out of discretionary money. You can subsidize a team too! Contact us for more information. **Closing the loop.** It is hard to get teachers to tell us what they did to "share the wealth" after their intensive participation year. We often can't stop them from sharing, and we know they are getting out there, but we need to be persistent to find out what they are doing. **Sustaining a community** of trained educators. Now we have 80 educators who want more, more science, more data, more resources. We have started a "continuing education" series of web-based tutorials for 2013. **Measuring this experience.** This is a complex program, and requires careful and labor-intensive evaluation. Each team, each year, is unique. The impact of the program may be felt most intensively 6, 12, 18+ months after the intensive year is done. We have embarked on a careful study of the 2013 teams.

4. Impact, by the numbers

Since 2005, through August 2013, we have had 38 science posters, 40 education posters, and 8 refereed journal articles come out of NITARP work. Eighty teachers have participated, from 33 states. About 250 different students (gr 7-13) have travelled to the AAS and/or Caltech.

Based on a survey conducted in 2013 of 40 alumni spanning 2005-2013 (~50% of alumni, so multiply numbers by ~2 to approximate net impact):

- ~181 student trips.
- ~752 students at home who didn't travel but worked on aspects of the project (avg ~20 per educator).
- ~3650 students worked with on smaller aspects of the project (avg ~100 per educator).
- ~6500 students benefited from skills/resources the educator learned about via NITARP (avg ~183 per teacher).
- ~10,700 students taught by NITARP educators **per year** – research in other fields suggests that simply being taught by a science teacher who has done real research makes an impact on the students' learning (Silverstein et al. 2009).
- ~2150 other educators reached with NITARP information, everything from "scientists are normal" through working with them on data (avg ~60 per teacher).
- Schools with NITARP teachers are 70% public and 30% private.
- Schools with NITARP teachers have between 0-65% of students on free/reduced lunch; we are not just reaching elite students.

5. Selected Quotes From Particpants

- This program has opened many doors for all of us. It has been the greatest experience in my life and my students' lives.
- The NITARP program ranks at the top of the dozens of professional development programs in which I have participated.
- As a result of this program...my life has been altered forever. I will never be the same educator I was before.
- My NITARP experience is giving me opportunities to teach/engage with students/parents/community members in ways that I would not be able to otherwise.
- My NITARP experience made my science department realize that we need to bring the use of real data into our curriculum. [..Because of NITARP,] I am now working with my dept. chair to bring a research component into all our science classes.
- [Because of NITARP,] I now design lessons with the goal of getting students to do more of their own searching for answers, instead of being "handed" that information by teachers in lecture or power point presentations. It is so much more exciting.
- As a result of this program, I am inspired to include real data in my astronomy course.[. . .]My focus on incorporating real science into my classroom has inspired other teachers in my department to do the same, and generally improved the level of science teaching at my school.

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References

Silverstein et al. 2009, Science, 326, 440