

## **NASA Astrophysics EPO Community: Enhancing STEM Experience of Undergraduates**

James Manning,<sup>1</sup> Bonnie K. Meinke,<sup>2</sup> Brandon Lawton,<sup>2</sup> Denise A. Smith,<sup>2</sup>  
Lindsay Bartolone,<sup>3</sup> Greg Schultz<sup>4</sup>, and the  
NASA Astrophysics EPO community

<sup>1</sup>*NASA SMD Astrophysics Science EPO Forum*

<sup>2</sup>*Space Telescope Science Institute, Baltimore, Maryland, USA*

<sup>3</sup>*Adler Planetarium, Chicago, Illinois, USA*

<sup>4</sup>*Astronomical Society of the Pacific, San Francisco, California, USA*

**Abstract.** The NASA Science Mission Directorate (SMD) Astrophysics Education and Public Outreach (EPO) community and Forum work together to capitalize on the cutting-edge discoveries of NASA Astrophysics missions to enhance the Science, Technology, Engineering, and Math (STEM) experience of undergraduates. The NASA SMD Astrophysics EPO community has proven expertise in providing both professional development and resources to faculty at two- and four-year institutions and in offering internships and student collaboration opportunities. These mission- and grant-based EPO programs are uniquely poised to foster collaboration between scientists with content expertise and educators with pedagogy expertise. We present examples of how the NASA Astrophysics EPO community and Forum engage the higher education community in these ways, including associated metrics and evaluation findings.

### **1. Introduction**

In 2009, NASA's Science Mission Directorate (SMD) awarded four cooperative agreements for the creation of four Science Education and Public Outreach Forums (SEPOFs), one for each of its science divisions. The charge of the SEPOFs was to work with and across their respective Division EPO communities to increase the collaboration, coordination, and coherence of the SMD Education and Public Outreach (EPO) effort, which uses NASA scientists, educators, facilities, and science results to uniquely contribute to the improvement of STEM education and ultimately the STEM workforce in the U.S.

In keeping with these objectives, the SMD Astrophysics SEPOF, among its many initiatives, has worked closely with its community of mission and program EPO professionals to coordinate and collaborate on the development of NASA-based resources for use in higher education—by teachers and their students at both four-year universities and two-year colleges. This poster documents the current work of the SMD astrophysics community in addressing the needs of the higher education community.

## 2. Reinforcing the Methodology

The SMD Astrophysics Forum and community employ education best practices in a kind of feedback loop to achieve meaningful outcomes. *Evidence-based approaches* are used to *leverage resources and expertise* to create impactful efforts. We then *share what works*—which feeds back into the evidence-based approaches that inform the next generation of effective programs and projects.

The effort to engage the higher education community in providing resources to further their education goals and ours uses this reinforcement approach, as outlined in the narrative that follows.

## 3. Evidence-Based Approaches

### 3.1. Understanding Audience Needs

Understanding the needs of the audience we strive to serve is foremost in using NASA assets to create useful and useable education resources. The Forums identify the needs of education audiences and how to support them by:

- Organizing working groups to engage these audiences, develop and confirm a knowledge base, and develop strategies for creating initiatives.
- Conducting audience surveys to determine needs.
- Reviewing literature to corroborate, confirm, and enlighten the effort.

### 3.2. Connecting at Conferences

The Forums conduct sessions and presentations at professional conferences to gather audience and community feedback regarding higher education resources and design strategies. These conferences include meetings of the American Astronomical Society (AAS), Astronomical Society of the Pacific (ASP), and American Geophysical Union (AGU) among others.

### 3.3. Bringing New Science Into the Classroom

In the case of developing higher education resource support, the Forums' Higher Education Working Group surveyed community college faculty to better understand the challenges and opportunities concerning NASA SMD EPO engagement with two-year colleges. Responses from 183 community college faculty nationwide included the following insights:

- Two-thirds of respondents try to include new science either every day, or once per week.
- Most get that science from science web sites—for example, 80% access NASA's website (NASA.gov) and 58% access CNN's homepage (CNN.com).

Among their articulated needs:

- A place to find or share activities, homework assignments, and/or lectures for that science (68%).

- Workshops that would deepen understanding of that science and/or its discoveries (59%).
- A community of faculty that could share news and classroom assets (53%).
- News updates for their field(s) (49%).

