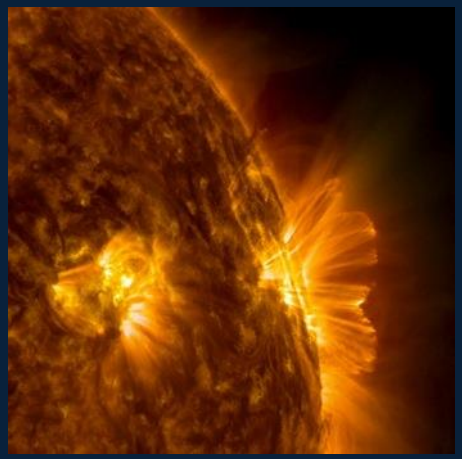



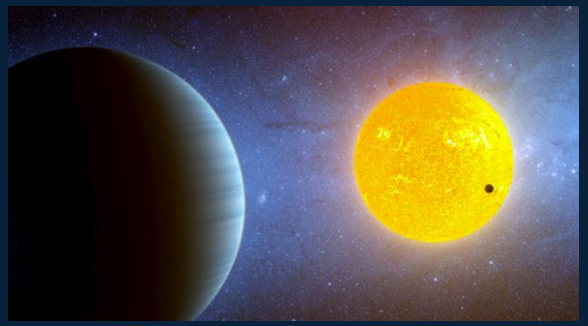
Setting the Stage

The NASA Science Mission Directorate Education Program: Sharing the Adventure with the Student

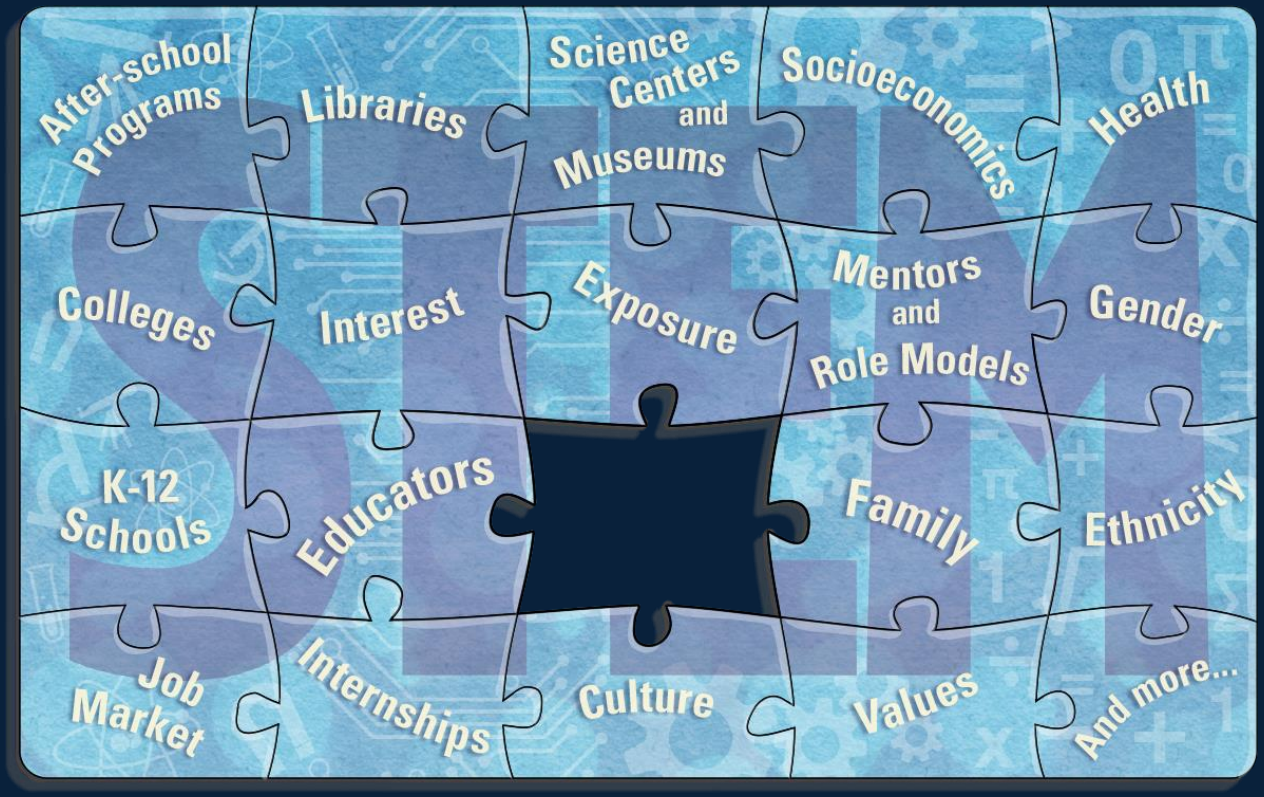
Laura Peticolas, University of California-Berkeley
Theresa Schwerin, Institute for Global Environmental Strategies
Stephanie Shipp, Lunar & Planetary Institute
Denise Smith, Space Telescope Science Institute

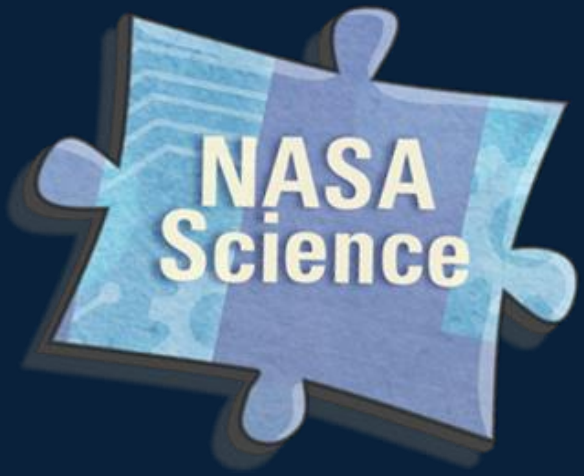
Science and Science Education Go Hand-in-Hand

Denise Smith
Lead, Astrophysics Science Education and Public Outreach Forum



Sharing the Adventure with the Student: NASA Science is an Essential Piece of the STEM Puzzle





