Teacher-Scientist Partnerships in Astronomy Panel Discussion

Panelists:

Luisa Rebull, Spitzer Science Center

John Blackwell, Phillips Exeter Academy

Timothy Spuck, Oil City High School and Center for Authentic STEM Education

Ardis Herrold, Grosse Pointe North High School

Sue Ann Heatherly, National Radio Astronomy Observatory

Moderator: Stephen Pompea, National Optical Astronomy Observatory

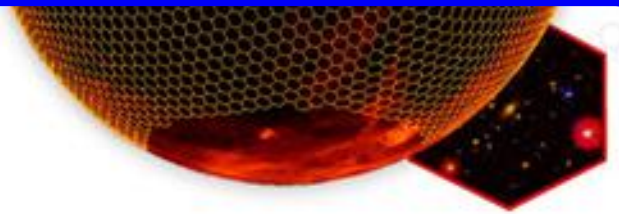
Acknowledgements – Thanks to Chelen Johnson - Breck School

Teacher-Scientist Partnerships in Astronomy

Stephen M. Pompea
National Optical Astronomy Observatory
Tucson, Arizona

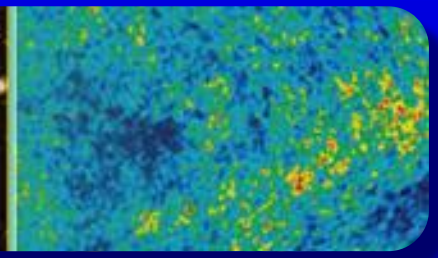
NOAO is engaged with three of the most important Science Frontier projects of the next 15 years….

THE DARK ENERGY SURVEY



The Ground-Based Stage IV BAO Experiment

BigBOSS



Large Synoptic Survey Telescope

LSST

"We need to out innovate, out-educate, and out-build the rest of the world."

NOAO is Highly Committed to Science Education our scientists and engineers ….

- Deliver over 300 educational educational events and teacher professional development workshops each year
- Lead sessions on teacher professional development for research at AGU (for the last ten years).
- Publish widely in formal and informal science education
- Are world leaders in optics and dark skies education
- Support a science outreach center on Kitt Peak and in Chile
- Lead national and international projects (U.S. and Chile especially)

Some Examples of NOAO Teacher Scientist Partnership Projects

Collaboration to Advance Teaching Technology and Science (CATTS)

(NSF GK-12, with University of Arizona (2000-20009)

Trained 134 CATTS Fellows (University of Arizona graduate students in science) worked in Tucson schools 15 hours per week.

Hands-On Optics

(NSF ISE with Optical Society of America and SPIE-The International Society for Optical Engineering)

Teamed scientists and engineers with afterschool and museum educators to reach 20,000 middle school students.

Astronomy from the Ground Up

(NSF ISE with Astronomical Society of the Pacific and Association of Science Technology Centers)

Professional development for 400 educators at 180 nature and small science centers from 48 states

More Examples of NOAO Projects

International Year of Astronomy 2009 and Galileoscope

Large national and international collaborations of scientists and educators with the project office at NOAO.

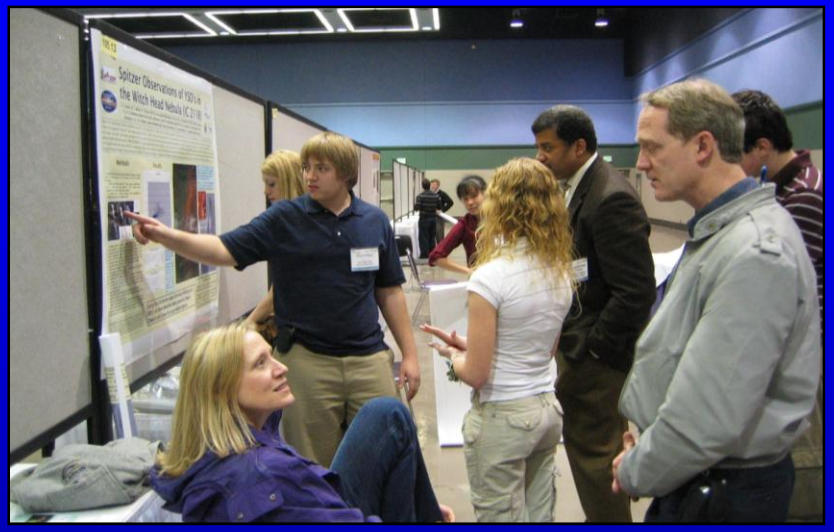
RBSE and TLRBSE

Over 12 years we trained over 130 teachers on astronomical research through a thirteen-week distance learning course and a 10-day summer research institute, and 4 major research projects.

GLOBE at Night

International light pollution research and education program started at NOAO. Citizen science data from 104 countries.

Spitzer Space Telescope Research Program for Teachers and Students (NOAO and NASA)



Thirty two teachers on eleven major research projects yielded 31 scientific posters and 11 research articles. Over 1200 students used Spitzer data through the four-year program.

IPAC = Infrared Processing and Analysis Center, at Caltech; center for Spitzer, Herschel, WISE, [illegible] the IPAC Communications and Education Team (ICE)

American Astronomical Society

NITARP IN ONE SL

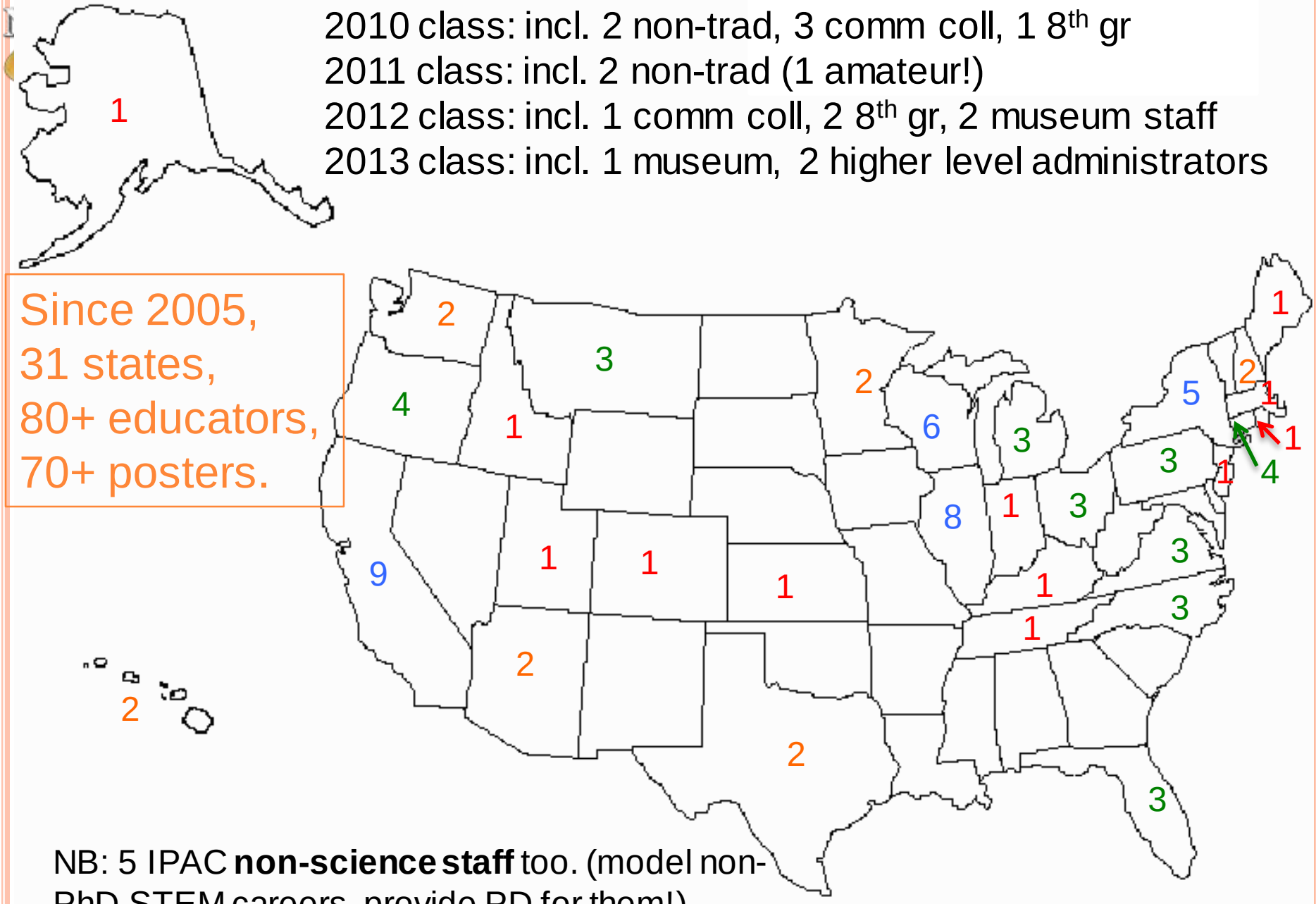
- NITARP = NASA/IPAC Teacher Archive Research Program
- NITARP is designed to give teachers an *authentic research experience* using *real data and tools*.
- A group of teachers are paired with mentor astronomer, write a proposal (peer reviewed!), do research, write up results, take it to AAS → model 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

"Unusual" things about NITARP

- Goal is to ***give educators an authentic research experience*** using real astronomical data and tools.
- Our program is aimed at **educators**, selected from a **nation-wide** application process.
- Our participants do *real research*. No foolin'.
- Our program involves educators for at least **13 months** (Jan→ Jan).
- 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.

