

SOFIA's Airborne Astronomy Ambassadors

An External Evaluation of Cycle 1

Inverness Research conducted an evaluation of SOFIA's Cycle 1 Airborne Astronomy Ambassadors (AAA) program, collecting data that demonstrates the power of the AAA model while highlighting areas for improvement and growth. This brief summarizes data collected from surveys and interviews with Cycle 1 Ambassadors from March 2012 to July 2014. (See back page for details of the evaluation focus.)

What is the Airborne Astronomy Ambassadors (AAA) program?

The SOFIA Airborne Astronomy Ambassadors (AAA) program is a component of SOFIA Outreach that draws upon the distinct opportunities available through airborne astronomy to improve and further STEM literacy for educators, students, and the general public. AAA is a professional development program for both formal and informal educators who work with a range of populations (including under-represented groups) across the United States. Through the AAA program, these educators become Ambassadors for SOFIA. The program seeks to inspire educators and the learners and communities with whom they interact.

Ambassadors work in teams of two to complete online preparatory courses, attend webinars, and refine their outreach plans before traveling to Palmdale, California, where they spend a week preparing for and participating in their SOFIA flights. While in flight, the Ambassadors discuss the scientists' research projects and assist them in monitoring and compiling data from the various instruments onboard. Following the flight, Ambassadors gather with the scientists for a post-flight debrief meeting. Upon returning to their communities, Ambassadors implement their Education and Outreach plans.

Cycle 1 of the program ran from spring 2012 to summer 2014. As of 2015, SOFIA is in Cycle 2 of the AAA program and will continue with Cycle 3 implementation later in the year.

What Is the Stratospheric Observatory for Infrared Astronomy (SOFIA)?

The Stratospheric Observatory for Infrared Astronomy is the largest airborne research observatory in the world—a heavily modified Boeing 747 SP aircraft that flies to altitudes of 39,000 to 45,000 feet (12 to 14 km), carrying a 17-ton reflecting telescope 2.5 meters in diameter, various cameras, spectrometers, data-monitoring consoles, and a high-speed photometer. Typically, SOFIA carries a flight crew of three, a mission crew of two to six, and five to fifteen scientists and educators.

SOFIA represents a partnership between NASA and the German Aerospace Center (DLR). SOFIA operations are managed through NASA's Ames Research Center at Moffett Field in Northern California, in cooperation with the Universities Space Research Association (USRA) and the German SOFIA Institute (DSI). After an extensive mechanical overhaul at the Lufthansa facility in Hamburg, Germany, SOFIA is currently at its regular base at NASA's Armstrong Flight Research Center in Palmdale, California.

SOFIA is the only major research observatory that brings non-scientists into close contact with scientists conducting research, and therefore, provides opportunities for science, technology, engineering, and mathematics (STEM) educators—including K-16 teachers and informal educators from museums, science centers, and libraries—to interact directly with the scientific process and contribute to the advancement of STEM literacy.

Key Elements of AAA

- Ambassadors are formal and informal STEM educators from around the United States who work with K-14 students as well as with specialized audiences and the general public.
- Ambassadors participate in an online *Astronomy for Teachers* course, administered by Montana State University and the National Teacher Enhancement Network.
- Ambassadors participate in a SOFIA-specific online course module, administered through the SOFIA program.
- Ambassadors work in teams of two throughout the course and the flight.
- Ambassadors travel in teams to Palmdale, California to fly on SOFIA at scheduled times.
- Ambassadors implement Education and Outreach plans for their students and/or the communities in which they work.

Who Are the Cycle 1 Airborne Astronomy Ambassadors?

The 25 Cycle 1 Ambassadors include educators from a school for the deaf, an alternative school for the developmentally challenged, rural schools, a Native American school, and informal education venues such as museums and libraries.

Eighty-four percent are teachers, including 12 high school, 7 middle school, and one elementary. The others work in an informal science center, school administration, science journalism, at a public library, and at an unspecified institution providing dual high school/college courses.

Most Ambassadors teach multiple subjects, including general or integrated science (40%), Earth science (36%), physical science (32%), and a number of other related subjects: chemistry, technology, mathematics, astronomy, biology, engineering, and physics.

