

NASA SCIENCE4GIRLS AND THEIR FAMILIES: CONNECTING LOCAL LIBRARIES WITH NASA SCIENTISTS AND EDUCATION PROGRAMS TO ENGAGE GIRLS IN STEM. L. V. Bleacher¹, B. Meinke², K. Hauck³, C. Soeffing⁴, A. Spitz⁵ and NASA SMD E/PO Community. ¹NASA Goddard Space Flight Center, 8800 Greenbelt Rd., Greenbelt, MD 20771 (Lora.V.Bleacher@nasa.gov) ²STScI, Baltimore, MD ³UCB Space Sciences Laboratory, UCB, Berkeley, CA ⁴IGES, Arlington, VA ⁵Lunar and Planetary Laboratory, UA, Tucson, AZ.

Introduction: NASA Science4Girls and Their Families (NS4G) partners NASA Science Mission Directorate (SMD) education programs with public libraries to provide hands-on science, technology, engineering, and math (STEM) activities and career information for girls and their families, along with training for librarians, in conjunction with Women's History Month (March). NS4G is a collaboration among education teams within the four NASA SMD education and public outreach (E/PO) Forums: Planetary, Earth, Astrophysics, and Heliophysics. It began in 2012 as an Astrophysics-led program (Astro4Girls) with 9 events around the country. Upon expanding among the four Forums, over 73 events were held in Spring 2013 (Fig. 1), with preparations underway for events in Spring 2014. All events are individually evaluated by both the student participants and participating librarians to assess their effectiveness in addressing audience needs.

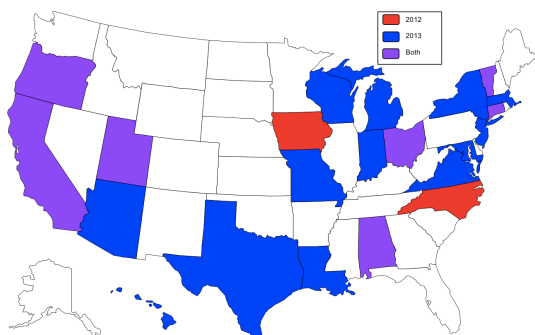


Fig. 1 Map of the United States showing the expansion of NS4G events from 2012 (red and purple) to 2013 (blue and purple).

Why engage girls in STEM: The number of women entering STEM fields is not keeping pace with the rise in demand for STEM workers. Although women constitute approximately half of the total workforce, they only constitute 27% of the STEM workforce, with the greatest disparities in the physical sciences, engineering, and computer science [1]. Note that less than 1% of employed scientists and engineers are minority women [1]. It is argued that a diverse workforce could yield innovative solutions to 21st century problems [2].

Girls and boys differ not in their ability to perform well in STEM subjects, but in their confidence in their ability to do so and in their interest in STEM overall [3]. Gender differences in an individual's perceived

interest and confidence in STEM appear as early as elementary school [3]. More can be done to strengthen girls' interest and confidence in STEM, particularly in the physical sciences, engineering, and computer science, before high school when they are presented with doors to higher education STEM opportunities and careers.

Current state of women in the planetary science field. A 2011 survey of both individual planetary scientists and planetary science academic departments [4] looked at degree and employment trends within the field. Although 25% of the survey respondents were women, only 14% of planetary faculty were women. This number is far below the 40% of PhDs awarded to women by these academic departments in recent years. The survey also indicated that planetary science is similar to the other physical sciences in that there are a low number of ethnic minorities (~10%) in the field.

Effective strategies: An excellent resource on tips and strategies for effectively engaging girls in STEM and building their confidence is the *SciGirls Seven* [5]. The *SciGirls Seven* are research-based strategies that have been proven to work with all learners, including boys and underrepresented students. 1) Girls benefit from collaboration, especially when they can participate and communicate fairly. 2) Girls are motivated by projects they find personally relevant and meaningful. 3) Girls enjoy hands-on, open-ended projects and investigations. 4) Girls are motivated when they can approach projects in their own way, applying their creativity, unique talents, and preferred learning styles. 5) Girls' confidence and performance improves in response to specific, positive feedback on things they can control – such as, effort, strategies, and behaviors. 6) Girls gain confidence and trust in their own reasoning when encouraged to think critically. 7) Girls benefit from relationships with role models and mentors.