- Inspiration
- Exposure
- Role Models
- Unique Science Content
- And More…

Today's NASA

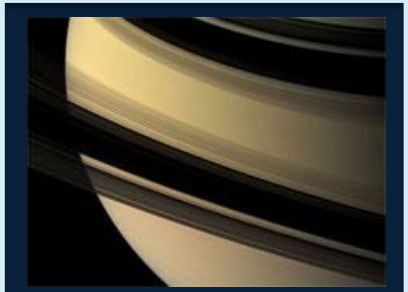
4 Mission Directorates

Office of Education

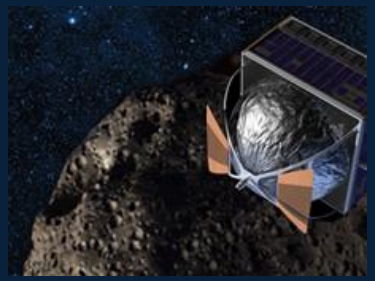
Office of Communications

Aeronautics Research

Human Exploration



Science



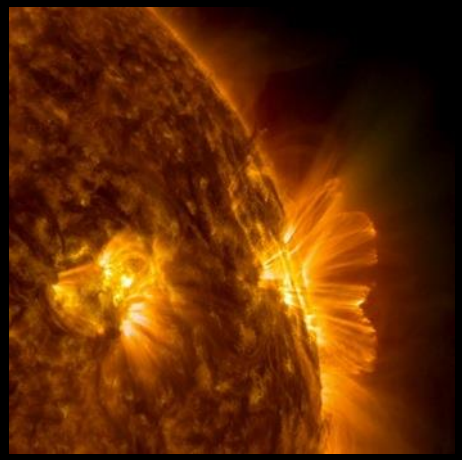
Space Technology

10 Field Centers

NASA advances its goals through a wide-range of partners

Missions and Research Programs Seek Answers to Fundamental Questions

Earth Science



Heliophysics

Planetary Science

Astrophysics

To share the science, the story, and the adventure of NASA's scientific explorations of our home planet, our Sun, the solar system, and the universe beyond… providing a direct return on the public's investment in NASA's scientific research.

Scientist-Educator Partnerships are the Cornerstone of SMD Education

Scientists bring…

- Knowledge of Earth and space science
- Knowledge of research and data
- Knowledge of STEM career paths

Educators bring…

- Knowledge of science education pedagogy
- Knowledge of audience needs
- Knowledge of education standards

When Science and Science Education Go Hand-in-Hand…

- ✓ Cutting-edge science and technology are carried into schools and public programming in a way that is **accurate and meets audience needs**.

- ✓ Students, educators, and the public are able to participate in the **practice of science** called for by the National Research Council (2012) and embodied in the Next Generation Science Standards (2013).

This partnership has become so deeply engrained, that many feel it epitomizes **NASA's social contract with the nation.**

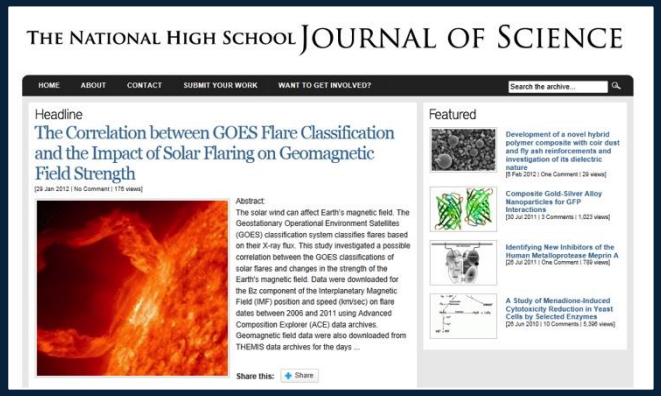
Current, Accurate, Audience-Focused Resources are **Needed and Used**

Hubble's Amazing Space:

- Uses Hubble's discoveries to reinforce key science concepts and process of science
- ½ million teachers per year; 6 million students per year
- Selected by more than half State Departments of Education; used in all 50 states

Students, Educators, and the Public Participate in the **Practice of Science**

MY NASA DATA- over 200 classroom-friendly Earth science datasets and tools; 100+ peer reviewed lessons ~80,000 unique visitors annually; 60,000 back links



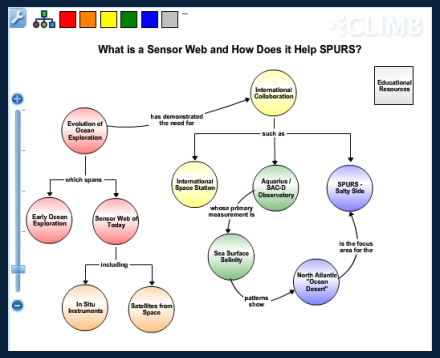
High school student publishes paper about his research using THEMIS data

Science magazine selected the Mars Student Imaging Project as one of the top inquiry-based education modules in the U.S.

Educators fly side-by-side with scientists on SOFIA

Scientists are Engaged in Education in Meaningful Ways

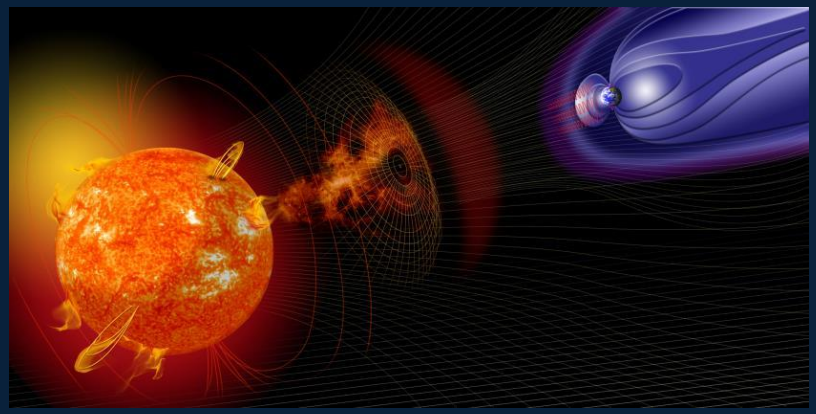
Choices	Percentage
Review of science content for products/resources	88.00%
Give presentations to the public	76.00%
Interpretation/clarification of data and results for the EPO team	75.00%
Write science content for products/resources	73.00%
Provide website content	69.00%
Participation in electronic media efforts (podcast, vodcast, videos, etc.)	68.00%
Create educational activities and/or resources	63.00%
Other	
Participation in social media efforts (Facebook, Twitter, etc.)	48.00%

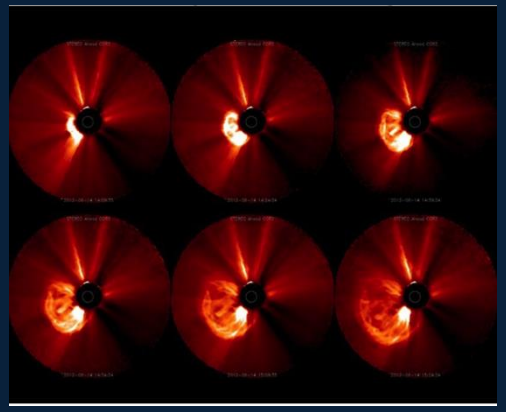


Aquarius Mission: Concept mapping workshops and tools helping ocean scientists represent and communicate science

