Getting Educators Involved in Authentic Astronomy Research: The NITARP Model

Luisa Rebull
NITARP Director/Research Scientist
Caltech

29 April 2013
[Astronomy] Data in the Classroom

- Now, many avenues for non-professional astronomers to access real, high-quality, astronomy data.
- There are so many that I started a list: http://nitarp.ipac.caltech.edu/page/other_e po_programs and I had to sort it by wavelength and level of commitment!
- Some themes emerge...
[Astronomy] Data in the Classroom

- Four categories, with different audiences, challenges, goals:
  - Reproductions of simple or done projects, using real data (professional quality or really good amateur).
  - Essentially reproductions of done projects, using new data (or a combination of new+archival data).
  - Looking for new things in old data (e.g., citizen science).
  - Original research, professional quality new or archival data.

- Each is valid and worthy and important; each has a different footprint and reaches a different audience of educators and students and the public.

- …But the last bin is kind of…empty. Reaches fewest people, requires most of participants.
NITARP IN ONE SLIDE:

- NITARP = NASA/IPAC Teacher Archive Research Program
- NITARP is designed to give teachers an *authentic research experience* using *real data and tools*.
- A group of educators are paired with mentor astronomer, write a proposal (peer reviewed!), do research, write up results, take it to AAS → model entire research process.
- Three trips: (1) Jan AAS to start (kickoff workshop), (2) visit Caltech/JPL for 3-4 days in Summer, (3) Jan AAS to present results
- (Can bring up to two students per educator on the second 2 trips.)
- Educators then conduct PD/workshops locally/regionally/nationally – spreading the wealth.
- Aimed at high school teachers; middle school, community college, informal educators may also benefit.
- Teacher application available Spring, due Fall; any US-based educator can apply.
- Google NITARP to learn more! Or [http://nitarp.ipac.caltech.edu](http://nitarp.ipac.caltech.edu)
WE ARE UNIQUE (AS FAR AS WE KNOW)

- Our program is aimed at educators.
- We select participants from a nation-wide application process.
- Our program involves educators for at least 13 months (Jan → Jan).
- Our participants do real research. No foolin’.
- Our participants present their results in the same sessions as professional astronomers, and they must ‘hold their own’ in that domain.
- Our participants are encouraged (but not required) to involve students in the entire process.
PARTICIPANT REACTIONS

“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.”

“Becoming empowered in the language and nature of inquiry and investigation was also life changing for our participants.”

“It invigorated me to become part of the greater message, which is the story of space- and ground-based observatories.”

“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 kept wishing this program had been available when I was a kid.”
A Challenge (not unique to us)

- **Finding the right educators.** (recruitment)
  - We depend on them to be:
    - Savvy educators (already capable of working with data, involving students).
    - Somewhat savvy astronomers before we get to them, but **no experience in real research.**
    - Willing to commit to **fluctuating time commitment** over 13+ months, for free. (Need to figure out how to pay them something.)
- **National** application process. (Due September!)
  - For 2013 class, did very well – we had ~5x as many applicants as spots. (in 2012, ~4x)
  - Will it persist in 2014? (Is this discouraging?)
Since 2005, 33 states.
(number in state is number from there; roughly color coded by size of number.)

In the NITARP era:
2010 class: incl. 2 non-trad, 3 comm coll, 1 8th gr
2011 class: incl. 2 non-trad (1 amateur!)
2012 class: incl. 1 comm coll, 2 8th gr, 2 museum staff
2013 class: incl. 1 museum, 2 higher level administrators

NB: 5 IPAC non-science staff too. (model non-PhD STEM careers, provide PD for them!)
A CHALLENGE (NOT UNIQUE TO US)

- **Finding the right scientists.**
  - We depend on them to be:
    - Very patient. These educators are not undergrad students.
    - Able to help team come up with a project that MUST be done within a year, no deferrals.
    - Willing to step in and rescue team (quickly finish reducing data, code something up, etc.), if team becomes too frustrated.
    - Willing to commit to fluctuating time commitment over 13+ months, for free. (Need to find $ at 10-20% level.)
    - See the partnership as a partnership of equals.
  - All essentially local, experienced scientists (so far).
  - Let them work independently, manage their teams, with support if they want it.
  - If we expand, how to train, support scientists?
CONSTRUCTING A TEAM