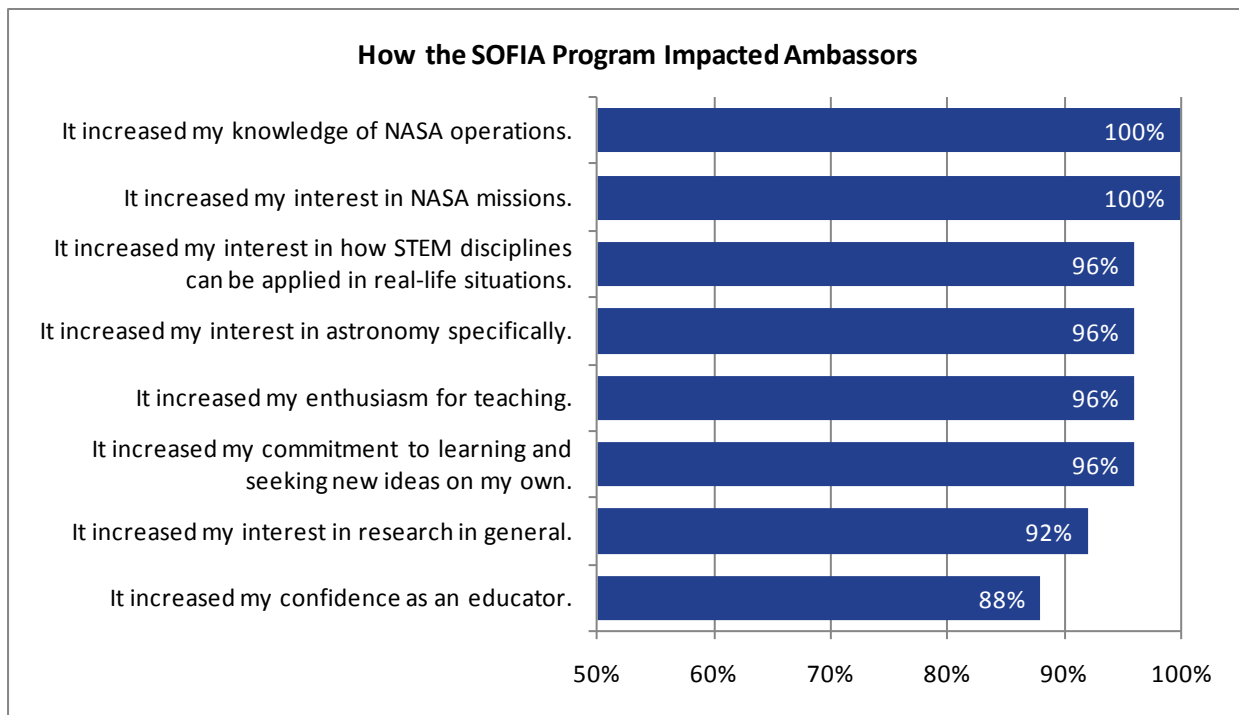
For the vast majority of the SOFIA Airborne Astronomy Ambassadors, participating in a NASA research mission was a dream come true—something they had thought about since they were children or since they first heard about SOFIA 13 years ago.

I applied so I could bring a real-world experience back to my students. Coming from a small rural area, they are not exposed to many scientific opportunities, and I want to bring as many different types of science to them as I can in a real-world setting. The fact that I learn along with them is a bonus for me.

Outcomes of the Airborne Astronomy Ambassadors' SOFIA Experience

Inspiration and rejuvenation

As shown in the following graph, SOFIA's AAA program has had positive personal and professional impacts for almost all participants in several areas: increasing their knowledge of NASA operations; their interest in NASA missions, astronomy, research in general; and interest in how STEM disciplines can be applied in real-life situations. It has increased participants' enthusiasm for teaching and their confidence as teachers. Nearly all participants say they have been impacted to a large or great extent in each area. Open-ended comments on the survey and in interviews also revealed that the Ambassadors' experience in the SOFIA program highlighted the value of teamwork and collaboration in STEM fields.



Participants responded to survey statements using a 5-point scale: “not at all,” “to a small extent,” “to some extent,” “to a large extent,” and “to a very great extent.” Percentages above represent responses of “to a large extent” and “to a very great extent.”

I am grateful for a program that gets teachers out into a real-world setting and then lets them come back and inspire others. It is so powerful...excited teachers will impact many students and other educators and adults. It is a fantastic program. Being part of the initial group was an honor and I know the program will just get stronger as it continues.

What impacts me, impacts my students! We will spend more time with what is new in astronomy research and do more hands-on astronomy inquiry projects.

This experience has made me a better teacher. I can bring the real world back to my students. They understand that as they apply themselves they can gain amazing opportunities. They also learn about real-life job opportunities. I am excited to inspire everyone to the possibilities. I will never be the same.