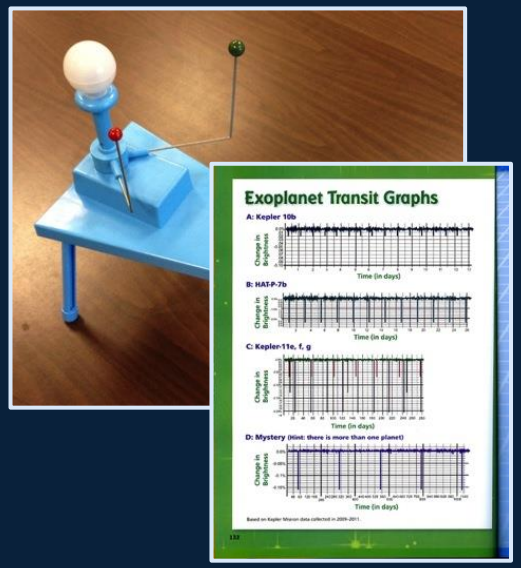
A Nationwide, Coordinated Community of Practice

Laura Peticolas
Lead, Heliophysics Science Education and Public Outreach Forum

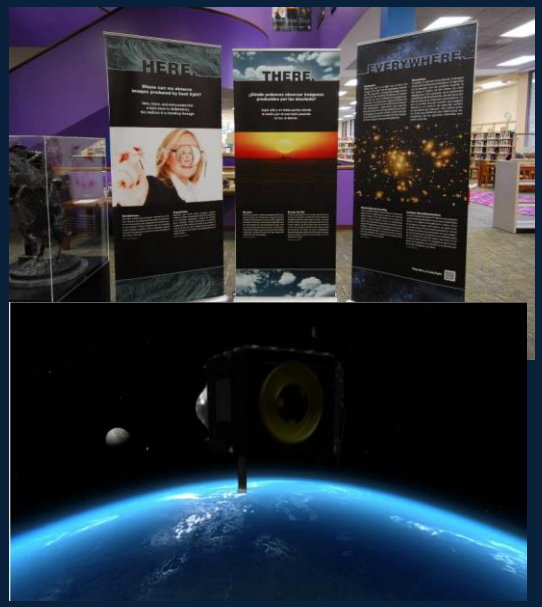




SMD Education Spans the Spectrum



Curriculum Support



Exhibits & Shows

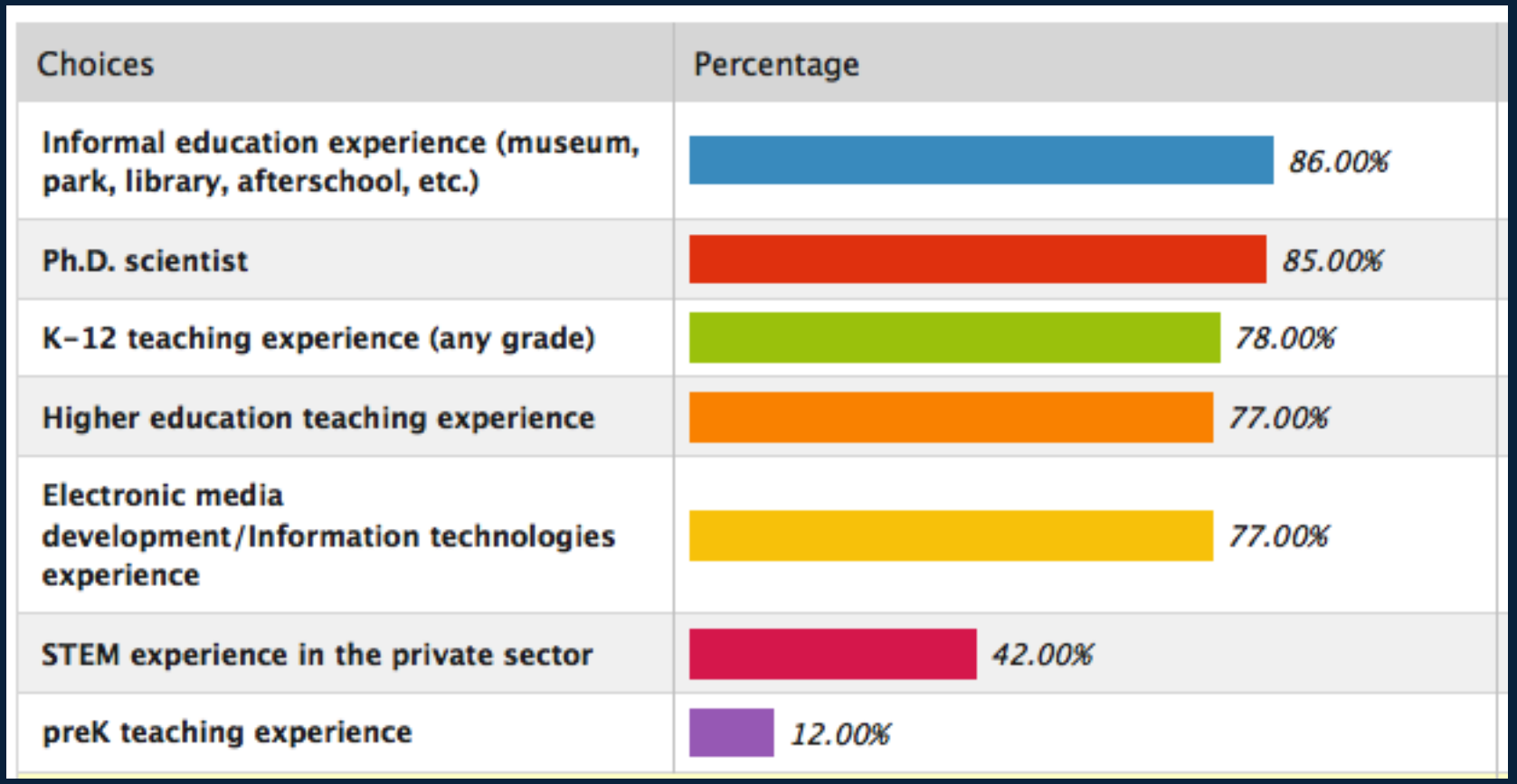
Professional Development

Student Activities

Research Experiences

Out-of-School-Time
& Community Events

SMD Education Leverages a **Highly Skilled Community of Practitioners**



Choices	Percentage
Informal education experience (museum, park, library, afterschool, etc.)	86.00%
Ph.D. scientist	85.00%
K–12 teaching experience (any grade)	78.00%
Higher education teaching experience	77.00%
Electronic media development/Information technologies experience	77.00%
STEM experience in the private sector	42.00%
preK teaching experience	12.00%

