Inquiring minds want to know…

How do we inspire and engage Americans with astronomy and space science at SSL?

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http://cse.ssl.berkeley.edu
It all started with EUVE...

1986: Drs. Stuart Bowyer and Roger Malina begin the EUVE project
1988: Dr. Isabel Hawkins joins EUVE group as researcher
1989: Dr. Nahide Craig joins group as researcher
1994: Drs. Hawkins and Craig work with Dr. Roger Malina to start doing education using EUVE science, discoveries, web tools.


1996: Dr. Hawkins becomes Coordinator of Public Programs
1997: Dr. Hawkins starts CSE@SSL as Director and Senior Fellow with Sun-Earth Connection Education Forum, Project FIRST, Science Education Gateway (SEGway)
1996: Dr. Luhmann supports Dr. Hawkins proposal to NASA to run the Sun-Earth Connection Education Forum

1997-98: Vondrak, Hawkins, Thieman

We are a team of dedicated scientists, educators, students, artists, writers, computer programmers, and staff working in a dynamic environment that develops our talents and ideas to their fullest potential for the benefit of space science education.
Our Mission

“We share the wonder of our Universe by building bridges between scientists, educators, students, and the public. By placing science within its broadest cultural context, we make science discovery accessible to all.”
Questions for discussion

What activities of ours have you heard about?

How have you been involved?
General Misconceptions

“The education group at SSL mostly visits classrooms”

False! Our group mostly works with established education partners and astronomers and space scientists in a variety of ways described in this talk to get the most “bang for the buck”

“Scientists are too busy to contribute to astronomy and space science education and outreach”

False! We work hard to make it easy for scientists to participate in our education and public outreach (E/PO) programs
Since 1997, 0.25% to 2% of the total budget of every NASA space science satellite mission is dedicated to Education and Public Outreach (E/PO) programs.

This is an investment of approximately 25 million dollars per year focused on space science E/PO nationwide.

NSF has a requirement for broader impact in proposals and supplemental E/PO programs.
E/PO Audiences

- Formal Education
  - Links to Systemic Reform
  - Educator Workshops
  - K-14 Curriculum Development
  - Distance Learning Courses
- Informal Education
  - Museum Exhibits & Programs
  - Planetarium Shows
  - Youth Programs (e.g., Scouts, 4H)
  - IMAX films
- Public Outreach
  - Educational TV
  - Radio Programs
  - Webcast
  - Popular Science Articles in Magazines

Courtesy of Dr. Cheri Morrow, SSI
Outline of Talk

Reaching many hundreds of thousands; building an awareness of astronomy and space science

Reaching thousands; building in-depth knowledge of astronomy and space science

Reaching out to new audiences; creating opportunities for those who are under-represented in science
Fact #1: There are far more non-scientists than scientists

There are

~10,000 space scientists and astronomers (+ 10x more engineers in aerospace industry)

Compared with

~300,000,000 people in the U.S.**
~45,000,000 students enrolled in grades K-12***
~3,000,000 teachers in K-12 classrooms***
~87,000 K-12 schools***

**http://www.nationmaster.com/country/us-united-states
The Challenge

Given the small numbers of scientists and engineers compared with the large numbers of the general public, teachers, and students...

How might a program leverage scientist and engineer involvement in education and outreach?
How we strive to meet this challenge in our E/PO programs

**SCALE** ~ 5,000 astronomers/space scientists interested in E/PO and millions of students, teachers, and general public to inspire.

**HIGH LEVERAGE PROGRAMS** amplify our individual contributions. We use existing educational infrastructure and connect scientists to educational professionals and programs.
Bringing an awareness of astronomy and space science to large numbers of people

Sun-Earth Day and World Space Week*

Professional development of community and education leaders in space science and astronomy
- Teachers (workshops at SSL, at invited venues (SMUD, Turtle Bay Exploration Park), state and national science teacher conferences)
- Park Rangers
- Museum and science center docents (people who work with public/teachers at these institutions)

Science Center and Museum Exhibits
- Alien Earths Exhibit – WISE E/PO
- ViewScience

Internet through web sites
- Stardust@home (100,000 people involved)
- Mission E/PO (THEMIS, STEREO-IMPACT, RHESSI, FAST, WISE)

*You can easily participate
Most textbooks and science education standards try to cover every science topic, but just at a shallow level.

