

SOFIA's E/PO Program: Education Partnerships at 41,000 feet



- **Over-arching Objectives:**
 - Support NASA's goals to inspire the next generation of explorers
 - Enhance science and technology education in communities across the US
 - Establish long-term relationships between NASA, educators and scientific researchers
 - Contribute to general public understanding of the value of scientific research



SOFIA - A Unique NASA E&PO facility

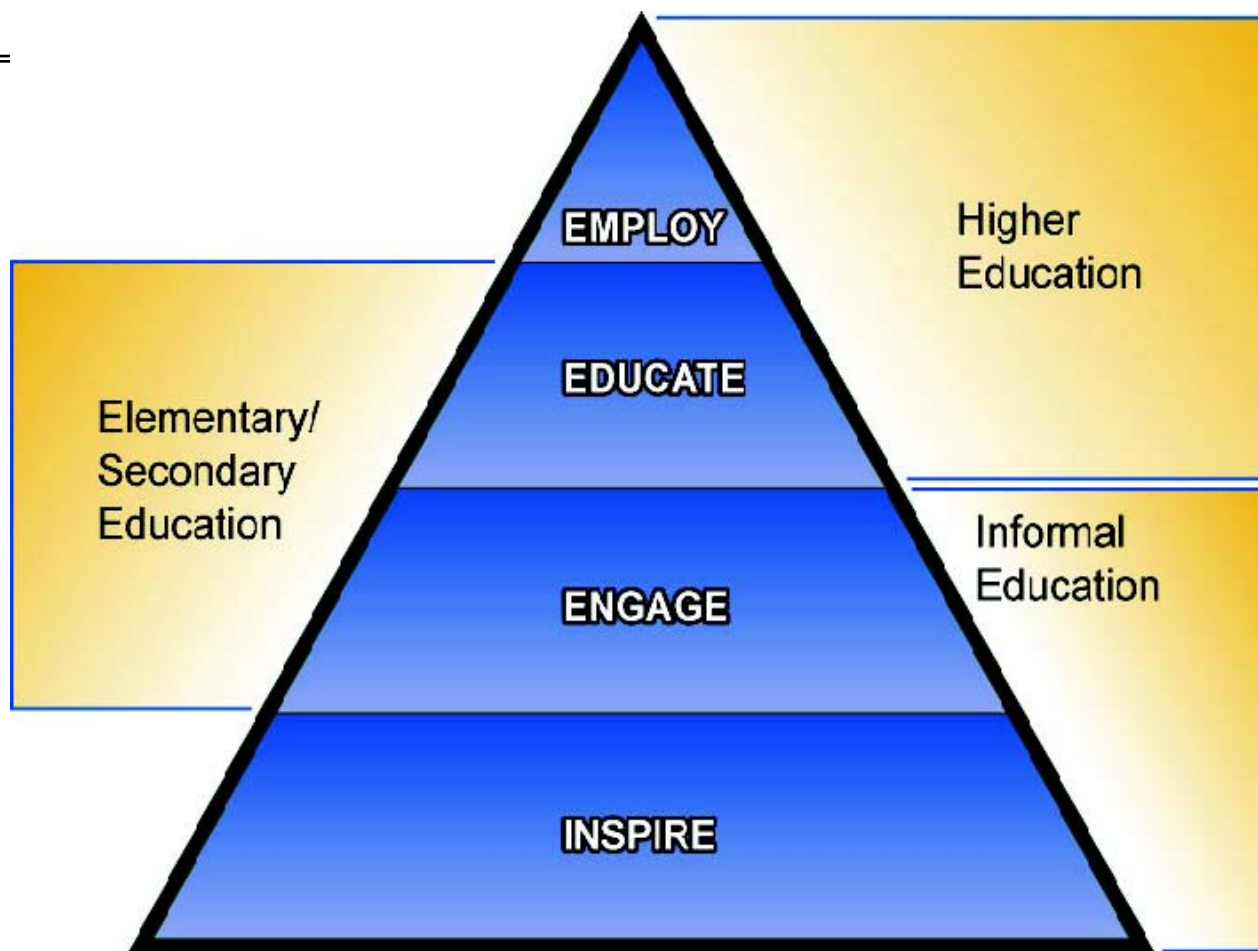


- SOFIA's day-to-day operations are like a high flying ground-based observatory
- BUT, in terms of its scientific promise SOFIA is more like a space observatory -- which calls for a substantial Public Affairs (press & media) function to inform the public that their investment has paid off
- SOFIA is the only major observatory -- ground- or space-based -- designed from the start, both physically and administratively, to foster partnerships between educators & scientists in a research environment
- SOFIA is uniquely capable of giving members of the public – teachers, college faculty, undergraduate students, amateur astronomers -- familiarity with the processes of scientific research
- SOFIA is capable of delivering unique impact -- rivaling the magnitude of HST or Mars Rovers, but more personal -- in communities across the U.S.