Outreach

SOFIA provides educators with new experiences and ideas that, in turn, inspire their students and communities. Some Ambassadors spoke specifically about how important their SOFIA participation is for their students who are under-represented in the sciences—particularly female and minority students. Ambassadors have gone on to present at conferences, as well as at local school board and city council meetings.

- Ninety-one percent have given a presentation to the community about their SOFIA experience.
- One Ambassador has written an article for *Astronomy* magazine.
- One has applied for and received additional research opportunities.

There’s rarely a week that goes by without someone wanting to hear about the flights.

I learned so much to bring back and share with the community. I am glad that I can inspire others.

The community has become more interested in astronomy, and a number of students and parents are interested in starting a class at the school.

Ambassador Vignettes

Chelen Johnson teaches Advanced Biology to 10th-graders, and Astronomy, Astronautics, and Environmental Science to 11th and 12th-graders in Minnesota. She took two SOFIA flights in February 2013 and describes it as “a dream come true.” Chelen’s SOFIA experience is directly relevant to her teaching on Saturday mornings with her high school Girls Astronomy Club. Eight junior and senior girls meet with Chelen every week to analyze and make meaning of astronomy data. They began by looking at data from SOFIA and moved on to data from the Spitzer Telescope, another project with which Chelen has been involved. The Astronomy Club collaborates with a couple of other schools, and this year the girls published a poster at the American Astronomical Society Conference, based on their Spitzer work.

There is always at least one person who asks, ‘Why do we need to spend millions of dollars putting a telescope on an airplane?’ I love it when people ask that because that is when my passion really comes out. I tell them, if we never went to the moon, we wouldn’t really know, we would just wonder. We have to satisfy that curiosity somehow and this is a way to help put together the puzzle of what is our Earth and what is it like in different parts of our universe.

Adriana Alvarez teaches first grade at a dual language school that serves linguistically diverse students in a low-income community in El Paso, Texas. She is currently on a leave of absence working toward a Doctorate degree in educational equity and cultural diversity at the University of Colorado-Boulder. As a little girl growing up in Mexico, Adriana would lie on the grass and look up at the sky with her father, a math and science enthusiast obsessed with astronomy and science missions, and he would teach her about the constellations and the stars. Never in her wildest dreams did Adriana imagine that she’d have an opportunity to take part in a NASA research mission.

It was incredible to see how something from my childhood could carry on and I was able to live a dream that as a child seemed so unobtainable, so far away. I was standing there wearing that NASA jacket and living my dad’s and my own dream. I make the connection now to how powerful my experiences can be for my students. I can have that same influence my dad did. I think it is so important for them to see what is possible, especially in the community where I teach, where most students are disadvantaged.

Additional Evaluation Results

★ *Success of flight experience*

As shown in the following graph, nearly all participants said their SOFIA experience was enjoyable, stimulating, and appropriate for them. More than three-fourths said that the scope of the project was appropriate for the time they were on site and in flight, and that it was responsive to their professional development needs. Two-thirds said it provided opportunities to engage in inquiry-research activities that they can adapt to their instructional practice. There was less agreement on whether expectations for their roles were clearly defined, with about half agreeing to a large or great extent. Most of the rest agreed to some extent.