NS4G Strategy 1 – Use of field-tested educational activities and resources provided by NASA SMD educational teams: By connecting libraries with NASA SMD scientists and educators, participants in NS4G events have access to not only cutting-edge scientific discoveries and data but also pedagogically sound and scientifically accurate educational activities and resources. Many NS4G events pull activities from NASA Wavelength (nasawavelength.org), a clearinghouse for educational products and resources featuring

SMD content that is searchable by grade level, type of audience, content, etc. These products have undergone NASA's Earth and Space Science Education Product Review (nasareviews.strategies.org), a rigorous review process by both educators and scientists to ensure appropriateness for the intended target audience and scientific accuracy. By participating in NS4G, librarians are made aware of these resources for bringing STEM content into programs beyond NS4G as well.

2013 example. A NS4G event in Elkridge, MD included discussion and hands-on activities about the electromagnetic spectrum and the Cassini mission. Activities such as "How can we find out about invisible light?" were pulled from NASA Wavelength. Participants made bracelets using UV beads and experimented with exposing the beads to different wavelengths of light and various shielding materials. They were encouraged to continue their investigations about light at home with their families and friends.

NS4G Strategy 2 – Use of best practices and research-based methods for engaging girls in STEM: Scientists, educators, and librarians participating in NS4G are provided with access to, and professional development on, research-based best practices and strategies for engaging girls in STEM, such as the *SciGirls Seven* [5], so that the activities, resources, and approaches they use during NS4G events are effective. The SMD E/PO Forums collaborate with the National Girls Collaborative Project, (NGCP) an NSF-funded organization dedicated to supporting and connecting girl-serving organizations, to provide the NASA SMD E/PO community with professional development and access to resources on best practices.

2013 example. The OSIRIS-REx mission implemented strategy 7 from the *SciGirls Seven* when they created a website dedicated to women in STEM (osiris-rex.lpl.arizona.edu/?q=WomensHistoryMonth), with a focus on women working on the OSIRIS-REx mission in various roles. It includes biography vignettes and video profiles, a role model resource for NS4G participants.

NS4G Strategy 3 – Collaborations with libraries as community-centered, free-access venues that allow all members of a community access: Libraries often offer evening and weekend programs tailored to a variety of audiences and interests, as well as career development tips and resources. Many libraries have children's and teen's programs that they offer on a recurring basis. In recent years, libraries have sought to increase their STEM-focused offerings and programs. The American Library Association (ALA) demonstrated their support of incorporating NASA STEM content into library programs by partnering with the SMD Astrophysics E/PO Program to implement Astro4Girls,

the precursor to NS4G. The ALA continues to support and advertise the NS4G effort.

2013 example. NS4G events in Butler, MO allowed members of an underserved rural farming community the unprecedented opportunity to experience NASA science, learn about STEM majors at a state university, and meet role models in science.

NS4G Strategy 4 – Partnerships with local and national organizations with a common focus and shared resources: NS4G relies on partnerships to extend its reach and ensure its sustainability. A new partner for NS4G in 2014 is NASA Nationwide, an online community dedicated to supporting a consortium of volunteer Solar System Ambassadors and Educators who engage with libraries, museums, and schools in areas of the country where access to NASA scientists and educators in person is not always a possibility. Many Solar System Ambassadors and Educators are partnering with their local libraries for NS4G events in 2014.

2013 example. The OSIRIS-REx mission partnered with STEM coordinators of the Girls Scouts of Southern Arizona, the Pima County Library System, and organizers of the Tucson Festival of Books to reach local audiences in a variety of ways. These efforts formed the foundation for continued, self-sustained science programming at local libraries.

NS4G Strategy 5 – Remote engagement of audiences and access to science programming and resources: Online sites and communication platforms such as Google+ Hangouts and Skype allow scientists and educators to reach library patrons in rural areas and those not near a NASA Center, university, or other partner organization.

2013 example. The Institute for Global Environmental Strategies led the first NASA Google+ Hangout in Spanish for Earth science events at three California libraries. The public Hangout reached an additional online audience of over 1200 Spanish-speakers, plus at least 3600 viewers on YouTube as of late 2013.

How to get involved in 2014 and beyond: Scientist and educators, including males, are needed to partner with libraries for both in-person and remote engagement events. Give a talk to library visitors or staff, read a book during story-time, lead participants in hands-on activities, coordinate a star party, etc. Events do not have to take place during Women's History Month only. Contact Lora Bleacher (Lora.V.Bleacher@nasa.gov) for more information.

References: [1] National Science Board (2012) NSF. [2] Hill C. et al. (2010) AAUW. [3] Halpern D. et al. (2007) NCER. [4] White S. et al. (2011) AIP. [5] PBS Kids (2013) *SciGirls Seven*, <http://scigirlsconnect.org/page/scigirls-seven>.