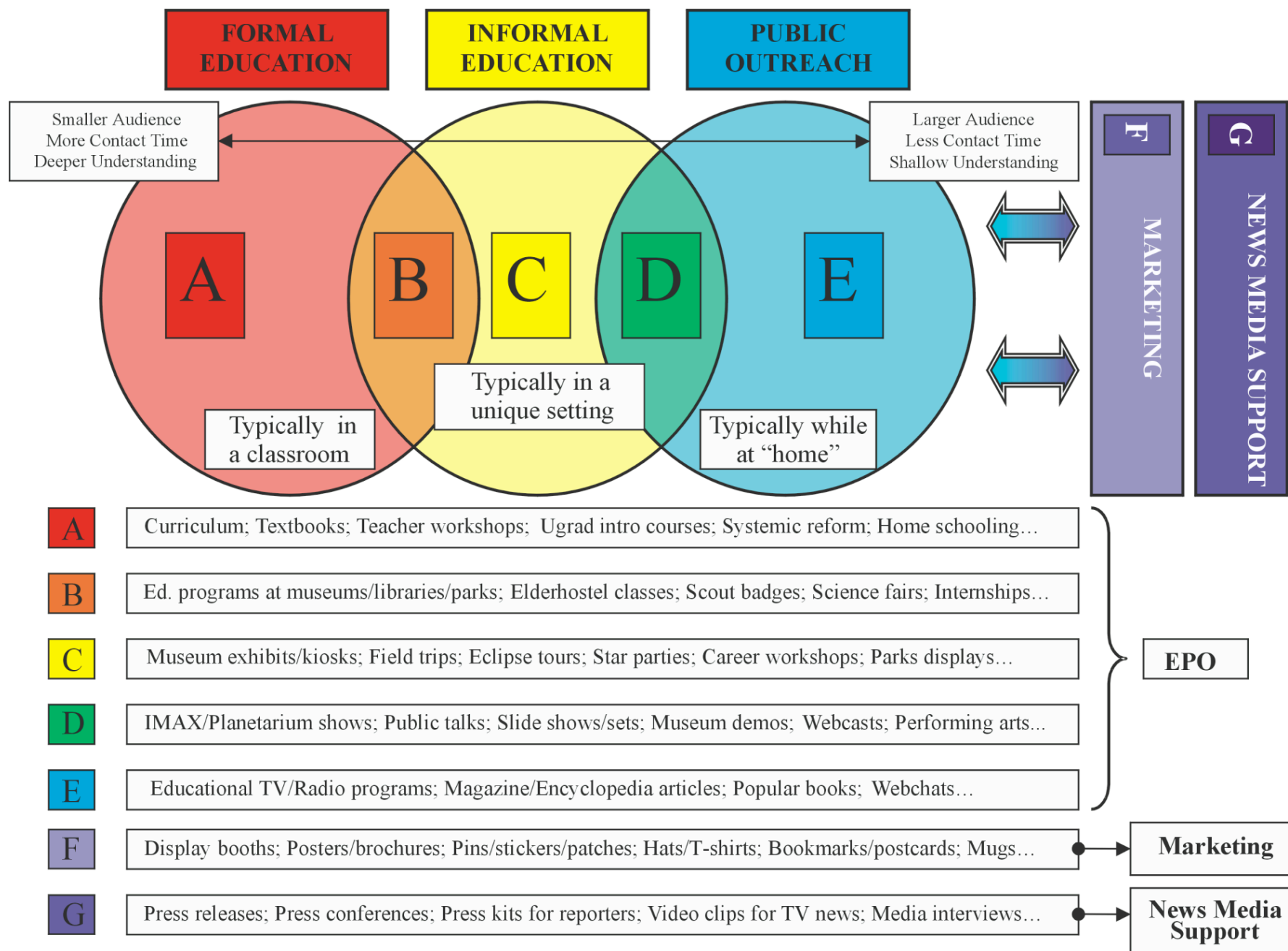


NASA's Education Strategic Plan



SOFIA's E&PO program addresses each level of the plan ...







KAO FOSTER educator flight program





KAO FOSTER flight program





Pre-history of the SOFIA Education Program



- In the late 1980s Larry Caroff (then, Ames astrophysics branch chief), Dave Koch (Ames astronomer & KAO observer), Garth Hull (then, Ames Education Officer) and Carl Gillespie (KAO Mission Director) envisioned inviting teachers onboard the Kuiper Airborne Observatory to work with astronomers during research flights
- The resulting FOSTER program, organized by Koch and administered by Edna DeVore (SETI Institute), flew 70 teachers during the final 5 yrs of the KAO's mission, 1992-1996
[FOSTER = Flight Opportunities for Science Teacher EnRichment]
- Caroff moved to NASA HQ, co-authored the RFP for SOFIA, and helped specify that flying educators onboard SOFIA would be a Level-1 mission requirement, recognizing the great potential benefit to NASA





Partnerships and collaborations



Nationwide partnerships to leverage NASA's education and outreach efforts

USRA, SETI Institute and ASP's institutional added values:

- Nationally recognized education organizations w/ mature networks
- Ongoing connections to other NASA & NSF education programs
- Successful track records in developing education programs and materials





Partnerships and collaborations, cont'