How Ambassadors Rated the Success of Their SOFIA Flight Experience

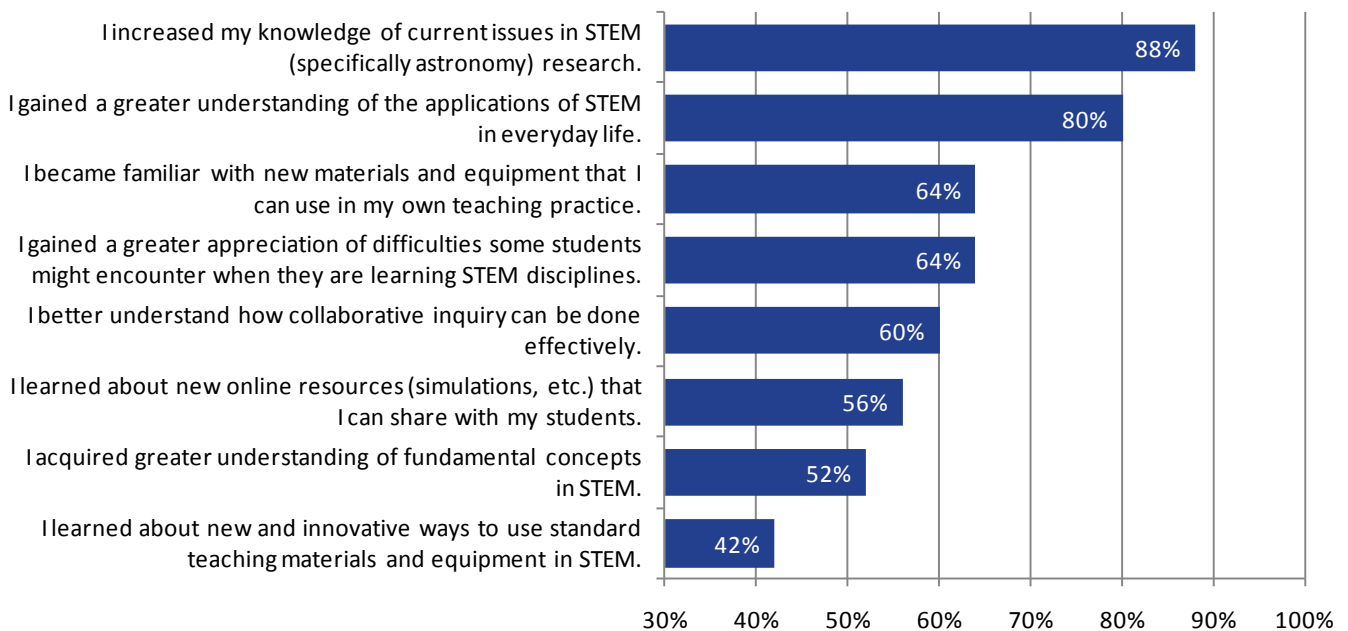


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★ Learning

The bar graph below illustrates what Ambassadors learned from their SOFIA flight experience. Six in 10 participants reported that to a large or very great extent their SOFIA flight helped them become familiar with new materials and equipment they can use in their own teaching (64%), they better understand how collaborative inquiry can be done effectively (60%), and they learned about new online resources that they can share with their students (56%).

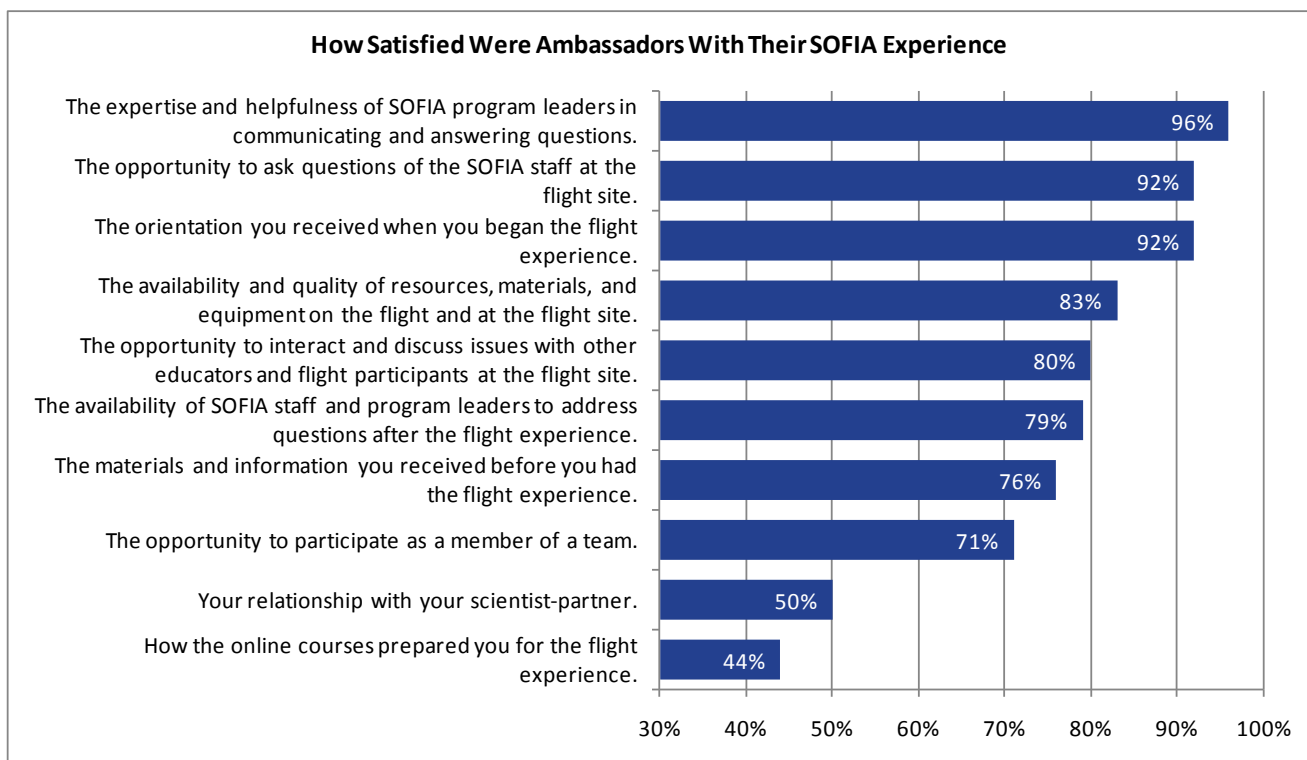
What Ambassadors Learned From Their SOFIA Flight Experience