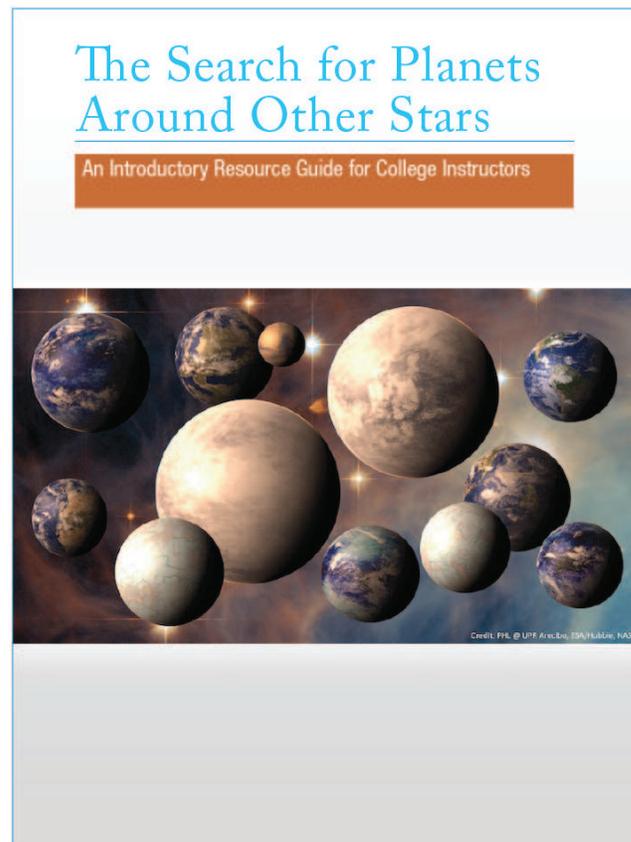


Figure 1. Title page of the Exoplanet Resource Guide.

#### **4. Leveraging Resources and Expertise**

##### **4.1. Building Connections and Best Practices**

The Forums facilitate connections both within the SMD EPO community and beyond to the higher education community. These collaborations strengthen partnerships, build best practices, and enhance coherence for NASA SMD-funded EPO missions and programs.

Among the specific ways in which the Forums accomplish this are to post references and information for the SMD EPO community workspace online for ready access, and encourage online thread discussions. Forums also sponsor Meetings of Opportunity and workshops at professional conferences of societies such as the AAS and AGU to bring together scientists, college-level educators, and EPO professionals to discuss needs, share and review their work, identify best practices, and forge connections.

## **4.2. Developing New Resources**

Informed by evidence-based approaches and our engagement of stakeholders, the Astrophysics Forum has collaborated with the Astrophysics EPO community, researchers, and Astronomy 101 instructors to create two new resources: Astronomy Resource Guides and Astro 101 Slide Sets, briefly described as follows.

### **4.2.1. Astronomy Resource Guides**

The Astrophysics Forum and EPO community have collaboratively developed Astronomy Resource Guides on two of the “hot” topics that college-level astronomy instructors have indicated a special interest for incorporating into their teaching in greater depth: cosmology and exoplanets. The Guides include:

- A variety of sources of background information, including web sites, books, and print articles.
- Links for video/audio lectures, classroom activities, apps, animations/simulations, and references on teaching each topic.

The Guides have been beta-tested by astronomy instructors with subsequent revisions, have gone through NASA Education Product Review, and are available at the Astronomical Society of the Pacific website (link follows).

### **4.2.2. Astro 101 Slide Sets**

The Astrophysics Forum is coordinating the development of a series of slide sets to help introductory astronomy (“Astro 101”) instructors incorporate new discoveries into their classrooms. Each set employs the following elements:

- Consists of five-to-seven PowerPoint slides in a standard, modular design.
- Covers a new development or discovery from a NASA astrophysics mission.
- Provides a “big picture” context.
- Includes instructor notes and resources.
- Uses image graphics, videos (in some cases), and links to relevant websites.

Two pilot slide sets—“Debris Belts Around Vega” and “Black Hole in M83”—have been reviewed by introductory astronomy instructors and content experts, and have been submitted to and, as of this writing, have been approved by NASA Education Product Review. The slide sets are accessible at the Astronomical Society of the Pacific link given in the next section. Additional sets are currently in development and, by the time of publication of this article, are also expected to be available at the link.