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

Since 2005,
31 states,
80+ educators,
70+ posters.



NB: 5 IPAC **non-science staff** too. (model non-PhD STEM careers, provide PD for them!)

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."

Participant Reactions

- "..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…"
- "I never realized how much **computer programming** is done in astronomy. I think this will help me reach out to students who might not be interested in "science." These students may not realize that their programming skills are vital for analyzing astronomical data."
- *"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**!

Changing the culture

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

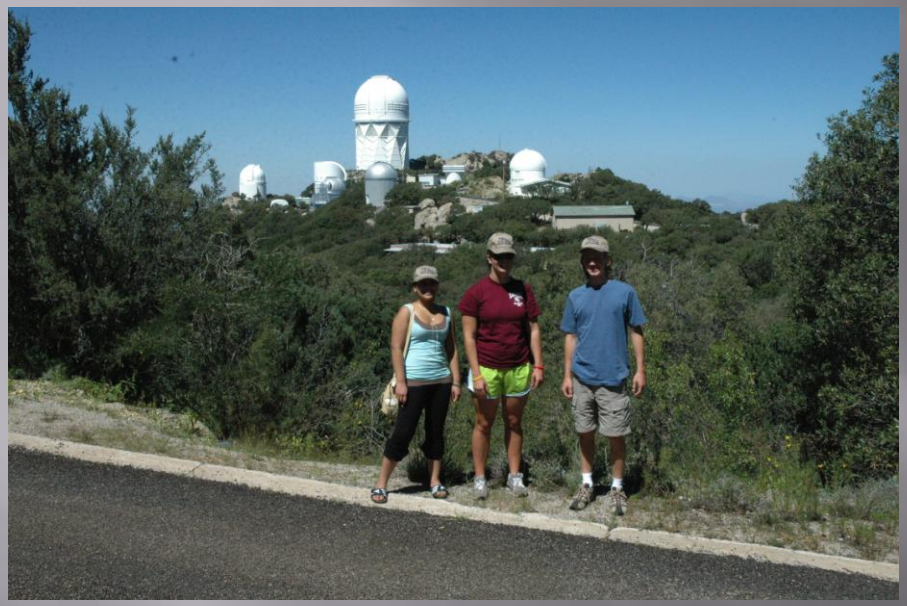
9 Years of Scientist-Teacher Collaboration at Phillips Exeter Academy

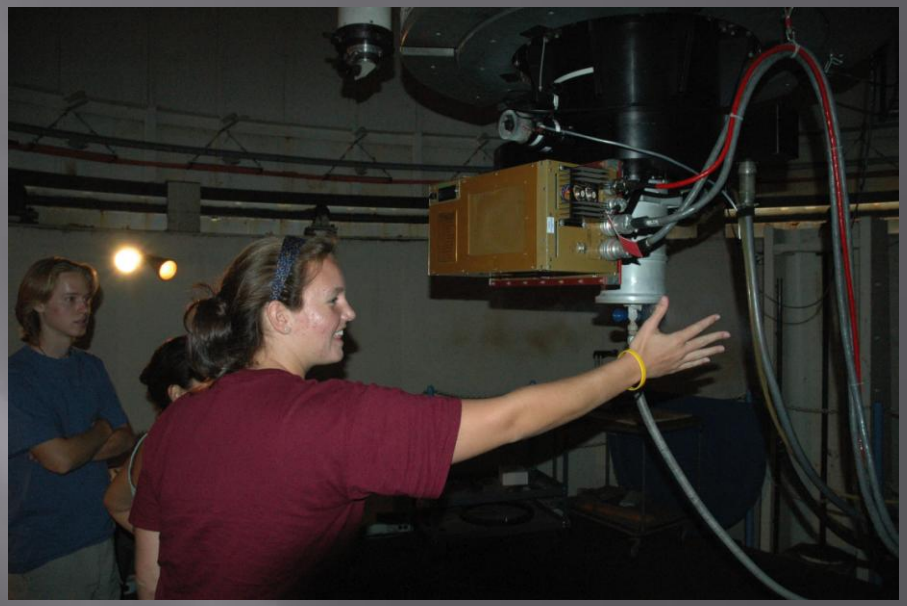
- Commitment to students:
  - A Unique Pedagogy….which is catching on.
  - Provide solid scientific knowledge with more depth.
  - Allow research opportunities at the advanced level.

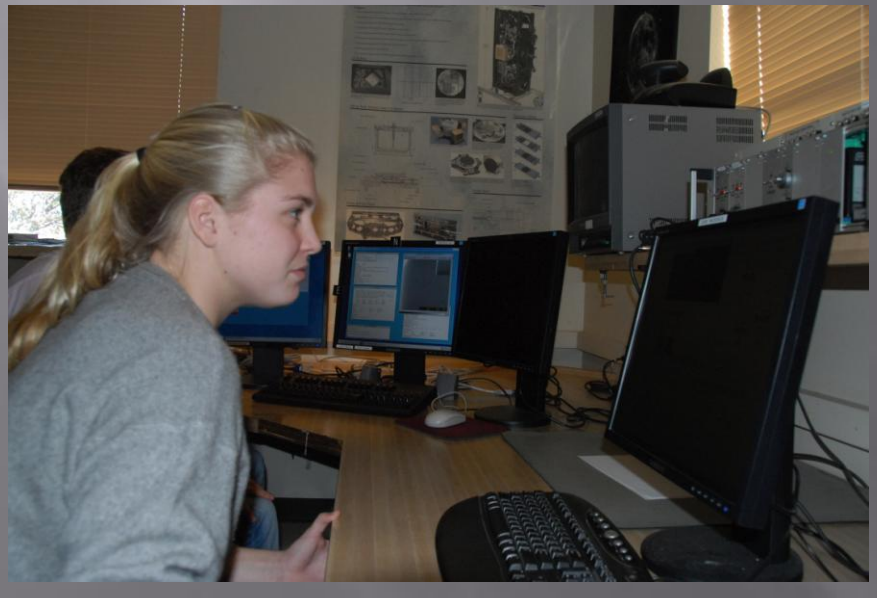
Astronomy

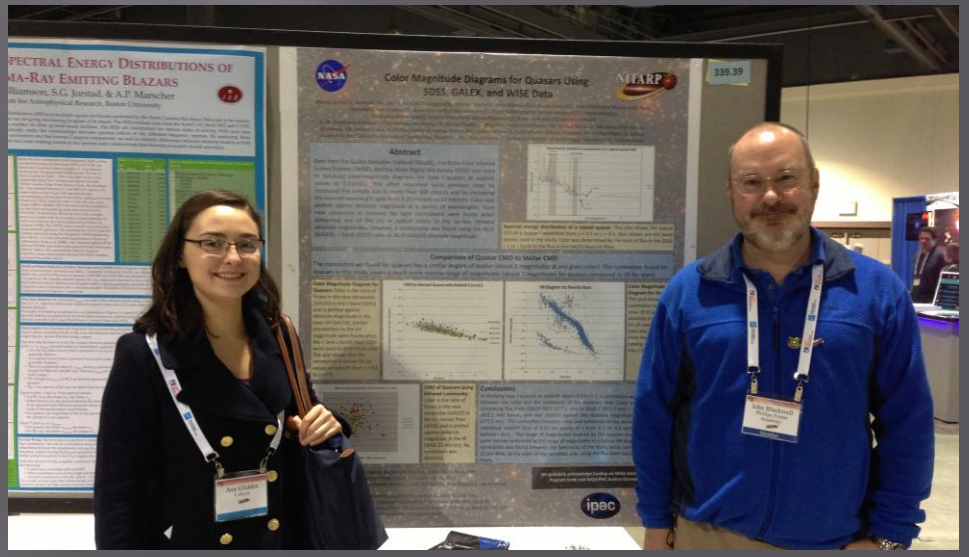
- Astronomy:
  - Introductory Astronomy
    - A shotgun course with a background in essential topics.
  - Special Topics in Astronomy
    - Research based course covering two or three topics.
  - Advanced Astronomy Methods
    - Research based course focusing specifically on instrumental and analytical methods in modern astrophysics.

Of the TOP and AAS









Biology Research

- A collaboration with Dr. Seung Kim's genetics research facility at Stanford.
- 28 Students per year working to perfect specific genetic lines of fruit flies to assist in diabetes research.

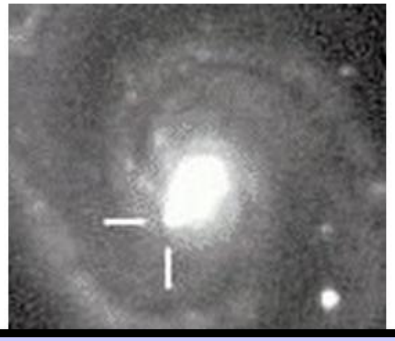
It all started with…

- Programs like:
  - Astronomy Research Based Science Education (ARBSE, TLRBE).
  - Spitzer Teacher Research Program, which became…
  - NASA/IPAC Teacher Archive Research Program.
  - Parent, student and alumni interest!