Nationwide partnerships to leverage NASA's education and outreach efforts

Universities Space Research Association (USRA)

- Consortium of 97 universities in the US and abroad



- 20 research facilities and programs - some at each NASA center
- Operates the Lunar and Planetary Institute in Houston





Partnerships and collaborations, cont'



Nationwide partnerships to leverage NASA's education and outreach efforts

SETI Institute



- Curriculum Materials Development:
 - Voyages Through Time*--high school, 400 schools
 - Life in the Universe*--teacher guides grades 3-9, US and Australia
 - Life in the Universe*--most popular college text for astrobiology
- Teacher Professional Development:
 - FOSTER Project on Kuiper Airborne Observatory, 1992-96
 - Astrobiology Summer Science Experience for Teachers, 2004-09
 - 100+ teacher workshops and short courses
- NASA Mission E/PO Programs:
 - SOFIA, Kepler Discovery Mission, & NASA Astrobiology Institute lead team
- Informal Education:
 - Science museums and planetarium collaborations, exhibit development
- Outreach Activities:
 - Weekly radio show, *Explorer* magazine, SPACE.com weekly column





Partnerships and collaborations, cont'



Nationwide partnerships to leverage NASA's education and outreach efforts

Astronomical Society of the Pacific (ASP)



- Project ASTRO: 1500+ astronomer-teacher partnerships
- NASA Night Sky Network: 1000+ amateur astronomers doing targeted outreach
- Astronomy From the Ground Up: training professionals in smaller science centers
- Cosmos in the Classroom: conferences for college faculty
- ASP annual conference: bringing together E&PO professionals
- NASA Explorer Schools: potential connection to ASP and amateurs
- Mercury magazine: read by 4000+ astronomers and educators





U.S. Partnerships and collaborations, cont'



SOFIA E&PO collaborations with other NASA missions & science centers / tech museums

- Partner in several Origins/SEU E&PO Forum initiatives:

EM classroom poster

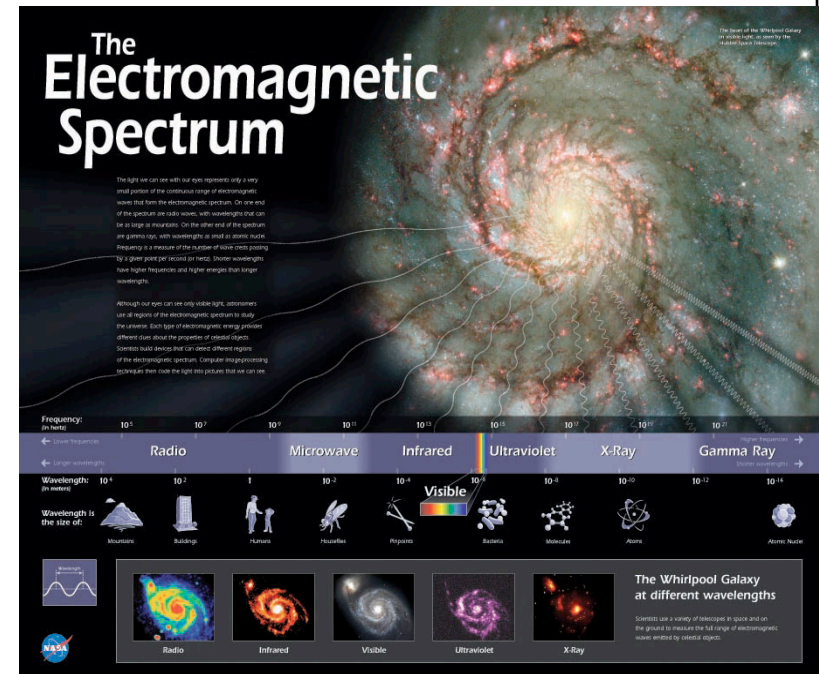
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PBS NOVA “Origins” series

“Alien Earths” museum exhibit

“NASA Room for a Day” at
National Science Teacher
Association conventions

AGU conference NASA booth





U.S. Partnerships and collaborations, cont'



Examples of collaborations with other NASA missions

- Close collaborations with Spitzer E&PO:

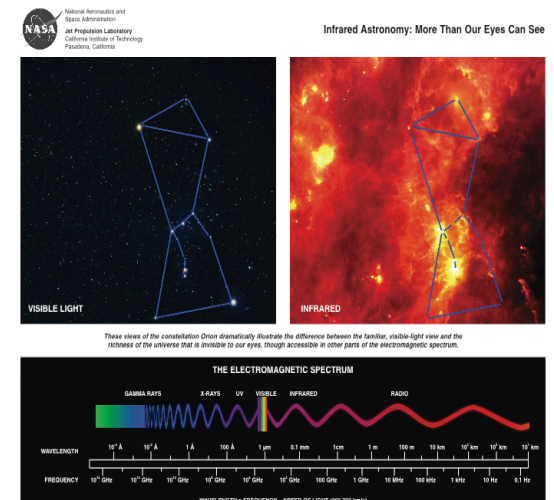
“Orion at optical and far-IR wavelengths” =>