- Each team has a **mentor astronomer**.
- Each team also has a **mentor teacher** (who has been through program before) to act as ~deputy lead, translating for both camps, which helps everyone.
- Each team has 3-4 **new educators**. (sometimes more, but usually not!)
- They usually are multi-state, crossing time zones, but we try, e.g., not to put the Maine folks in the same team as the Hawaii folks; they need to find a time to talk regularly!
- They meet for the first time at an AAS meeting.
AAS MEETING – JUST ONE TEAM

My team, 2008 class
AAS this year – Jan 2013

2012 class finishing up; 2013 class getting going! ~85/~3000=~3%!
A CHALLENGE (PROBABLY UNIQUE TO US)

- Getting all the travel logistics sorted out.
- These folks don’t necessarily normally travel for business, and for 2 trips, they are invited to bring along minors, to whom they are unrelated.
- Government travel rules require some outlay of cash; we can’t pay for everything directly, and it must be reimbursed → stress on teachers.
- (Each school has different chaperone rules; we let the educators work that out.)
- We need to find $ to pay administrator, manager for all of these details.
PARTICIPANT REACTIONS (TO THE AAS)

“"I had an amazing, exhausting time at the AAS meeting."

“I didn't anticipate meeting engineers and graphic artists.”

“I was surprised at the number of young people[...] I am used to seeing older people as astronomers.”

“Astronomers are a remarkably collaborative lot. I knew this, but I was amazed by how friendly everyone was.”
**AFTER THE AAS**

- The teams go home and work on their *proposals* remotely.
- They turn in the proposals, which get *reviewed* and revised in response.
- All the proposals are posted on the web.
- They do literature reviews or other preparation work for their trip in the summer.
- They should be having *regular telecons* (weekly or bi-weekly) and *regular (reliable!) email* communications in order to accomplish this.
A Challenge (not unique to us)

- *Working remotely, across time zones.*
- We have a wiki on which people can share information – text, discussions, instructions, examples, images, files. Many of the other vehicles you can think of for long-distance collaboration are blocked by some or all schools.
- School email breaks far more often than it should – attachments vanish or entire mail vanishes. (Fall back to gmail [et al.] if any problems.)
- We strongly encourage **regular telecons**, via Skype or tollfree number. If they don’t do this, team often dysfunctional.
A CHALLENGE (NOT UNIQUE TO US)

- **Software installation.**
- Many schools prohibit software installation, or make it really hard.
- We encourage use of commonly available programs (e.g., Excel) rather than things requiring installation.
- Web-based programs are probably ultimately the answer, but not particularly easy to implement to the required accuracy with no money.
- Free standalone Java-based (more platform-independent) software, or free professional packages available for a variety of platforms.

(I hate Windows...)
**SUMMER VISITS**

- Teams come to visit us at Caltech for 3-4 days.
- (Historically 3 days; offered groups 4 days in response to feedback.)
- Educators bring 0-4 students (≤2 on us).
- These visits are very intense and usually represent the first time these folks have worked with data in anything like this detail.
- 0.5 day is a JPL tour, for context (takes more than just astronomers to run a mission, and you can work in STEM without a PhD).
- 4\textsuperscript{th} full day is “training wheels.”
THE SUMMER VISIT

2011 - Bright Rimmed Clouds
A 2012 TEAM ON THEIR JPL TOUR
Summer visit = Intense experience!
WE WORK ‘EM HARD!
PARTICIPANT REACTIONS

• “We did real science!”
• “To have stayed for such a short amount of time and to have done so much work [...] was overwhelming.”
• “One evening, while working on some homework, I had the realization that THIS WAS REAL. There is no right answer, in fact, no one knows the answer. I can't just go and ask someone the answer. It was like a light bulb went off and I experienced a feeling of excitement and also felt a little bit scared. I thought to myself -- Is this how astronomers feel about their work? It was a great feeling and exciting that I too am part of this now.”
PARTICIPANT REACTIONS

“..this experience definitely changed the way I thought about astronomy and astronomers.”

“I never realized how much computer programming is done in astronomy.”

“Real astronomy is making little mistakes that cause you to check all the data again.”

“I kept thinking about how much I couldn't wait to share all I was learning with my Astronomy students this coming school year.”

“I actually felt like I was able to accomplish something that would have some meaning to the scientific community.”