SMD education leads have deep, significant experience in NASA STEM: 71% have > 6 years (41% > 10 years)

Community of Practice Levels of Participation: A Common Picture

Credit: Adapted from slide by Etienne and Beverly Wenger-Trayner (http://wenger-trayner.com/resources/slide-forms-of-participation/)

NASA SMD Science Education: A National Community of Practice

Characteristics (Wenger-Trayner):

- Our **Domain** is **SMD science education**
  - Community is interested in how to best incorporate NASA Science as a meaningful part of the National Science Education landscape while understanding how to navigate NASA culture, requirements, & needs.
- Our **Community** is **coordinated primarily by Forums**
  - Community is maintained through virtual and face-to-face meetings, an online workspace, shared resources on NASA Wavelength.
- Our **Practice** in being **effective SMD science education leads**
  - Experiences, stories, tools, ways of addressing challenges lead to understanding how best to do SMD science education

Forums **Maximize Cohesion, Effectiveness, Efficiency** Across a Nationwide Community of Practice

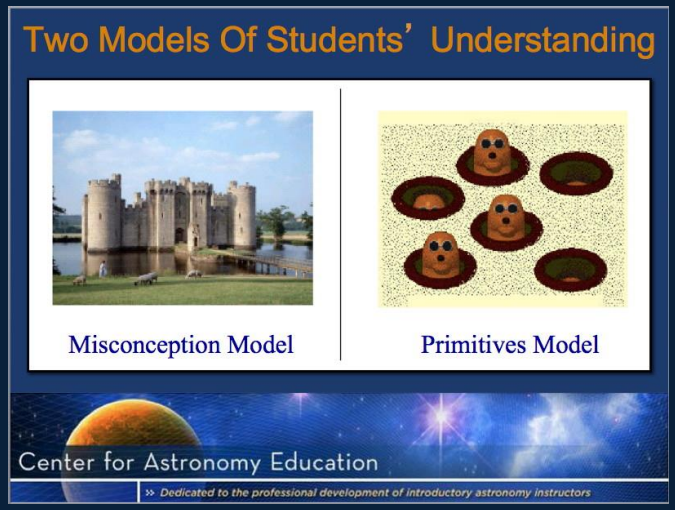
- Organize collaborations between programs to **reduce duplication**
- Enable sharing of **best practices**
- Align products to **national education standards**
- Create and maintain **NASA Wavelength** education product catalog
- Help disseminate program **metrics and evaluation findings**

Underlying SMD Efforts is the Application of Best Practices

As a community of practice we work together to:

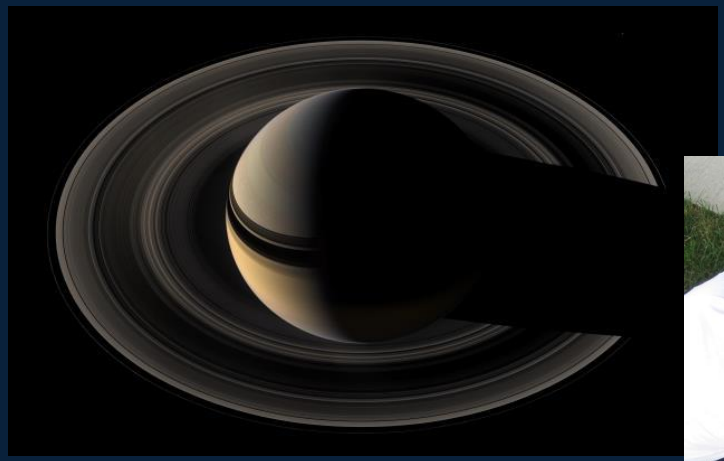
- Identify and raise awareness of existing body of best practices and educational research, including audience needs

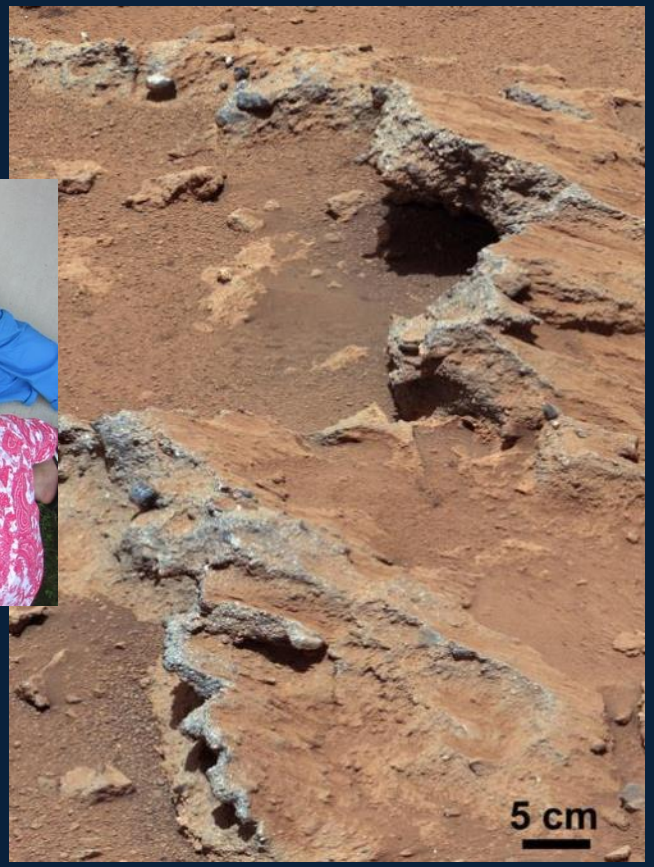
- Organize distance learning and face-to-face professional development opportunities for NASA science education professionals