National Science Teachers Association workshops and short courses

Active Astronomy classroom kits

On-line “Origins” astronomy graduate course for teachers through Montana State University (prototype for on-board educators training)

Multi-wavelength Braille book





Categories of E&PO Activities



**** Education ****

- FLAGSHIP PROGRAM: research flight experience for educators
- Curricula & class activities production & dissemination; school visits
- Workshops promoting research by college faculty and undergraduates

**** Public Affairs / Public Information / News & Media Support ****

- Press releases, press kits, press conferences regarding SOFIA achievements
- Long-term relationships with media & journalists (including science tutorial workshops)
- Support for SOFIA personnel in press and media interviews

Public Outreach (also called Public Engagement)

- Public web pages & printed materials
- Exhibits and presentations at public events, e.g. air shows
- Information for local government bodies & representatives

Science Community Outreach (added on, not part of original PM09 plan)

- SOFIA exhibits, talks, posters and technical materials at science conferences
- Support for presentations by SOFIA scientists and engineers across the U.S.
- Assist in definition and management of Early Release Observations program

**** 2 AREAS OF PRIMARY FOCUS AND STAFF/BUDGET REQUIREMENTS ****





E&PO in the new program structure



DIVISION OF LABOR DURING OBSERVATORY DEVELOPMENT:

- Ultimate authority, policy-making and budgeting rest with the Program Office (DFRC, R. Meyer)
- Activities focused through the Science Project (ARC, E. Austin; USRA/SETI, D. Backman):
 - EDUCATION (e.g. teacher training, curriculum kits, Project ASTRO)
 - PUBLIC OUTREACH (e.g. air shows, web pages, printed materials)
 - SCIENCE COMMUNITY OUTREACH (e.g. AAS meetings, sponsorship of colloquia, ERO planning)
- Activities focused through DFRC Public Affairs, (DFRC, F. Johnsen; USRA/SETI, D. Backman):
 - PUBLIC AFFAIRS / PUBLIC INFO / NEWS & MEDIA SUPPORT
- ARC- and DFRC-focused SOFIA E&PO activities overlap and will be opportunities for coordinated planning and execution





SOFIA E&PO: U.S. - German Collaboration



- General direction of German SOFIA E&PO program has been inspired by the U.S. SOFIA E&PO vision:
 - Recognize wisdom of locating E&PO with science operations
 - Desire to extend impressive results of KAO/FOSTER program
- German and U.S. SOFIA E&PO results mutually amplified by cooperation between two strong programs:
 - Sharing of data and ideas; quick communication
 - Sharing of resources: videos, images, curriculum kits, etc.
 - Training of on-board guests
 - Public relations & public outreach events coordination
 - Common workshops (teachers, students, scientists)
 - Mutual fostering of new partnerships
- Collaboration between the two programs continues to be excellent





German SOFIA E&PO

- Education (astronomy & space science) situation in Germany:
 - Nearly open field for SOFIA
 - Presently inhomogeneous, i.e. astronomy was part of standard high school curriculum in old East Germany but not in the West
- Main goal: attract the scientists & engineers of tomorrow, today
 - Start high quality education today (deficit of technically trained citizens looming in Germany, as in the U.S.)
 - Use educator training as multiplier
 - Astronomy is inherently multi-disciplinary, attractive
 - SOFIA program is inherently multi-disciplinary, attractive
- Comment: intellectual resources & innovative capacities historically have been among Germany's greatest strengths
 - Desire to continue this trajectory





German SOFIA E&PO, cont'



- Public Outreach (astronomy & space science) in Germany:
 - Nearly open field for SOFIA, as with education
 - e.g., visitor centers at science institutes are rare
 - Important to involve public in science
 - Public supports science when they feel included
 - Promoting interest in science & engineering careers benefits the entire society





German SOFIA E&PO Activities



Education

- Research flight experience for educators
 - Preparing, conducting, mentoring
- School projects
 - Curricula & class activity tools
 - School visits/support (e.g. public days)
- Workshops to promote program
 - E&PO, science, engineering)

Public Affairs / Information / News & Media Support

- Press releases, press kits, press conferences
- Long-term relationships with media & journalists
- Support for SOFIA personnel in press and media interviews





German SOFIA E&PO, cont'



Public Outreach

- Public web page & printed materials
- Exhibits and presentations at public events
 - e.g. ILA; Hannovermesse; Planetarium-Stuttgart; Airport-Stuttgart
- Information for local government bodies & representatives