Research in how people learn has shown that we learn better when we go into more depth on fewer topics, and can then more readily apply concepts and skills we have learned to other contexts.

(Countries that do this in their educational systems tend to out-perform the U.S. in international STEM testing).
Knowing that we learn best through in-depth instruction, but that textbooks and standards are a “mile-wide and an inch-deep”...

how do you help schools and teachers engage their students in more authentic and meaningful science learning?
How we strive to meet this challenge in our E/PO programs

**In-Depth instruction**: People learn best by delving deeper into a subject, and then applying their new knowledge and skills to other subjects.

**K-16 EDUCATION partners**
Partnerships with curriculum designers and K-16 educators to develop **practical, longer-term learning engagements**, for students and for teachers, using space science and astronomy concepts and data - fostering more in-depth study in K-12 classrooms.
Examples of our more in-depth programs

Building people’s knowledge of astronomy and space science concepts, and how science works, to **fewer numbers of people but to more depth**

**Curriculum development**
- Eye on the Sky (with literacy and art for elementary school)
- LHS/GEMS Space Science Sequences (addressing core concepts and known misconceptions, for grades 3-8)
- STEREO-IMPACT, RHESSI, and THEMIS E/PO teacher guides (addressing magnetism in the Sun and Earth)

**Undergraduate courses**
- Cal Teach course or future science teachers
- Berkeley City College space science seminar

**Longer-term teacher professional development**
- 2-day CSE@SSL workshops spread over a semester
- THEMIS and WISE E/PO teacher “ambassador” programs – working with teachers over years
Fact #3: Insufficient students with STEM degrees to maintain US competitiveness

Declining numbers of Americans are entering science and engineering fields*

Approximately half of those with professional or doctoral degrees working in engineering, math, and physical/biological sciences in the US, are foreign-born.**

*Committee on Science Engineering and Public Policy, 2006
**http://www.nafsa.org/public_policy.sec/international_student_1/immigration_reform_issues/presidents_economic_report
The Challenge

What are some ideas to increase the numbers?

How might a program draw in students who do not consider being scientists because they lack role models, or do not feel like they can do science, or think they are not interested in science?
Broaden participation of all to remain competitive

Tap traditionally under-represented communities

Tap growing population groups in US
  - In 2006, 39% of people < 18 are persons of color*
  - In 2050, 49.9% of people < 18 will be persons of color*

Work toward gender equity in science
  - 50% of people < 18 in the US are female

Increase participation of Hispanic, African American, Native American and female students in STEM fields.

*The Unfinished Agenda: Ensuring Success for Students of Color, Increasing Success of Minority Students in Science and Technology” The American Council On Education, 2006; US Census figures
Examples of New Audiences from our Programs

Engaging people in astronomy and space science who would traditionally not see themselves as scientists or scientifically engaged...

Bringing our programs to underserved communities

- Berkeley City College reaches people from a variety of different backgrounds and cultures
- THEMIS E/PO program works with teachers from rural schools and on Native American reservations
- Solar Week brings the science of the Sun and a message board to students where they can ask questions of women solar and space scientists

Integrating cultural heritage and ways of knowing with modern astronomy and space science

- Mayan Alive works with the Mayan community in the Bay Area and Mexico to combine the rich ancient Mayan science observations with current solar and space science in community events
- NSF Cosmic Serpent and NASA One Earth One Universe train museum docents and scientists in Native American ways of knowing, respecting their scientific knowledge while sharing modern astronomy and space science discoveries
Questions?