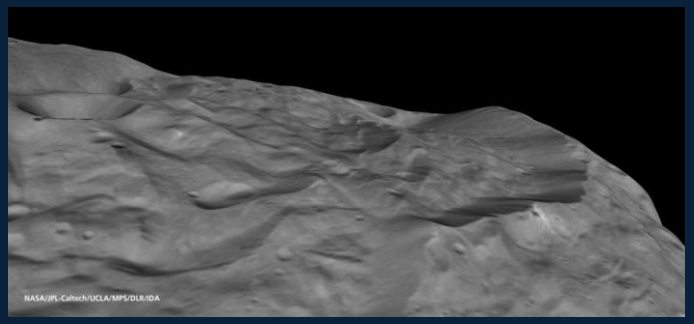


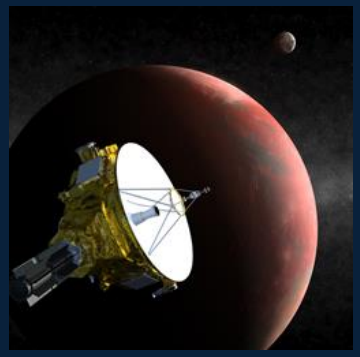
Putting Research into Practice:
Curriculum Support Resources & Professional Development

Stephanie Shipp
Lead, Planetary Science Education and Public Outreach Forum

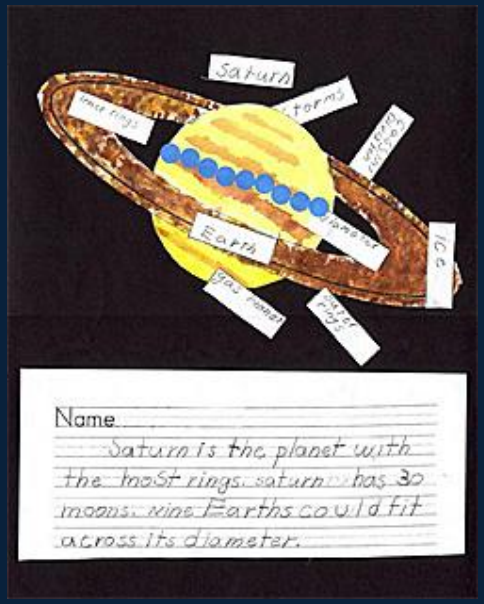








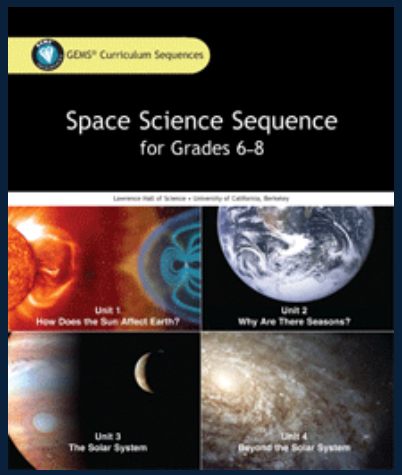
Curriculum Support



Literacy

Practices of Science

Project Based Learning

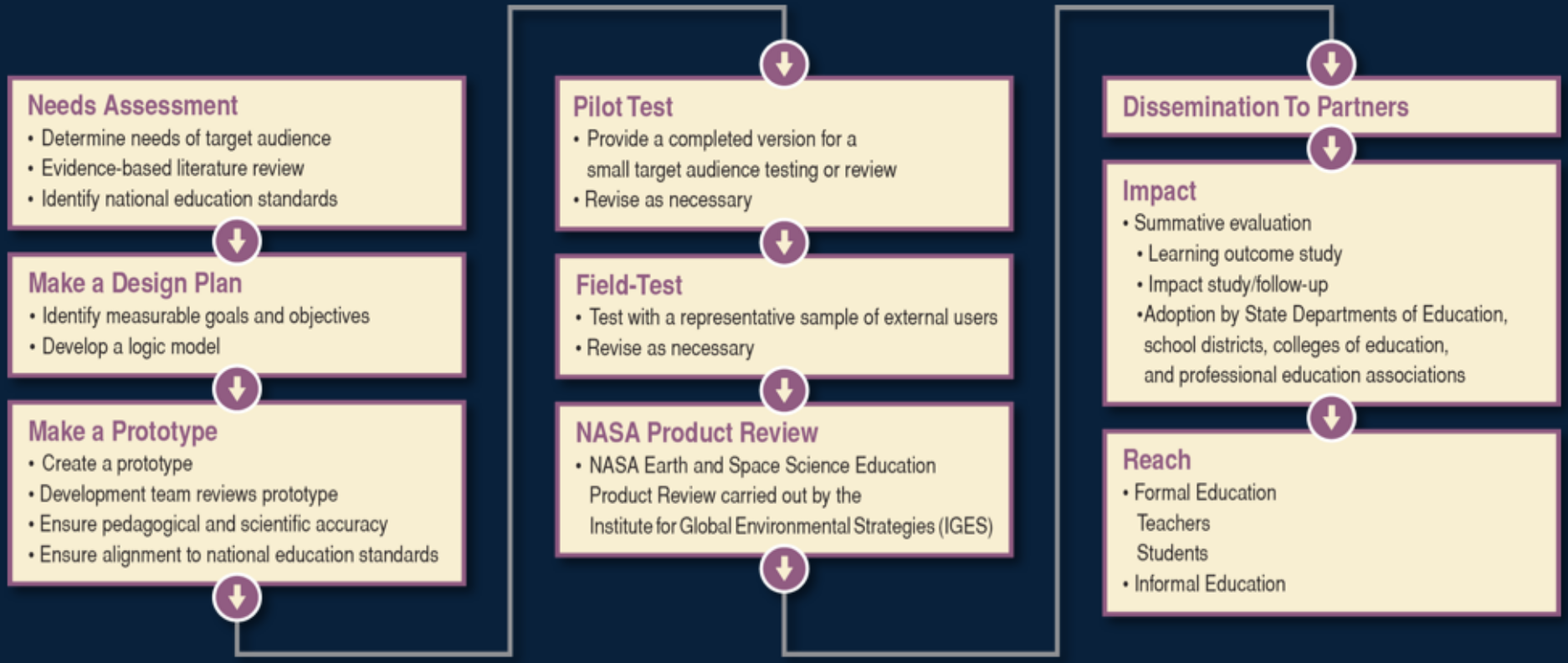


Partnerships

Leveraging NASA Science to Inspire, Engage, and Educate Students in STEM