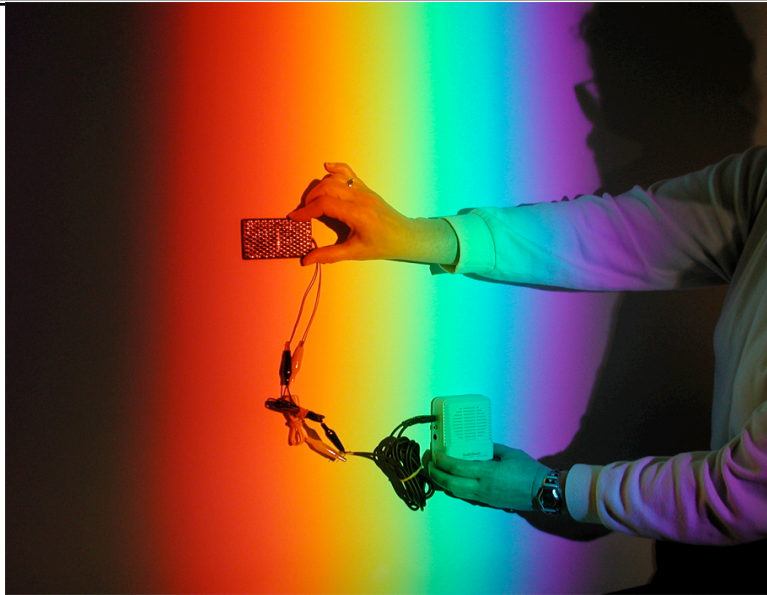
Plus, support and cooperation with Science Community

- Exhibitions, presentations, prepare outreach material





SOFIA E&PO Components



Education -- Support for “Formal” (classroom) education

Enrichment for educators

- Training and flights
- Partnerships with local SOFIA scientists
- NSTA etc. short courses and workshops
- summer workshops

Production and dissemination of curricula





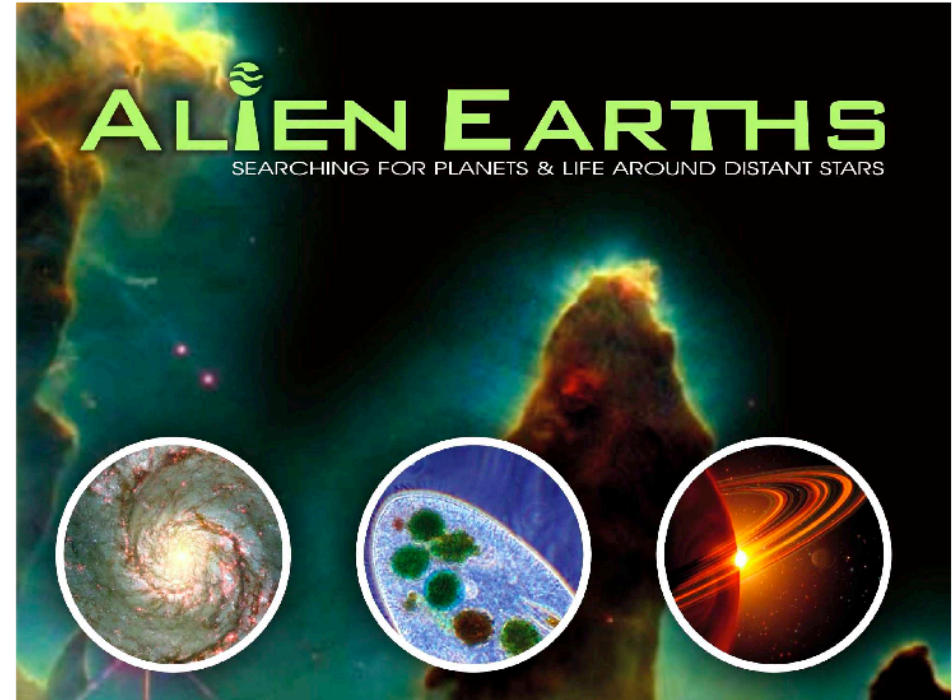
SOFIA E&PO Components cont'



Education, cont' --

Support for "Informal" education (museums, etc.)