Astronomers are normal, friendly people!
FALL-WINTER

- The teams go home and finish their projects.
- (Sometimes they finish vacations first, which often result in “brain drain” and stuff has to be reviewed in the Fall.)
- Submit abstracts to the AAS early October.
  - One per team on educational aspects of project
  - One per team on science!
- Submitted to the **science** poster sessions, e.g., they must “hold their own” with other professional astronomers from all levels!
POSTERS AT THE AAS

- Most of the ~60-90 people we send annually are the people presenting results.
- Each team takes (at least) one science and at least one outreach poster; up for one day each.
- Total of six posters in Austin in 2012 (from the 3 teams in the 2011 class).
- Total of nine posters in Long Beach in 2013 (from the 4.5 teams in the 2012 class.)
AT THE AAS

(Most of a) 2010 team
A 2010 team
At the AAS

Part of a 2011 team
A CHALLENGE – THE NEXT STEPS

- They know about our **12 hour PD obligation** going in, and have to write up tentative plans as part of their application.

- *Getting them to tell us what they did is a challenge.*

- Generally can’t stop them from sharing 😊, but *closing the loop* is hard.

- We know their “going-in” **plans will change** in a year, and thus we are very flexible in what we ‘accept’ – basically, want them to share the experience:
  - Workshops/Lectures (school, local, regional, national)
  - Articles (they write, or are interviewed for)
  - Anything else …

- Many alumni have moved up and out of the classroom into **higher-level administration**, taking our experience with them!

- Need to chase down impact, trace longer-term impact.
A BIG CHALLENGE (UNIQUE??)

- **Measuring this experience.**
  - It is **open-ended** by design. Each team, each year, has different chemistry, **measures ‘success’ differently**. (e.g., null result is still valid, still a poster, still real science! But probably not a journal article.)
  - Each team **studies something different**, possibly using vastly different techniques and wavelengths (2012: uv, optical, IR, submm – 5 orders of mag in wavelength!).
  - **Formal assessment tough;** tried a few different approaches; formal evaluator for 2013.
  - Can count some things, anecdotally assess others. (We have placed a lot of what we have on our website.)
NITARP ACCOMPLISHMENTS (2005-DATE)

- 80 educators trained/training in real astronomy research, from 33 states.
- 38 science posters, 40 education posters presented.
- 7 refereed articles published in major astronomical journals. (plus one more in The Physics Teacher)
- 150+ students (high school, middle school, college) visited IPAC and/or attended AAS meetings.
- 1200++ students used data through the program.
CHANGING THE CULTURE

3 went to AAS; 8 think differently about astronomy and science.
PARTICIPANT REACTIONS

“I had no idea there was so much research going on in astronomy.”

“The number one thing that the new people should know is that this experience is one of the best they will ever have.”

“Of all the professional development programs in which I have been involved, NITARP continues to rank among the best.”
**A Challenge (not unique to us)**

- **Finding funding.**
  - We are currently funded out of IPAC Archives and Spitzer EPO money, plus some NASA HQ discretionary money.
  - We influence the classroom, but because each team, each project, each teacher, each classroom is unique, few “lesson plans” are produced or marketable. With so few educational products, and such a small footprint, we are not particularly competitive in EPO calls.
  - We are doing real, legitimate science, but not of the highly competitive caliber that would allow us to compete on the open market for archival research money.
    - Timescale for such calls >1 yr.
    - Competitive proposals focus on one question; we have one question per team, the sum of which is diverse indeed.
    - We produce more publications (==posters+articles) per year than most archival projects, and certainly more media coverage!

- Where can we find funding?
SUMMARY AND BROADER IMPLICATIONS

- NITARP gets **real data and real research into classrooms**.
- No school would hire a football coach who’d never played the game...
- The model *anecdotally* works. Need to quantify “works”, see if it really does. Thorough evaluation of **impact**, **benefit**, ‘success’, short/long term.
- Could model be **replicated** in other disciplines? Archives are **big** and just getting bigger. Not just astronomy – climate data, for one.
- “Citizen Science” is great and has a HUGE impact; that’s a hook. This is a **deeper** experience for those wanting it.
- Can it be replicated on a **larger scale**? (new standards!)
NITARP’S FUTURE

Getting real research and real data into the classroom.

I need educators! Application available in May; please help us advertise! (3 min video on the website.)

I need application and proposal reviewers; please let me know if you are interested!

rebull@ipac.caltech.edu