SMD education materials are standards-based, field-tested and evaluated

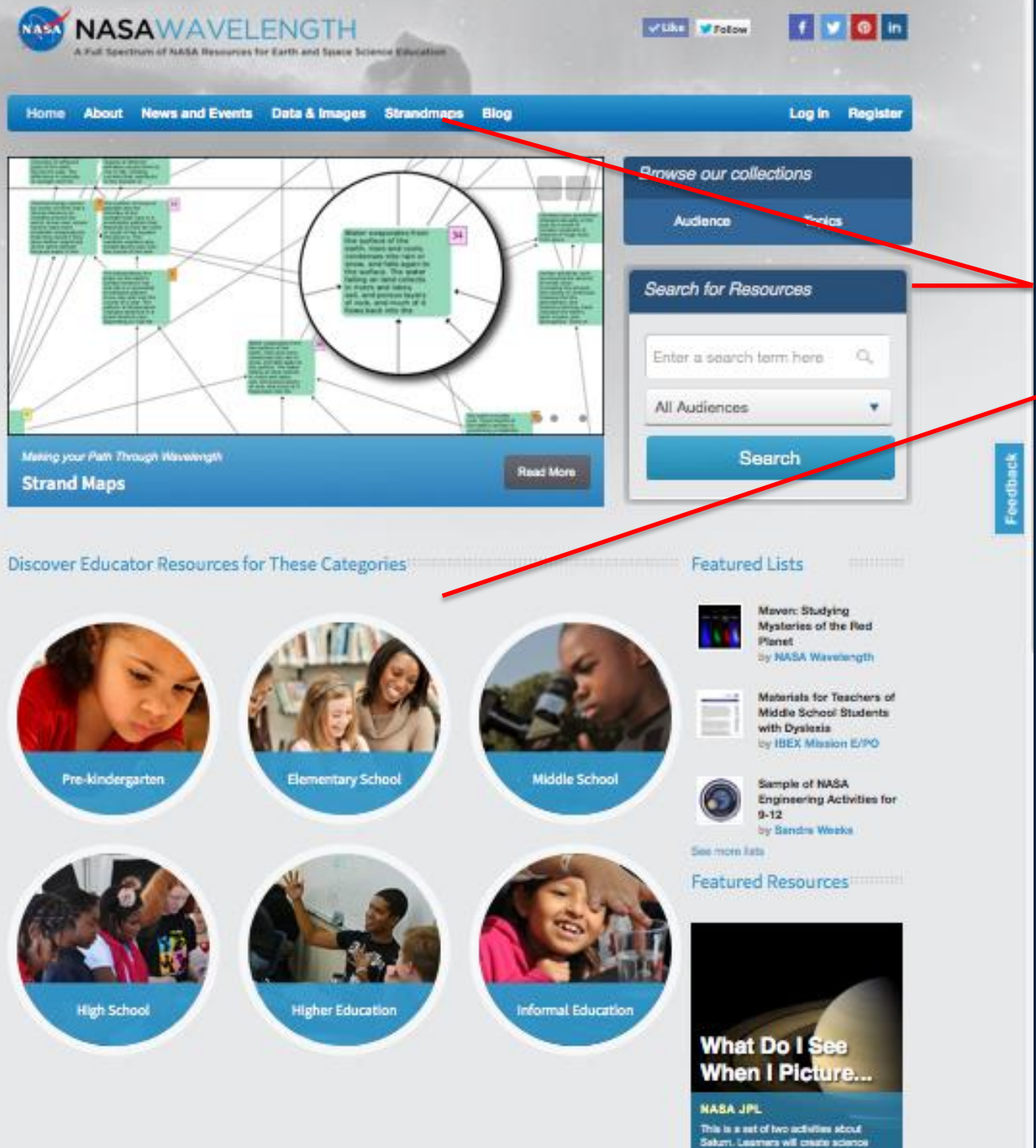
Development involves SMD Education Professionals, SMD Scientists, Audience Members



NASA Education Product Review Criteria Include:

- Relevance and Accuracy
- Alignment to national education standards
- Effective instructional practices and appropriate student assessment

* Graphic: Space Telescope Science Institute Design Process

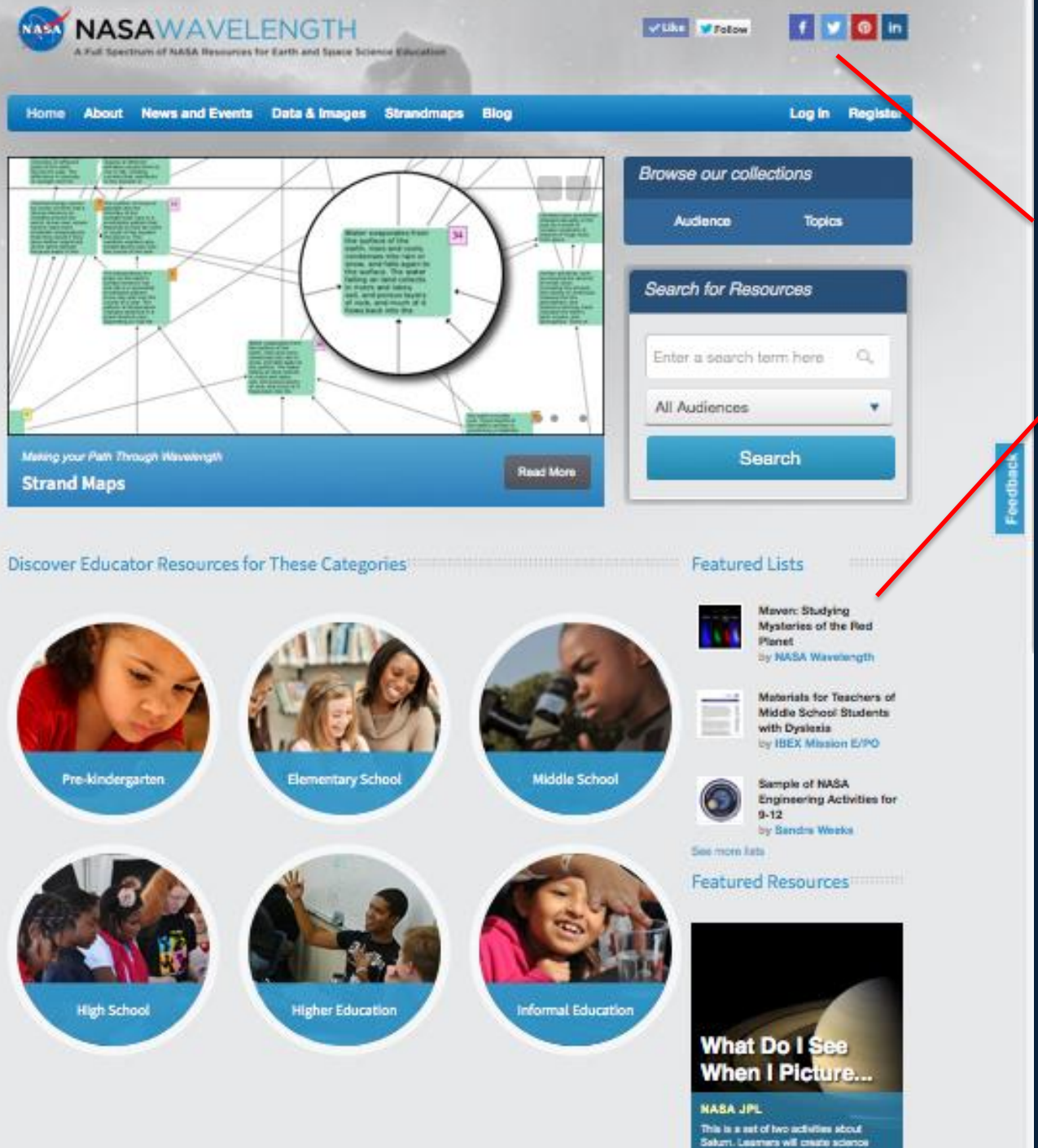


NASAWavelength.org

Design driven by audience needs and research-based best practices for digital libraries