- science centers
- planetariums
- youth organizations
- amateur astronomers



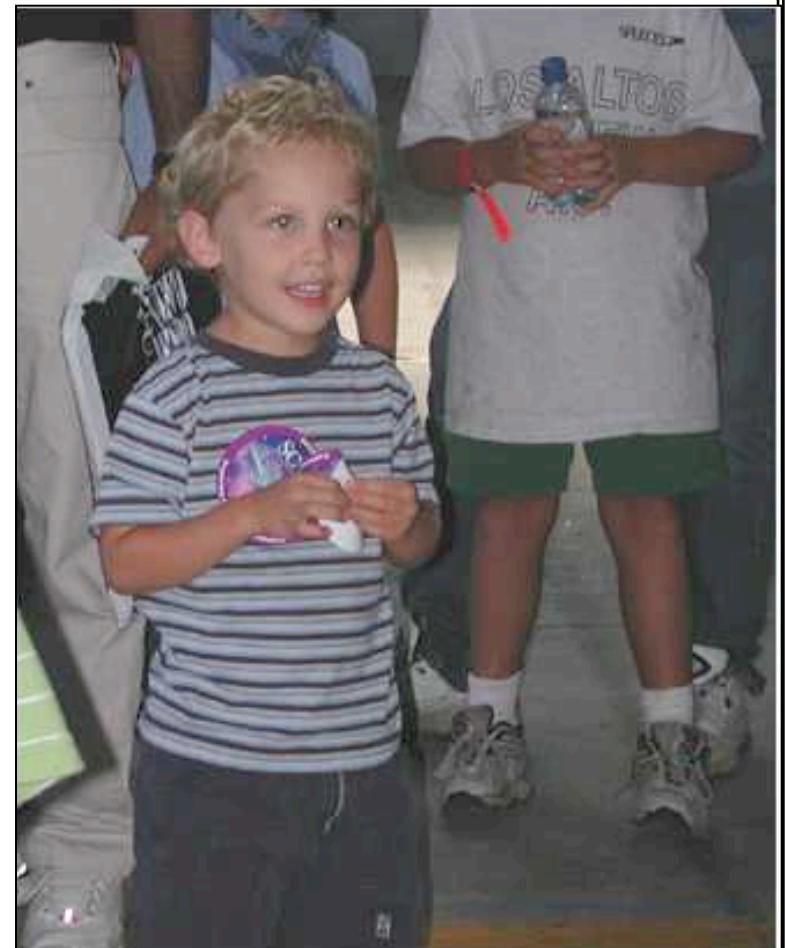


SOFIA E&PO Components, cont'



Public Outreach

- public displays (e.g. air shows)
- conference displays
- participation in media productions



Boy at ARC air show sees himself in infrared





Education programs



AAA = Airborne Astronomy Ambassadors

Teams of formal & informal educators & select amateur astronomers

- Chosen from applications
- Partnered by E&PO with consenting researcher teams,
- Trained by E&PO
- Involved in flight series w/ research partners
- Supported by E&PO after flights to enhance local education

PP = Planet Partners

Individuals or teams of educators

- Partnered by E&PO with SOFIA scientists in their local areas
- Not trained for flights
- Could serve as prelude to AAA participation





Education programs, cont'



SFW = Summer Faculty Workshops

- For college and university educators not involved in research
- To be mentored by SOFIA scientists and engineers re. front-line research
- Summer workshops managed by E&PO
- Aimed especially at participants from institutions of under-served populations
- Can be coupled with REU program (below)

REU = Research Experience for Undergraduates

- Summer fellowships at Ames (NSF-sponsored program)
- For select undergraduates
- Exposure to front-line science and engineering research
- Aimed esp. at participants from institutions of under-served populations
- Pre-REU bridge program to be managed by South Carolina State (an HBCU)





SOFIA E&PO Components, cont'



Public Affairs

- press releases regarding SOFIA achievements and events
- relationships w/ media & journalists: flights, workshops, background information
- press relations assistance to SOFIA scientists





Activities of E&PO office in full operations



- A) manage yearly cycle of educator applications:
publicity, collection, judging, scheduling
- B) train educators (+ journalists), accompany on flights;
- C) escort/host journalists and other visitors at Dryden & Ames
- D) facilitate continuing post-flight impact in
school districts and communities
- E) produce science visualizations, planetarium shows,
museum exhibits, curricular materials





Activities of E&PO in full operations, cont':



F) manage media relations, produce press releases
for investigators and educators in cooperation
with NASA
and investigators' university Public Affairs offices

G) continue development of web site content including
interactive simulations and interactive elements

H) nurture relations between SOFIA scientists & engineers
and local teachers (as in ASP's Project ASTRO)

I) host yearly workshops at Ames for faculty (SFW) and summer
undergraduate research partnerships (REU) especially from
institutions serving under-represented groups

K) continue rigorous evaluation of all program effectiveness





E&PO Operations Plan -- Education

- **Airborne Astronomy Ambassadors implementation:**
 - 2-4 educators per team
 - National application process analogous to, and timed with, G1 telescope time applications
 - Criteria for judging proposals: (1) quality of plans for changing science education “back home” after flight, (2) geographic and demographic distributions
 - Each educator team matched with willing SOFIA observer team and trained by E&PO to understand astronomers’ science goals
 - Educator teams accompanied by E&PO flight facilitators / escorts during flights
 - Educators’ proposal goals for home communities will be supported by SOFIA E&PO after flight experience
 - NOTE: several instrument teams have ongoing teacher-oriented E&PO programs that we will continue to support





Operations Plan - Education, cont'

Airborne Astronomy Ambassadors program - numbers:

- * 40 investigator teams flying per year at full flight rate
- * Educators (and other E&PO visitors, especially journalists) flying on 2/3 of science flight series (ESTIMATE)
- * E/PO personnel with flight attendant safety training always fly and work with educators and journalists

ESTIMATE: 50-100 educators and 25+ journalists fly per year (20% of which will be chosen by German SOFIA E&PO)

NOTE: need ~ 3-4 E&PO flight facilitators if each flies 1/4 time





E&PO Operations Plan -- Public Affairs



Press Release / Press Conference activity cycles:

- Press Release to educators' home town media expected for each educator team that flies (25 per year); local journalist may have flown
- Press Releases for outstanding science results
 - Observatory Press Officer and E&PO Manager identify upcoming flight series that are possible candidates for press releases, initiate discussions with science team
 - Press officer and E&PO Manager continue contact with observer teams post-flight, as data reductions and analyses proceed
 - E&PO staff prepare draft press release texts, ancillary graphics, animations, etc. in consultation with science teams
 - Observatory Press Officer and E&PO Manager support Ames PAO, Dryden PAO, NASA HQ PAO in preparation of final press release
 - NASA HQ (and/or DLR) issue agency-approved press release with standard credit line to USRA and DSI partners
 - Expect 3-6 such overlapping sequences in full operations