In the summer of 1992 I attended a 2-week institute at the National Radio Astronomy Observatory in Green Bank, WV.

The program was funded by the National Science Foundation.

Supernova: SN1994I



March 1994 - Oil City Students Heather Tartara and Melody Spence take first light image of SN 1994I providing professional astronomers with some of the earliest supernovae light curve data on record.

ads

The Smithsonian/NASA Astrophysics Data System

NASA

Home | Help | Sitemap | images SN1994I | Search

Successful Operation of Remote Telescopes for Education and Research

- Fulltext Article not available
- Find Similar Articles
- Full record info

Pennypacker, C.; Deustua, S.; Perlmutter, S.; Goldhaber, G.; Arsem, E.

American Astronomical Society, 185th AAS Meeting, #69.05; Bulletin of the American Astronomical Society, Vol. 26, p.1423

Since 1986, we have found over 20 nearby supernovae with the U.C. Leuschner Observatory's 30" automated telescope. This pilot search demonstrated that supernovae can be found reliably using automated search techniques, and we discovered a high rate of Type Ibc supernovae. In addition, we have successfully piloted a high school education project - "The Hands-On Universe Project." In this program high school students become proficient with modern CCD-based astronomical imaging, even undertaking real research. An example of the latter was the acquisition of the earliest images of SN1994I by two students from Oil City Pennsylvania. We have had remarkable success in changing students' attitudes about science, scientists, and education. We are in the final stages of completing the automation of a new 30" telescope to be operated robotically in a good, remote site. This telescope will be functioning by spring of 1995. It will serve the Supernova Search and the Hands-On Universe programs.

News
News From the Field

Press Release 98-079

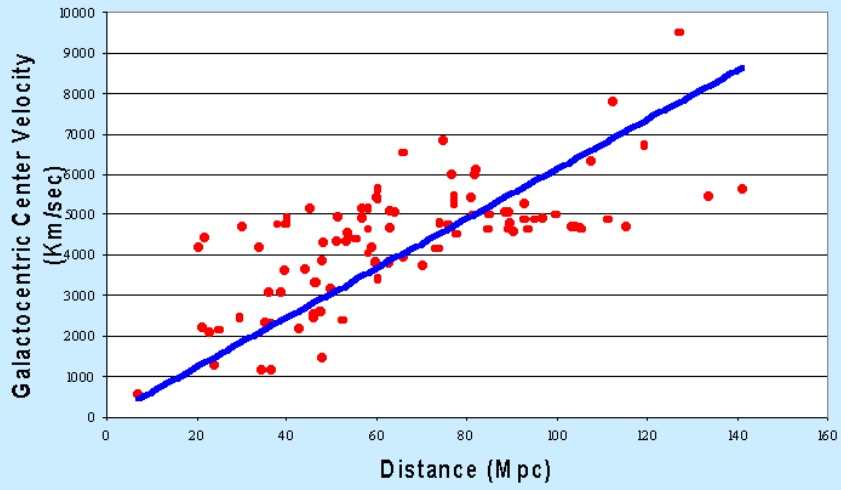
High School Students Discover Distant Asteroid Using NSF Telescope and Education Program

November 20, 1998

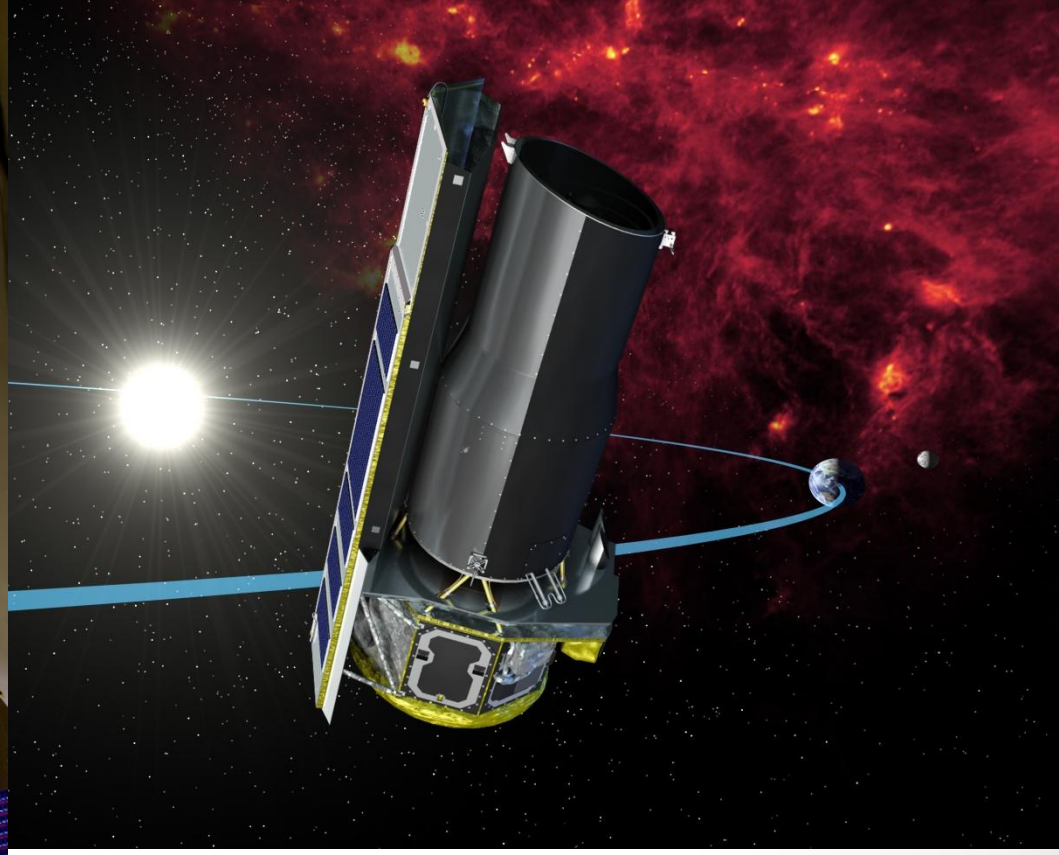
Astronomy teacher Hughes Pack directed the students' search of computer images provided by the Berkeley National Lab's Supernova Cosmology Program. A collaborating team, Stacey Hinds and Angel Birchard, students from Pennsylvania's Oil City Area High School, confirmed the location of 1998 FS144 for their peers at Northfield Mount Hermon. The Oil City students were led by teacher Tim Spuck, a 1998 Pennsylvania Christa McAuliffe Fellow.

"This is a fantastic piece of science, of education, of discovery," said Hands-On Universe founder and astrophysicist Carl Pennypacker of Lawrence Berkeley National Lab and The Lawrence Hall of Science. He added, "The Northfield students' discovery has shown that all students from a broad range of backgrounds can make solid, exciting and inspiring scientific contributions."

2002 - Thanks to an NSF funded RET experience my students and I designed a project to measure the expansion rate of the universe.