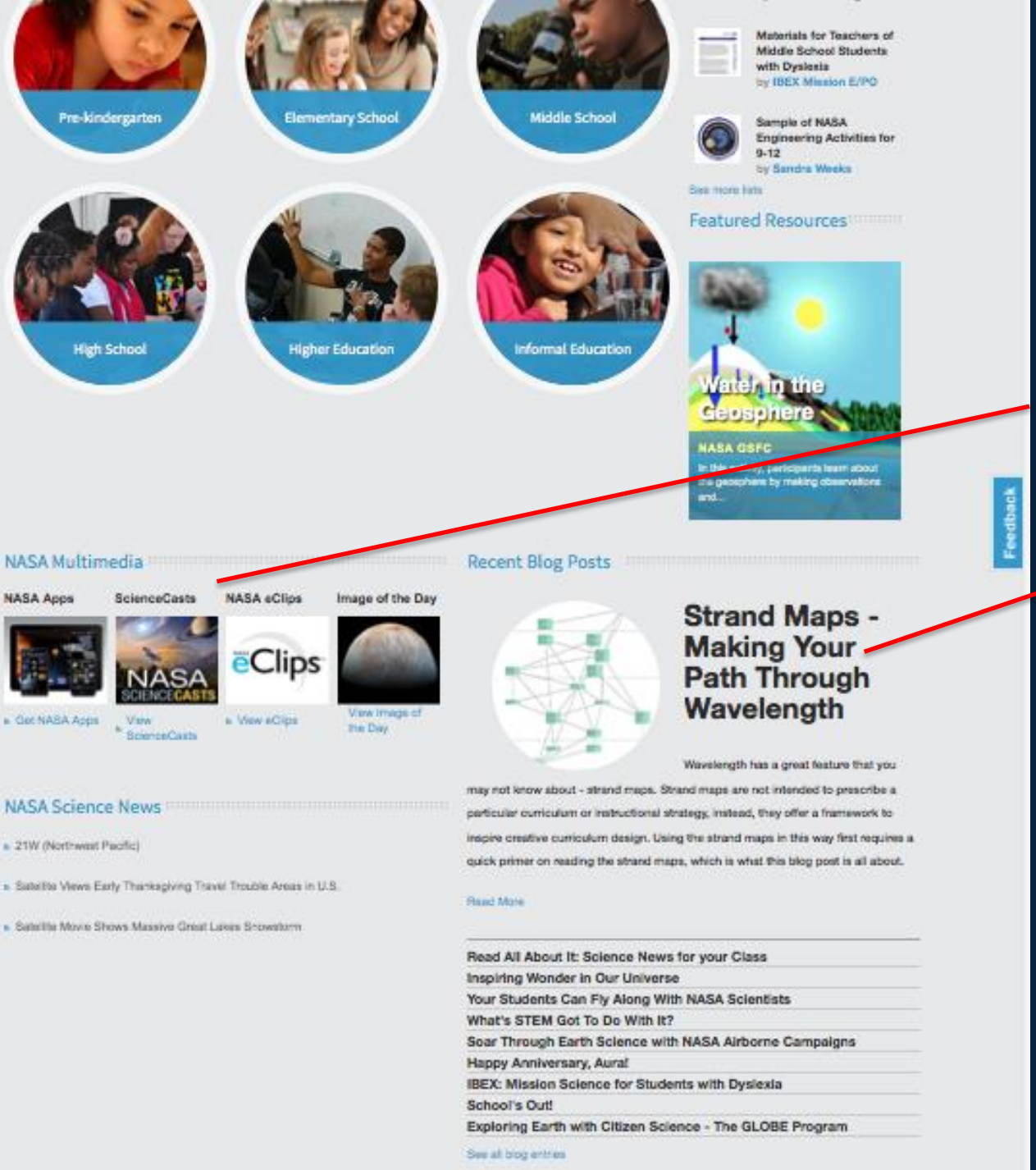
Multiple pathways through the collection, that are meaningful for educators

NEXT GENERATION SCIENCE STANDARDS
For States, By States



NASAWavelength.org

Create custom collections through list-building and share through social media and Atom feeds.



NASAWavelength.org

Connect to broader NASA family of multimedia, science news and images

Learn in-depth information about using resources in the classroom through the blog

Five Highest Rated Reasons to Attend a NASA K-12 Professional Development Experience

1. Learning Ways to Use NASA Resources with Students
2. Accessing NASA's Imagery and Science
3. Discovering Cutting Edge Scientific Work Done by NASA
4. Receiving Science Content from a NASA Scientist
5. Acquiring NASA Resources (Print/Electronic)

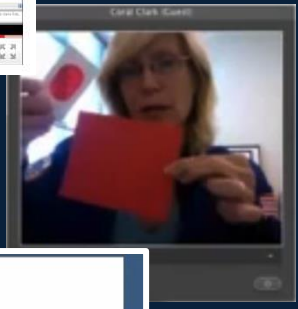
Source: 2013 Survey on Teacher Professional Development by NASA SMD Cross-Forum K-12 Working Group
http://smdepo.org/post/5656

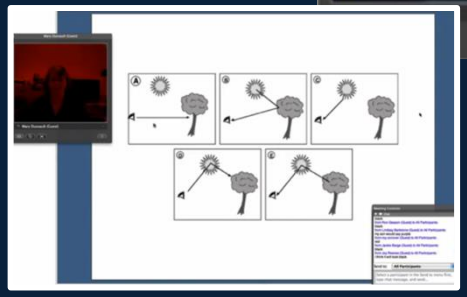
Coordinated Professional Development Tailored to Audience Needs

Train-the-Trainer

Face-to-Face

Online

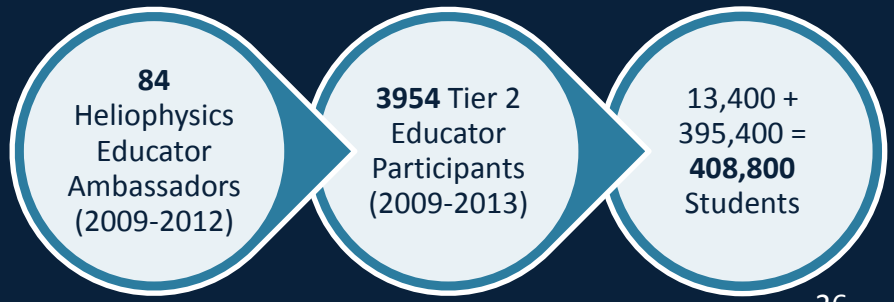




Our community of practice works together and with educators to identify **audience needs** and to tailor professional development that **leverages NASA science, community expertise, and education research** to meet those needs.