E&PO Operations Plan, cont'

Personnel:

E&PO Director		1.0 FTE
Education Manager	1.0	
E&PO Assistants	2.0	
Public Affairs Manager		1.0
Media Specialists	2.0	
Administrative Assistant		0.5
Total staff	7.5 FTE	

Corresponding Budget:

FY13 = \$ 1.9 M (2013 \$) for all E&PO including Public Affairs
(approximately 2.5% of total SOFIA program budget)





E&PO Operations Plan, cont'



- We have direction from NASA HQ that SOFIA E&PO falls under the old guidelines of $\sim 1.5\text{-}2\%$ of program budget for conventional E&PO (as applies also to Chandra, Spitzer, etc.)
- Public Affairs (the “press office”) and Science Outreach are not included in conventional E&PO, need separate funding & bookkeeping
- Comparison to major ground-based observatories such as Keck, Gemini: E&PO + Public Affairs $\sim 1\%$ of program budget





NASA's Goals and Objectives

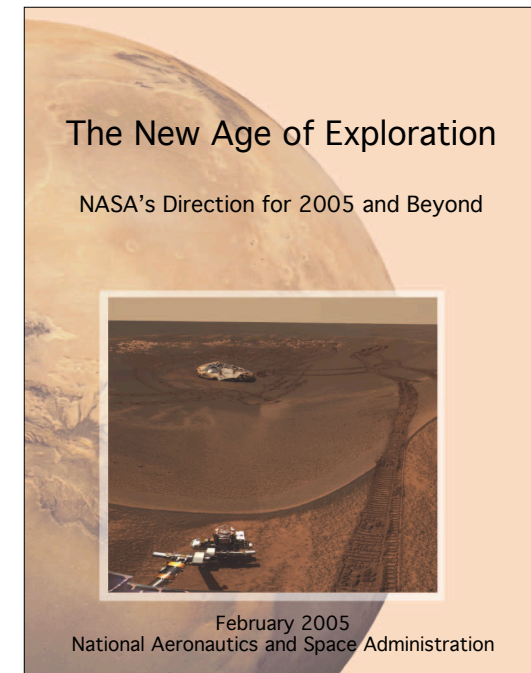


NASA's Mission

To inspire the next generation of explorers

NASA Strategic Objectives for 2005 and Beyond

Use NASA missions and other activities to inspire and motivate the Nation's students and teachers, to engage and educate the public, and to advance the scientific and technological capabilities of the Nation.





NASA 2003 Strategic Plan: E&PO Goals



GOAL	OBJECTIVES
Goal 6 Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.	<p>6.1 Improve student proficiency in science, technology, engineering, and mathematics by creating a culture of achievement, using educational programs, products, and services based on NASA's unique missions, discoveries, and innovations. AAA, PP and SLEP enhance teacher content knowledge which improves teaching and learning. Standards-based curriculum materials. REU program addresses this as well.</p> <p>6.2 Motivate K-16+ students from diverse communities to pursue science and math courses, and, ultimately, college degrees in science, technology, engineering, and mathematics. SOFIA unique capability to bring together educators and researchers together: motivated teachers motivate students. REU, AAA and PP reach diverse communities: urban, suburban and rural with special emphasis on underserved educators and students.</p>





NASA 2003 Strategic Plan: E&PO Goals



GOAL	OBJECTIVES
Goal 6 Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.	<p>6.3 Enhance science, technology, engineering, and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to educators and students. SOFIA is the only research observatory designed from the ground up physically and administratively to bring educators, students and researchers into close contact in the astronomical research environment.</p> <p>6.4 Improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements. SLEP and REU target higher education faculty and students respectively.</p>





NASA Strategic Plan: E&PO Goals, cont'



GOAL	OBJECTIVES
Goal 7 Engage the public in shaping and sharing the experience of exploration and discovery.	<p>7.1 Improve the capacity of science centers, museums and other institutions through the development of partnerships, to translate and deliver engaging NASA content. In collaboration with the Origins Forum E/PO programs, SOFIA E/PO continues to develop and disseminate museum exhibits, planetarium programs, informal education workshops and classes for science centers, youth groups and outreach via amateur astronomers.</p> <p>7.2 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the Internet. SOFIA will have a broad program of public outreach through speakers, conferences, public events as well as via the electronic (web site) and broadcast media. This reinforces outreach via Public Affairs.</p>





NASA Office of Education Criteria



A) Customer Focus - Programs have been designed to respond to a need identified by the education community...