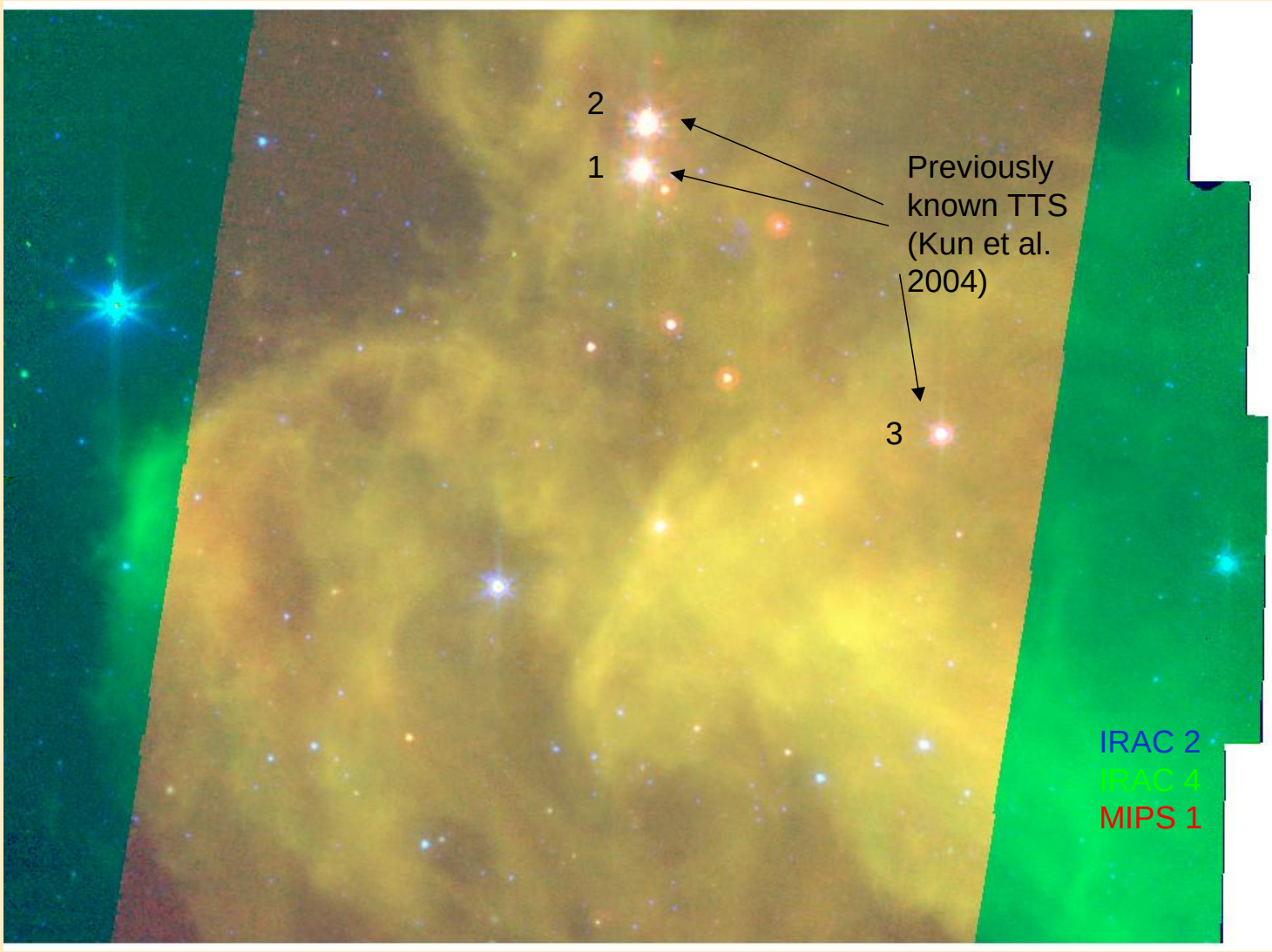
Hubble Constant = 61.2 Km/sec/Mpc

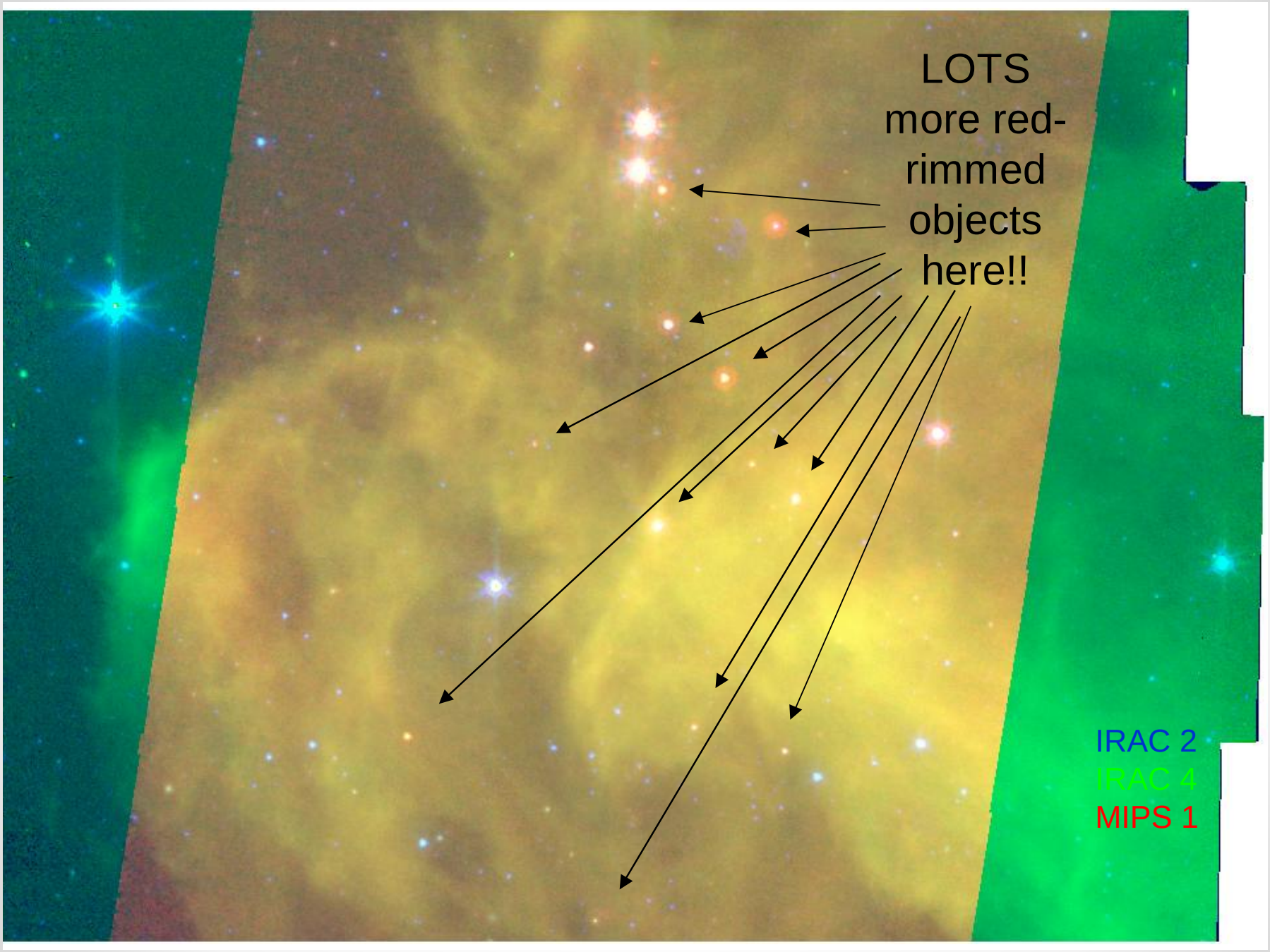


Spitzer Space Telescope Research Program for Teachers and Students

Literature Search

What did we previously know about IC2118?

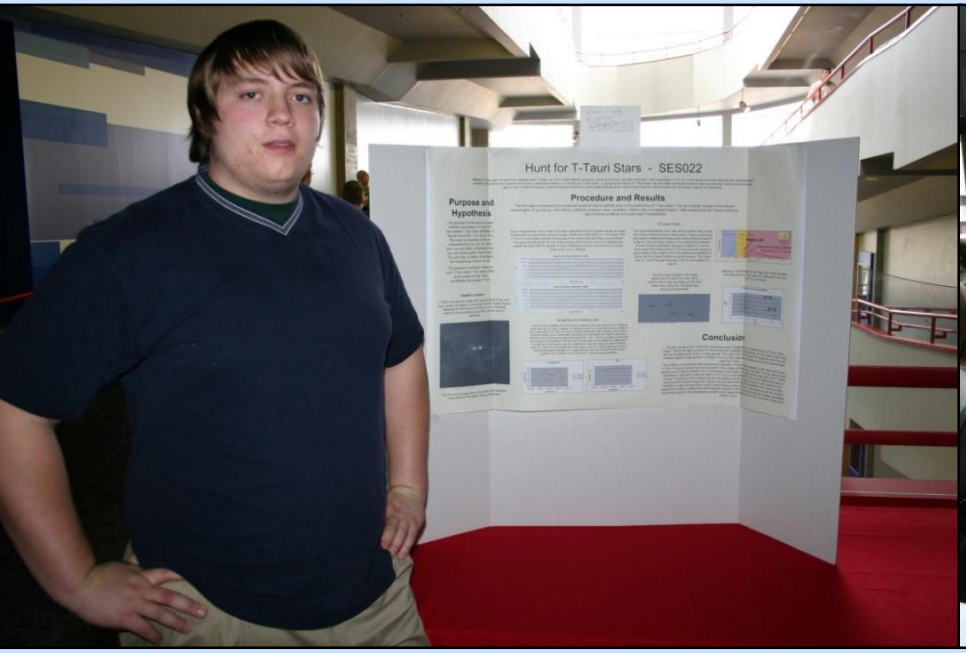



LOTS more red-rimmed objects here!!
IRAC 2
IRAC 4
MIPS 1

Expanding the Project!

Getting H-alpha Data Kitt Peak Observatory through NOAO - RBSE

Oil City junior Nick Kelley takes **1st Place Senior Division Earth/Space/Environment and Best of Science Fair Award** at the 2008 Pittsburgh Regional Science & Engineering Fair for his in-depth analysis of two YSO candidates in IC2118. (April 2008)



And Matt Walentosky goes on to International Science Fair and wins a 2nd Place for his research on the cataclysmic variable star WzSge!

•Rachel and Jennifer awarded time on the Kitt Peak 0.9 M telescope for research testing new method of identifying T-Tauri stars. (November 2008)

•Jennifer wins **1st place at Pittsburgh Regional Science & Engineering Fair and a 4th Place at the International Science & Engineering Fair** in Reno, NV. (May 2009)

Discovered at Berkeley

Perlmutter in his Berkeley Hills home; Laura Nelson reacts to a question about her husband's $750,000 prize money; the winner shares a moment with his daughter, Noa. *(Cathy Cockrell/NewsCenter photos)*

Saul Perlmutter awarded 2011 Nobel Prize in Physics

Unintended Consequences

What's the relationship between the 2011 Nobel Prize in Physics, the Supernova Cosmology Project, the Hands-On Universe Asteroid Search, and the discovery of 1998 FS144 by high school students?

Future Opportunities for Teacher-Scientist Partnerships in Astronomy

1. International Astronomy Research Collaboration between US and Chilean teachers, students, and scientists. NOAO-NRAO Project

2. Large Synoptic Survey Telescope (LSST) - www.lsst.org

- More data in first week than Hubble collected in 20 years
- Image the entire sky ~twice a week
- Ten-year survey; Queryable Database
- Alerts made available within 60 seconds to the World
- Robust EPO plan including online and classroom research opportunities.