Participants responded to survey statements using a 5-point scale: “not at all,” “to a small extent,” “to some extent,” “to a large extent,” and “to a very great extent.” Percentages above represent responses of “to a large extent” and “to a very great extent.”

★ Satisfaction

As the graph below shows, nearly all participants were satisfied to a large or very great extent with the expertise and helpfulness of the SOFIA leaders (96%), the orientation (92%), and the opportunity to ask questions of the SOFIA staff in Palmdale. Nearly as many were highly satisfied with other aspects of the flight experience. Ratings were lower for satisfaction with the relationship with the scientist-partner (50%) and how the online courses prepared them for the flight experience (44%). These results suggest that future efforts to refine the program might focus on assuring that more participants have satisfactory relationships with their scientist-partners and on improving the online course that prepares them for the flight experience.



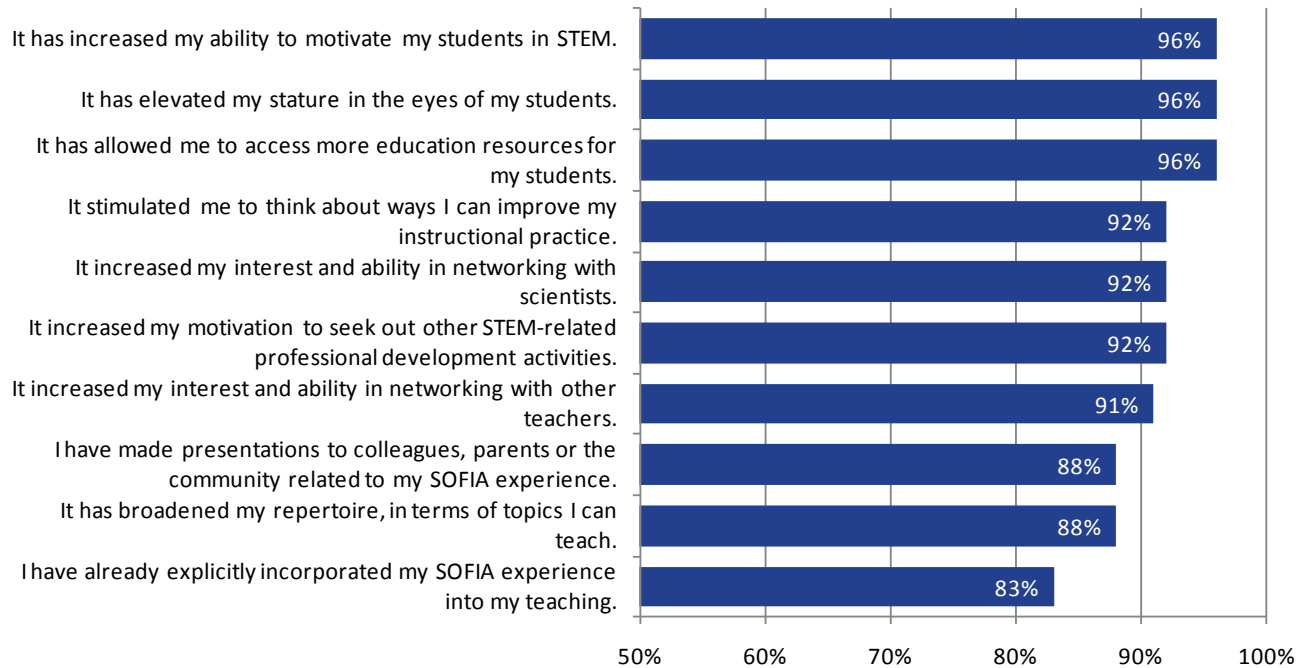
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★ Impact on Ambassadors as educators