- Success of FOSTER demonstrated invigorated science teaching, development of new science-centered school programs and activities, and community involvement.
- Planned market research at NSTA (teachers) and ASTC (science centers, planetariums) meetings to assess customer needs.
- “Professional development for teachers of science requires learning essential science content through the perspectives and methods of inquiry. Science learning experiences for teachers must involve teachers in actively investigating phenomena that can be studied scientifically, interpreting results, and making sense of findings ...” *National Science Education Standards*
- Addressed by SOFIA E&PO’s planned Airborne Astronomy Ambassadors (AAA), Planet Partners (PP) and Summer Faculty Workshop (SFW) programs.
- Partnerships with formal and informal educator networks sustains NASA’s involvement in communities across the nation.





NASA Office of Education Criteria, *cont'*



- B) Content** - Programs make direct use of NASA content, people or facilities to involve educators, students, and/or the public in NASA science, technology, engineering, mathematics.
- SOFIA is uniquely capable of bringing members of the public – teachers, college faculty, undergraduate and graduate students, amateur astronomers -- into close contact with the process of research exploration and discovery.
 - Educators complete on-line course in “Origins” astronomy, a graduate course based on the present SOFIA-sponsored NSTA Teacher Education Network (NTEN) course at Montana State University at Bozeman.
 - Participants in the PP program will experience content enrichment from local SOFIA scientists, managed and supported by the SOFIA E&PO office.
 - Participants in the SFW program will receive up-to-date astronomy and engineering content as a core part of the summer symposia.





NASA Office of Education Criteria *cont'*



- c) Pipeline** - Programs make a demonstrable contribution to attracting diverse populations to careers in science, engineering, technology, mathematics.
- Formal and informal education programs target under-served individuals and communities.
 - AAA, EP and SFW educators participate in focused science content training aimed at enriching the STEM education of their students.
 - Educators are sustained as a network of affiliates with updated information, classroom activities, and other NASA news. They comprise a widespread network of ambassadors for NASA and STEM education and outreach.
 - A pre-Research Experiences for Undergraduates (PREU) summer program for students in a group of southeastern US HBCU institutions connected to South Carolina State University (SCSU) supported by a MU-SPIN proposal to be submitted from SCSU to start implementing this plan.
 - REU plan in proposal stages with HBCU to bring undergraduates to SOFIA once operations commence.





NASA Office of Education Criteria *cont'*



D) Diversity - Programs reach identified targeted groups.

- AAA, PP, REU and SFW programs target under-served individuals and communities.
- AAA selection process will accomplish geographic and demographic diversity
- 2,000 (or more) educators during SOFIA's 20-year mission
- Mentoring partnerships with researchers, intimate exposure to research on the observatory, and long-term post-flight support from SOFIA E&PO.
- The PREU program is focused on HCBU students and their professors, ultimately aiming to help diversify the US science research community.
- REU program brings diverse undergraduates to the observatory for summer internships in cooperation with HBCUs and other minority serving institutions.





NASA Office of Education Criteria *cont'*



E) Evaluation - Programs implement an evaluation plan to document outcomes and demonstrate progress toward achieving objectives.

Key Factor: SOFIA's long duration mission will allow longitudinal studies of E&PO impossible on many other NASA missions.

- SOFIA E&PO will hire external professional evaluators to conduct “formative” (during the process) and “summative” (long-term or follow-up) evaluations to measure the impact and significance of SOFIA E&PO activities.
- Annual reviews by the SOFIA E/PO Working Group (SEPOWG)
- PERG is conducting a post-program evaluation of the FOSTER program that flew 50 teachers on the Kuiper Airborne Observatory to identify indicators of long-term effects on the STEM teaching and careers of the participants.
- Origins Forum evaluation team at STScI to help monitor the development of our AAA, PP, SFW and PREU programs between now and beginning of full operation of the SOFIA observatory
- Core value: as programs are developed, formal evaluation strategies and tools are created at the same time.





NASA Office of Education Criteria *cont'*



F) Partnerships/Sustainability - Programs or products achieve high leverage and/or sustainability through intrinsic design or the involvement of appropriate local, regional, or national partners in their design, development and dissemination.

Key factor: The SOFIA program is expected to extend for 20 years, much longer than most NASA missions.

- SOFIA E&PO educators teams fly together, continue to support each other and collaborate with their research team partners, and other SOFIA educators via the Network.
- Collaborates with NASA space science missions E&PO offices to share resources and ideas.
- Collaborates with Office of Education programs and projects
- Develops and sustains collaborations with formal and informal education organizations such as NSTA, ASTC, IPS, schools, community colleges and science centers, museums, and planetariums.
- Leverage the USRA network (97 universities); collaborate with the DLR (German space agency) and the Deutsches SOFIA Institute (DSI)





NASA Office of Education Criteria *cont'*



G) Quality and Feasibility

- NASA OSS *Explanatory Guide* and *NASA Strategic Plan* and *NASA Education Criteria*.
- *PM09 E&PO Strategic Plan* developed as proposed in original USRA proposal
- STEM Standards: programs and activities developed with National Standards as guides for student and teacher projects and programs

H) Resource Utilization

- E&PO leveraged through collaboration with other NASA missions, NASA ARC, USRA, DLR, and E&PO subcontractors SETI Institute and Astronomical Society of the Pacific
- SETI Institute and ASP are non-profits with low indirect costs which maximizes E&PO dollars to program





Looking forward ...