Bill Gates: "Giant Peripheral to the Universe"

Educator: "LSST will put a $500 million piece of lab equipment in every classroom around the World."

What does the research tell us?

Students who participated in original scientific research while in high school are significantly more likely to both enter and maintain a career in science compared to students whose first experience didn't occur until university. *(2009) Lesley F. Roberts and Richard J. Wassersug Does Doing Scientific Research in High School Correlate with Students Staying in Science? A Half-Century Retrospective Study.*

In years three and four after program entry participating in Columbia University's Summer Research Program, teachers' students passed Regents science exams at a rate that was 10.1% higher than that of nonparticipating teachers' students. Other program benefits include decreased teacher attrition from classroom teaching and school cost savings of U.S. $1.14 per $1 invested in the program. *(2009) Samuel C. Silverstein et al - Teachers' Participation in Research Programs Improves Their Students' Achievement in Science*

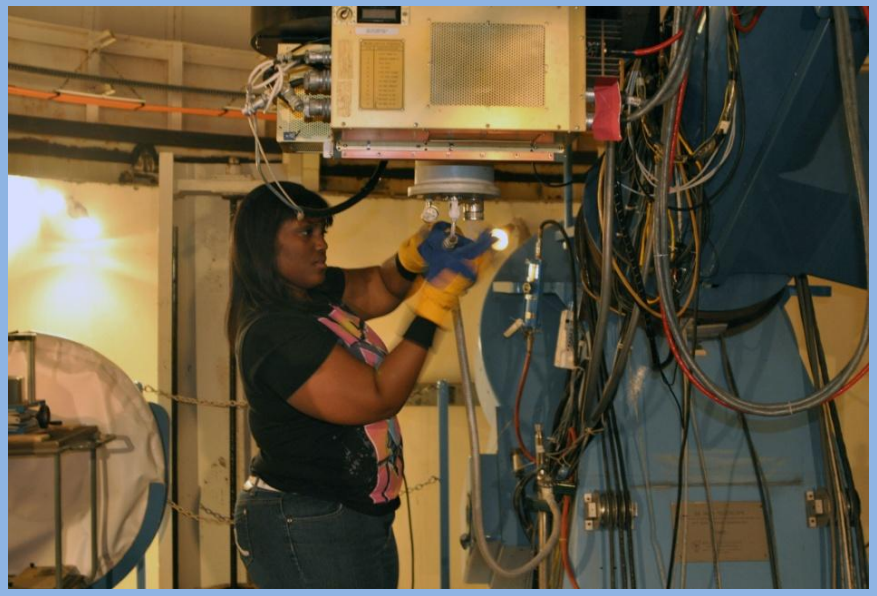
A dynamic learning community, authentic inquiry, a deeper understanding of the nature of science, and learning about scientific careers are all benefits of scientist-teacher partnerships. (2005) Marcelle A. Siegel, Susanna Mlynarczyk-Evans, Tamara J. Brenner, and Katherine M. Nielsen - A Natural Selection – Partnering teachers and scientists in the classroom laboratory creates a dynamic learning community

Partnerships benefit everyone involved. Teachers gain content knowledge and understanding of the nature of science, curricular resources, and increased professional development opportunities. Students' learning of science is enriched and their exposure to role models and scientific careers is enhanced Scientists gain communication and instructional skills, exposure to teaching careers, and interest in future outreach activities. *(2005) American Institute of Research and Wisconsin Center for Education Research - Final Report of the Evaluation of the NSF GK-12 Fellowship Program: Volume 1*

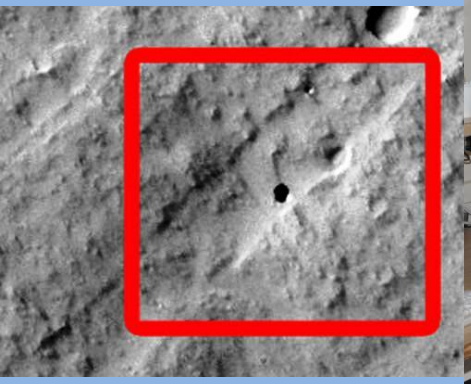
What do professional astronomers have to say about kids doing science?

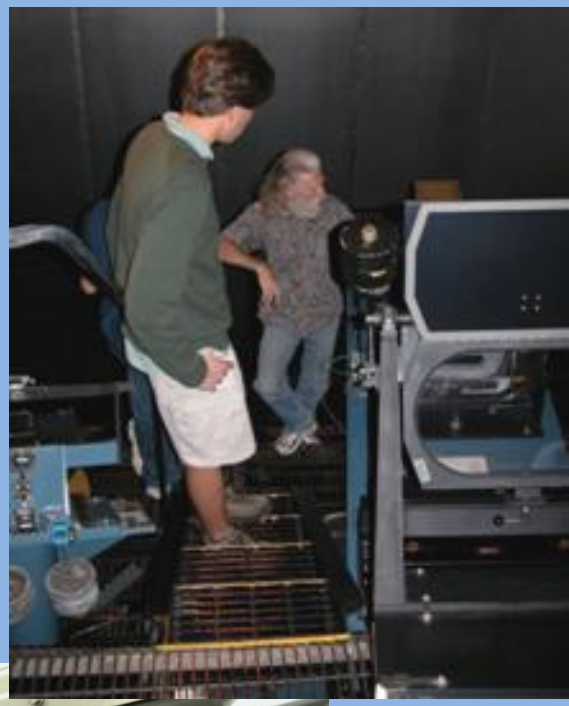
Dr. Neil deGrasse Tyson.