### 4.2.3. Resources Link

Both the Astronomy Resource Guides and the Astro 101 Slide Sets may be found at the Astronomical Society of the Pacific.<sup>1</sup>

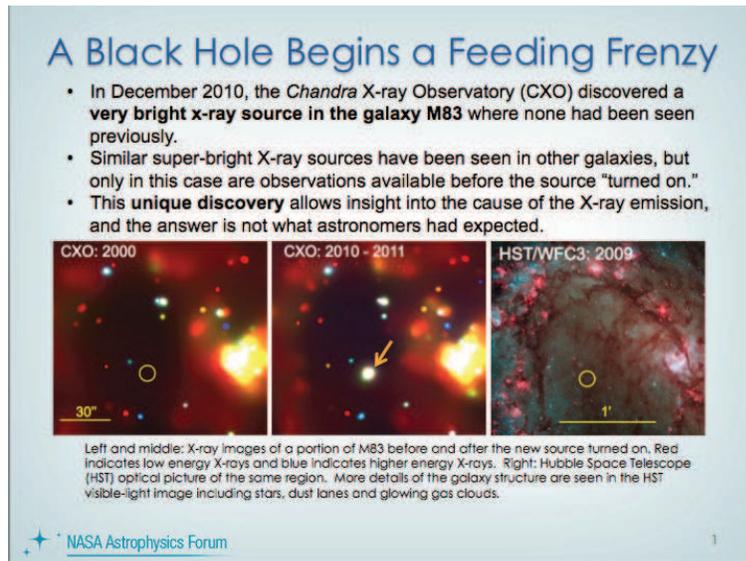


Figure 2. Sample slide of an Astro 101 slide set.

## 5. Sharing What Works

### 5.1. Providing Access to Resources

The Forums facilitate easy access to resources through a variety of means and sites. Forum-coordinated products place individual EPO resources in context and support audiences in incorporating SMD EPO resources into their programs via user notes and guides, workshops, and other means.

#### 5.1.1. Selected Sites:

- The collaborative workspace website for **NASA SMD EPO** points the public to resources such as the higher education products mentioned in this article.<sup>2</sup>
- **NASA Wavelength** is an online clearinghouse of NASA-based products and resources that have gone through NASA Education Product Review. The site has extensive search capabilities and includes resources for a wide variety of ages and education audiences.<sup>3</sup>

<sup>1</sup><http://www.astrosociety.org/education/astronomy-resource-guides/>

<sup>2</sup><http://smdepo.org/post/5544>

<sup>3</sup><http://nasawavelength.org>

- **Earthspace** is an online clearinghouse of resources, research and best practices for the higher education community.<sup>4</sup>
- The **Astronomical Society of the Pacific** serves as the host for the two higher education resources mentioned in this article, at the link given above.

## 5.2. Connecting at Conferences

The Astrophysics Forum has conducted sessions, workshops, and meetings at professional conferences such as those of the AAS and ASP (notably the Cosmos in the Classroom symposium catering to introductory astronomy instructors) to foster greater awareness of our higher education resources among educators attending these conferences.

## 6. Mission-Based, Science-Driven

The Forums facilitate easy access to the resources developed by the SMD EPO community. SMD EPO is embedded within each mission, allowing scientists and educators to efficiently develop products that deliver mission science to the higher education community—and in doing so, enhance the STEM experience of students taught by the instructors who use these products.

Through the means described—by using evidence-based approaches, leveraging resources and expertise, and sharing what works—we can encourage ongoing refinements to continually improve science education using NASA mission-based, science-driven content and experience.

**Acknowledgments.** Contributing NASA Astrophysics EPO programs include Astronomy Picture of the Day, the Chandra X-ray Observatory, the Hubble Space Telescope, the NASA Goddard Astrophysics Science Division, the Planck mission, the Sonoma State University EPO group (Fermi, NuSTAR, Swift, XMM-Newton, Using the Big Ideas in Cosmology), the former Structure and Evolution of the Universe Education Forum, the University of Arizona/JPL Exoplanet Exploration Program, Center for Astronomy Education, the University of Chicago EPO group, the Wilkinson Microwave Anisotropy Probe (WMAP), the Kepler Mission, the Night Sky Network, Planet-Quest, and the Spitzer Space Telescope/IPAC.

The Astrophysics Forum is supported by NASA under Cooperative Agreement NNX09AQ11A issued by the NASA Science Mission Directorate, and is a partnership between the Space Telescope Science Institute, the Adler Planetarium, the Astronomical Society of the Pacific, and Johns Hopkins University.

---

<sup>4</sup><http://www.lpi.usra.edu/earthspace/>