The SOFIA program has had many strong impacts on participants’ lives as educators in the classroom and more broadly professionally. Looking at impacts on their classroom practice in the bar graph on the next page, we see that 96% of Ambassadors agree or strongly agree that the experience has increased their ability to motivate their students in STEM, and 92% agreed it has stimulated them to think about ways they can improve their instructional practice. Eighty-three percent agree or strongly agree that they have already explicitly incorporated their SOFIA experience into their teaching (as of summer 2014), and 96% agree that their participation has elevated their stature in the eyes of their students. Almost all (96%) also agree that it has allowed them access to more education resources for their students, and 88% report that it has broadened their repertoire in terms of topics they teach.

Eighty-eight percent of participants say that they are sharing what they learned and experienced with colleagues and the community. Ninety-two percent agree that the experience increased their interest and ability in networking with scientists and other teachers. And almost all (92%) agree or agree strongly that they are now more motivated to seek out other STEM-related PD activities.

SOFIA's Impact on Ambassadors' Teaching and Professional Life



Participants responded to survey statements using a 5-point scale: “disagree strongly,” “disagree,” “mixed,” “agree,” and “agree strongly.” Percentages above represent responses of “agree” and “agree strongly.”

Challenges

Cycle 1 was the first full-fledged instantiation of the vision for the SOFIA Airborne Astronomy Ambassadors program, and there were some challenges along the way. First, the online courses were not as well aligned as the program leaders might have hoped. For some educators, the *Astronomy for Teachers* course was too elementary, while for others it was too advanced. This is to be expected when participants come from a variety of backgrounds and contexts and have a range of experience.

Logistically, the SOFIA flights also experienced some challenges. There were budgetary concerns, given the federal government’s priorities and allocations, and there were complications with scheduling the flights. While program leaders were addressing these concerns, some Ambassadors indicated that they were not entirely clear on the expectations for their roles and weren’t sure how best to communicate with each other and with program leaders. Once they were given this feedback, program leaders were very proactive and responsive in their communications with the entire program.

Finally, some Ambassadors found it challenging to connect with their scientist-partner, in part because the flight logistics were often uncertain and because the expectations around the partnership were not entirely clear. This can certainly be addressed in future programs.

Recommendations

In future cycles, it would be helpful to have more obvious methods for Ambassadors to communicate with one another—both during and after the program—and for Ambassadors to communicate with their scientist partners. The program could provide scientists with more coaching and support for partnering with educators. Educators can be valuable partners in research if they are provided with the appropriate preparation and tools, and if the expectations for their involvement are clear.

In Closing

Ambassadors participated in a unique STEM research and education experience that informed their classroom practice and their community outreach. This process brought NASA closer to members of the educators' communities and broadened its reach through the Ambassadors' education and public outreach work. The AAA program demonstrates the power of interweaving informal and formal education contexts.

The program has provided a transformative experience for the educators involved to date. Currently, and even more so with small additional improvements, the AAA program offers a comprehensive professional development opportunity for educators that will influence their own practice and career trajectories, as well as the attitudes and interest of their students and communities.

I cannot commend the SOFIA program leaders (or the flight personnel or the pilots or the scientists) ENOUGH on how welcome each and every participant made me and the other Ambassadors feel. I never felt my questions were "too elementary" to ask nor did I ever feel unqualified and/or that I somehow "didn't belong there" -- a feeling I had PRIOR to leaving for California (self imposed). The resources, the training, the opportunities -- everything surpassed my expectations.

Thank you for the amazing opportunity to fly on this amazing aircraft. The experience was truly the pinnacle of my career. Thanks!

Evaluation Overview

Inverness Research conducted an evaluation of SOFIA's Cycle 1 AAA program from March 2012 to July 2014, focusing on:

1. providing feedback on the quality and value of the *Astronomy for Teachers* online course and materials, the flight itself, and the supporting resources to ensure their effectiveness;
2. documenting the impacts of the program, particularly on educator participants, including their experiences in the program and how they have incorporated their new knowledge into their practices with learners;
3. supplying data and knowledge to inform planning for an effective Cycle 2.

Over the course of the project, Inverness conducted interviews with every SOFIA Ambassador, observed the online astronomy courses, administered a post-flight survey to all Ambassadors (100% response rate), and conducted follow-up interviews with a select group of educators to learn more about their education outreach efforts.

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Inverness Research, a national education evaluation and consulting group headquartered in Northern California, has over 25 years of experience studying local, state, and national investments in the improvement of education.

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