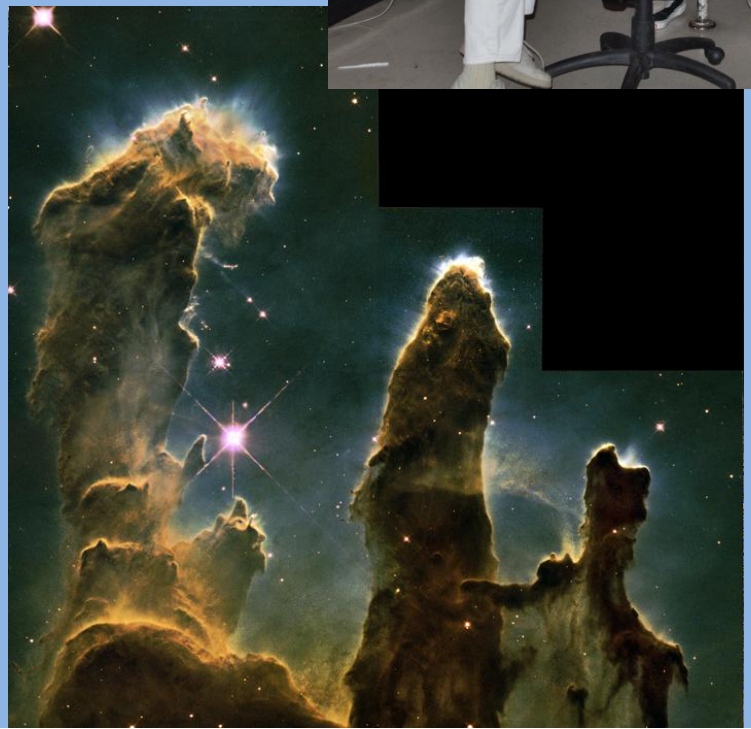
Benefits to students: the 5 C's



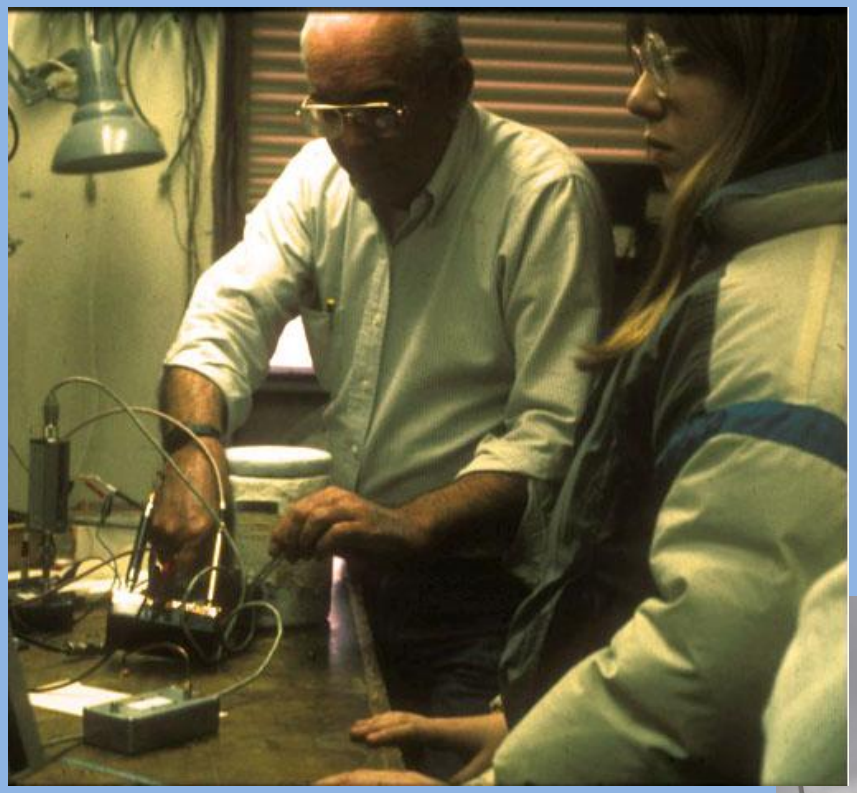
Benefits to teachers and scientists

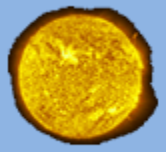






Impact on teachers and scientists

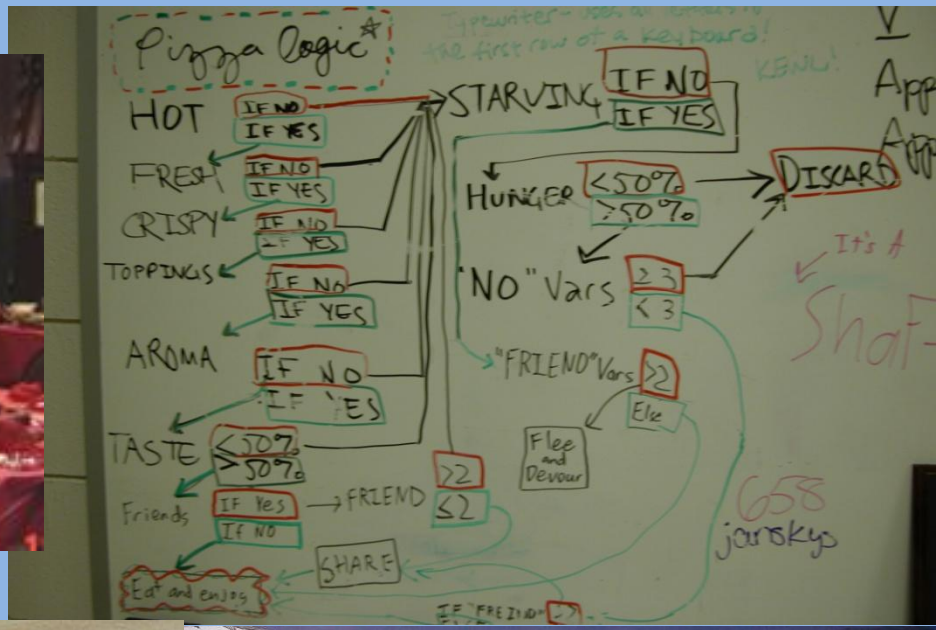


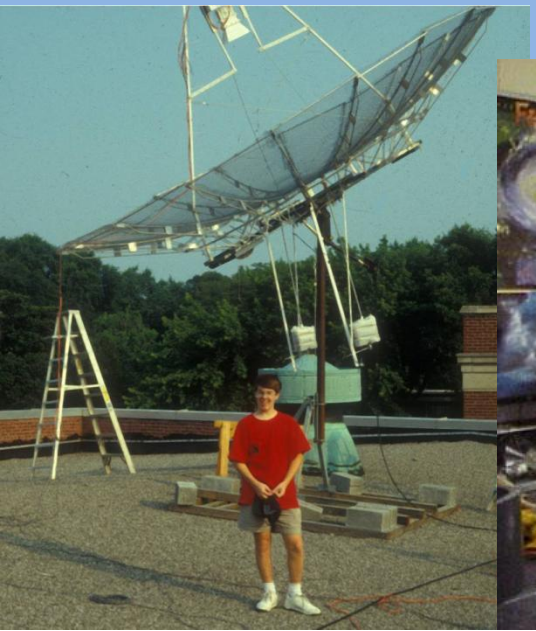


SPH10002911

mag : 14.74, radius: 1.002 x sol, Temp: 5816.0 K
A star with a potential planet of radius and period .
single dip @ 55.5d
First identified on 01/31/11 by planet hunters Denzyl, spoodle58, super-g-muc, pucovsky, amarrg, jomill, kcabral28, rickduff, Pegazus, vanislandguy

Impact on students





Learnings

Learnings

RATz

Partnerships at the National Radio Astronomy Observatory

Teacher Institutes

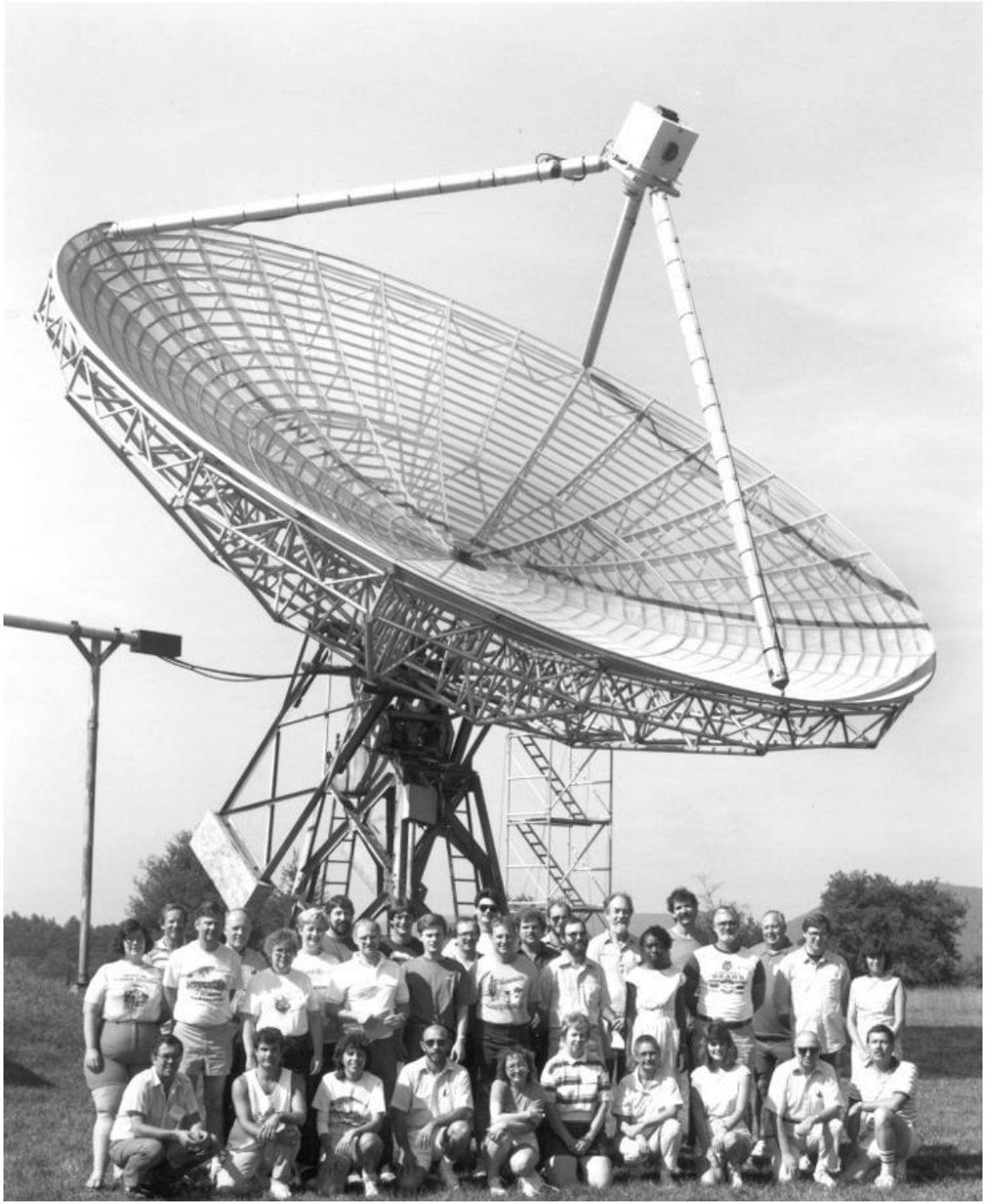
- 2-week residential, summer
- Target group: K-12 Teachers and Preservice teachers
- Began in 1987, 1100 teachers
- NSF, NASA funding

Research Experience for Teachers

- 8-week summer job
- Target group: 7-12 Teachers
- 13 years, 28 Teachers in the program
- Goal: teachers work with astronomers on their research

Pulsar Search Collaboratory

- One week summer residential program for teachers and students
- Capstone Seminar
- Target group: high school students
- Funded by the NSF



Pulsar Search Collaboratory

NSF award DRL # 0737641

The PSC is a collaboration between West Virginia University and NRAO. The goals of the PSC are to advance science teachers' and students' understanding of the nature of science, and to motivate students to consider pursuing STEM fields of all kinds - by apprenticing them within a professional scientific community doing scientific research—specifically analyzing GBT data in the search for new pulsars. Results and statistics include:

Geographic distribution of PSC teachers and schools.

- **Seventeen hundred students** have been exposed to research through the PSC ;
- **One hundred-six teachers** and 191 students from 18 states have participated in summer workshops;
- **Eight hundred and six students** are full PSC members (391 girls, 414 boys);
- As of 2/10/2013, PSC students have analyzed **1,824,060 pieces of data.**
- **Six pulsars and one transient object have been discovered by PSC students.**

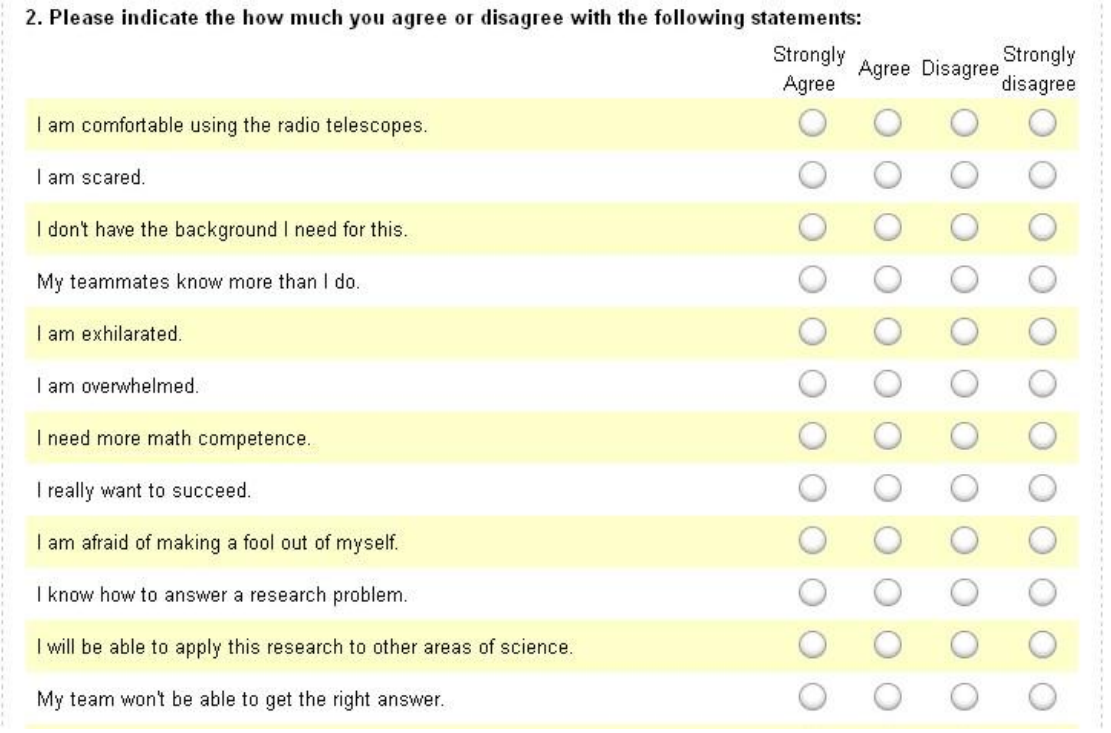
Evaluation: Measuring Outcomes

Evaluation Plan includes pre/post instruments to measure

- Confidence, attitudes toward research, scientific identity, etc.
- Gains in Understanding of the Nature of Science
- Gains in content knowledge
- Interest in STEM careers

Statistical analysis of teachers, and PSC students who participate in summer workshops, or capstone seminar.

Research Self Assessment for Teachers. Alpha Coefficient: 0.89



2. Please indicate the how much you agree or disagree with the following statements:

	Strongly Agree	Agree	Disagree	Strongly disagree
I am comfortable using the radio telescopes.	○	○	○	○
I am scared.	○	○	○	○
I don't have the background I need for this.	○	○	○	○
My teammates know more than I do.	○	○	○	○
I am exhilarated.	○	○	○	○
I am overwhelmed.	○	○	○	○
I need more math competence.	○	○	○	○
I really want to succeed.	○	○	○	○
I am afraid of making a fool out of myself.	○	○	○	○
I know how to answer a research problem.	○	○	○	○
I will be able to apply this research to other areas of science.	○	○	○	○
My team won't be able to get the right answer.	○	○	○	○

Table 1: Teachers. Research Self Assessment Total T-test Pre/Post Scores

	Cohort 1 Teachers			Cohort 2 Teachers			Cohort 3 Teachers			Cohort 4 Teachers		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Pre	15	82.53	8.37	10	84	11.11	10	84	11.11	31	83.87	9.33
Post	15	87.67	10.55	10	87.4	9.51	10	87.4	9.51	31	88.75	8.03
	1-sided paired t = 1.59 P < 0.0674			1-sided paired t = 4.69 P <0 .0009			1-sided paired t = 2.06 P < 0.0345			1-sided paired t = 4.10 P < 0.0001		

Rigorous External Evaluation shows that the PSC:

- **increases interest in STEM Careers in all students;**
- **increases self-efficacy and scientific identity in girls, two key predictors of future success in completing STEM majors (EG: Bandura, 1997, Lent, et.al. 1994).**

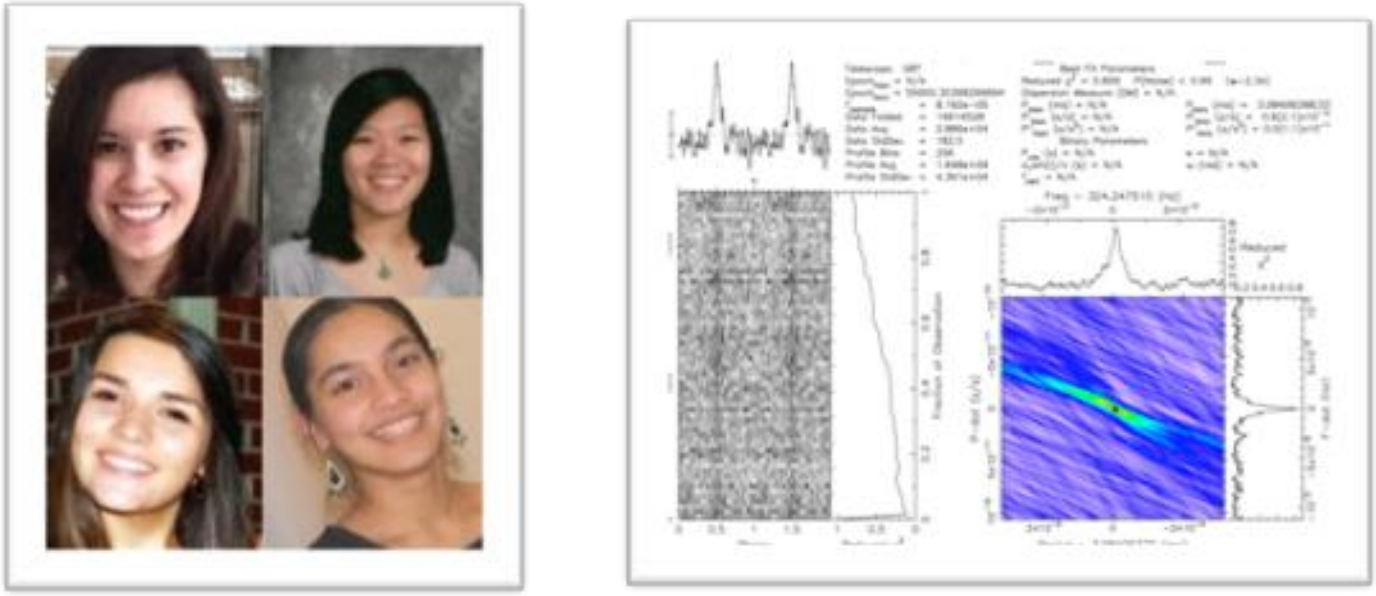
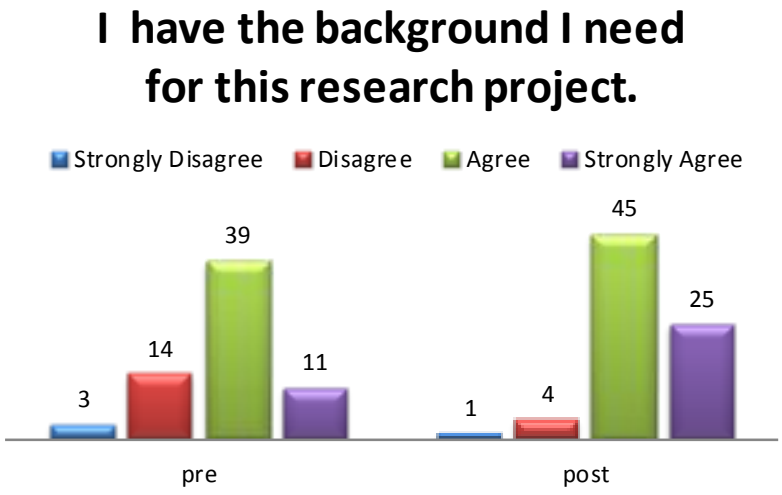


Figure 4. Discovery made by PSC students in January 2012. Left: Pulsar hunters Sydney Dydiw of Trinity High School, Emily Phan of George C. Marshall High School, Anne Agee of Roanoke Valley Governor's School, and Jessica Pal of Rowan County High School. Not pictured: Max Sterling of Langley High School. Right: Part of the Discovery Plot.

Boys (but not girls) show pre/post gains in two items indicating self confidence.

When I think **about** a research project I feel…

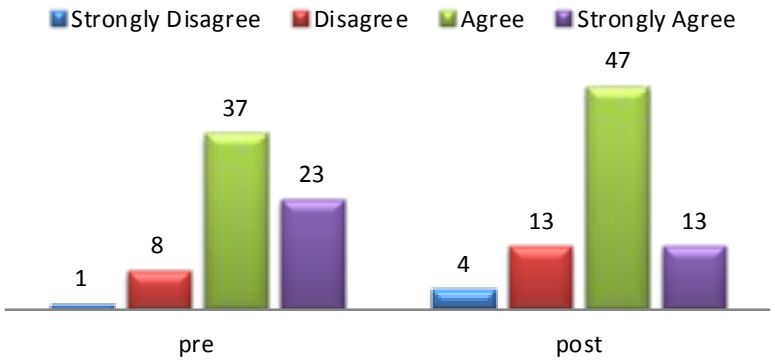


N= 76, Chi square test significant at P<0.05

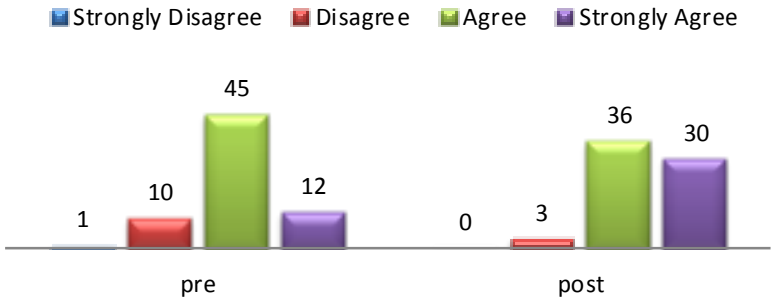
Girls (not boys) show gains in self confidence, confidence in their team.

When I think about the research project I feel…

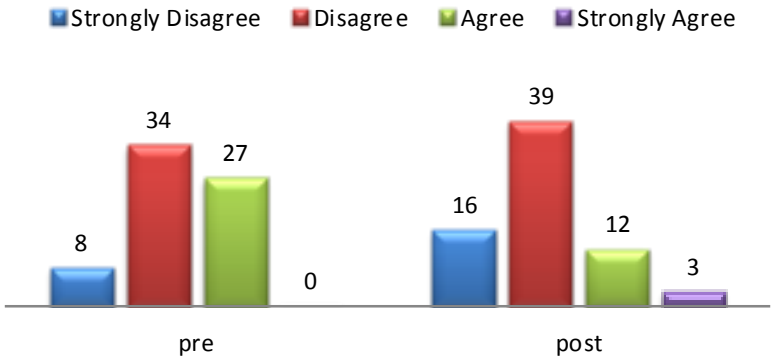
Challenged.



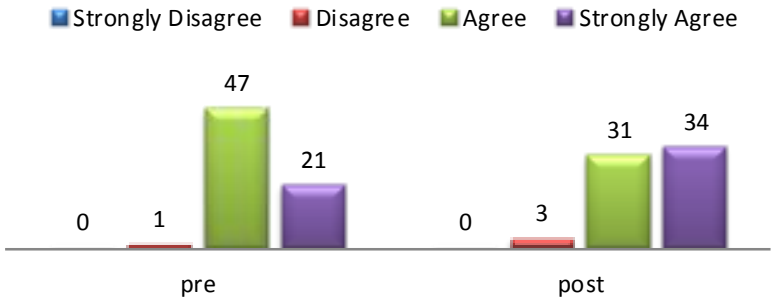
Comfortable using scientific instruments .



Overwhelmed.



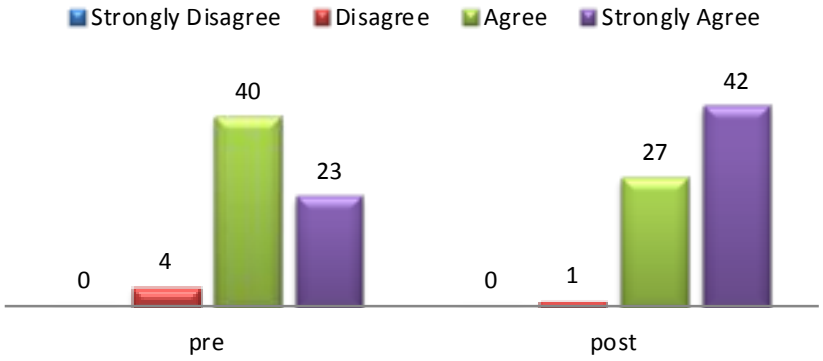
My team will be able to get the right answer.



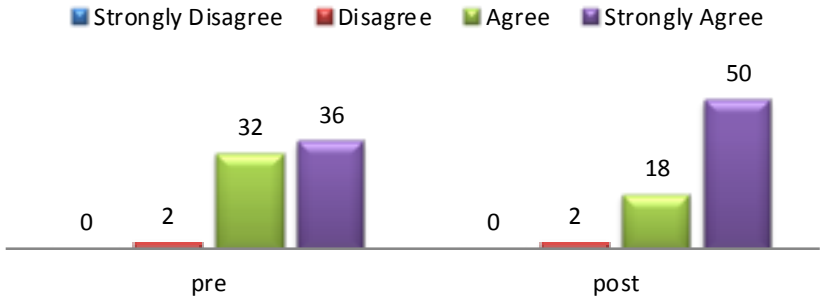
N= 77, Chi square test significant at $P<0.05$

Girls (more than boys) show gains in self-efficacy, identity as a scientist.

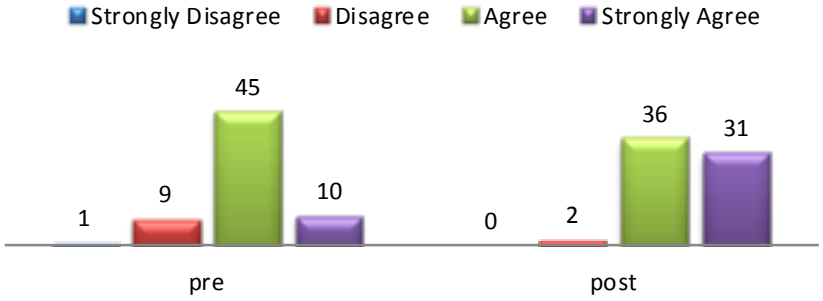
I'm a valuable member of a team.



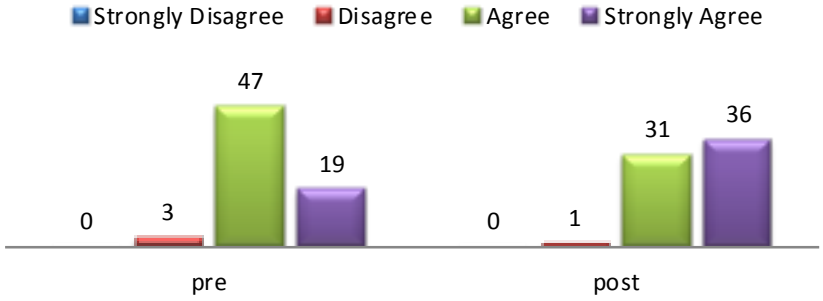
We will be doing valuable research.



I know how to answer a research question.



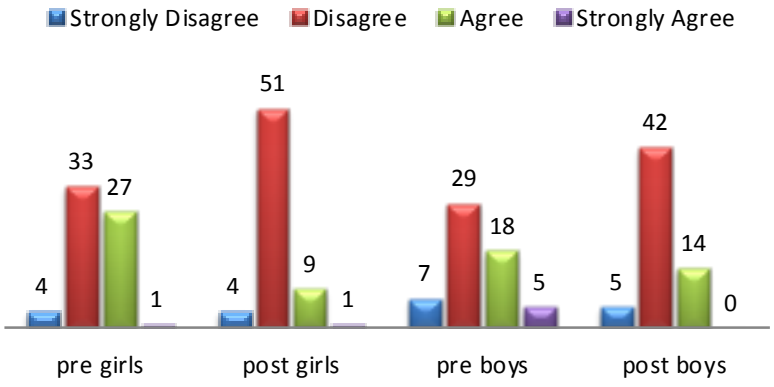
I understand the scientific method



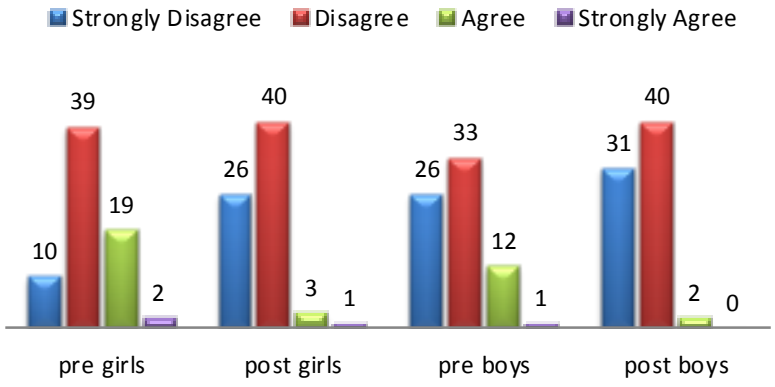
N= 77, Chi square test significant at $P<0.05$

Gains in Girls and Boys.

My teammates know more than I do.



Afraid to ask the scientists questions.



N= 153, Chi square test significant at P<0.05

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