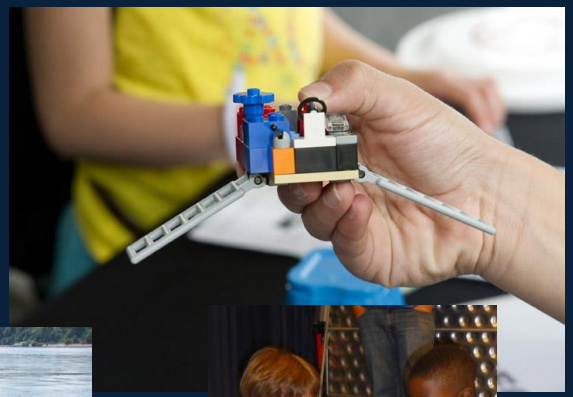
Leveraging: NASA Master Teachers Education Ambassador Model

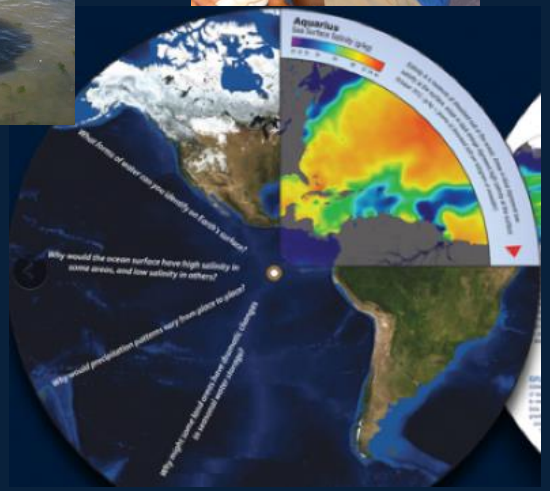
- **Tier 1** educators participate in week-long professional development workshops.
- **Tier 2** educators participate in day-long professional run by tier 1 educators.
- **Students** taught by Tier 1 and Tier 2 educators
- Often **multi-mission** collaborations
- Classroom educators and out-of-school educators



Collaborations, Partnerships, & Evaluation

Theresa Schwerin
Lead, Earth Science Education and Public Outreach Forum





SMD Education Programs Have Built a Broad Range of **High Impact Partnerships**

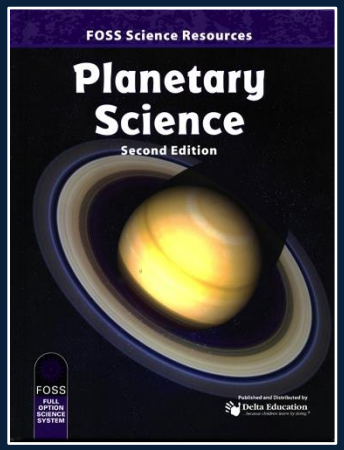
NFB National Federation of the Blind
Voice of the Nation's Blind

CHICAGO PUBLIC SCHOOLS | CPS

ART WORKS.
arts.gov

SACNAS

SCIENCE OLYMPIAD
Exploring the World of Science



SMD EPO Programs Have Built a Broad Range of **High Impact Partnerships**

Reached 4 million+ visitors through this NASA - National Park Service - US Fish and Wildlife Service Partnership

Our Audiences Reflect the Diversity of Our Nation

"Congratulations to these women that have gotten to NASA — and especially being Spanish and Panamanian. Yes, we can! Yes, we can!"

Collaborations with holders of cultural knowledge leads to renewed student interest in own culture and science

Scientists and educators empowered to serve their community.

Evaluation in the Context of NASA's Science Mission Directorate

Purposes of Evaluation:

- Characterize and communicate
- Inform decisions
- Improve design and implementation
- Ensure quality
- Demonstrate impacts

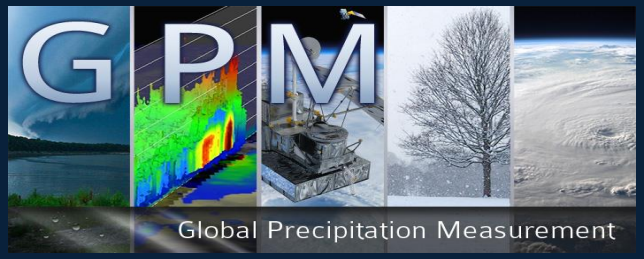
Types of Evaluation (Very Broadly):

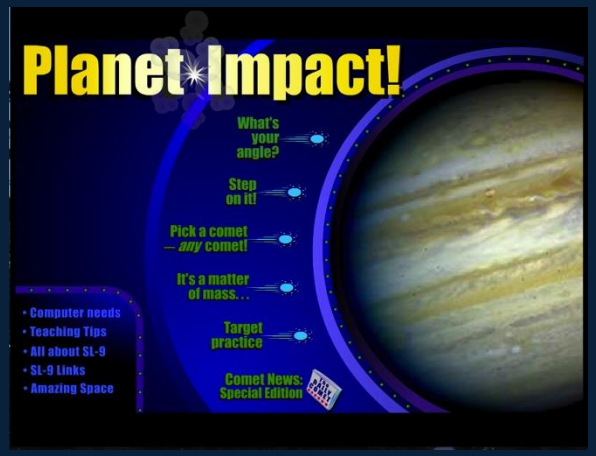
- Peer reviews, program reviews, and analyses
- Formative (Needs assessments, Implementation)
- Summative (Outcomes, Impacts)

Rigorous reviews, evaluation, and data-driven decisions

- Mission-embedded programs and programs funded via solicitations are expected to include evaluation plans.
- SMD convenes external review panels to evaluate its programs according to rigorous criteria.
- Mission plans undergo rigorous review at mission key decision points.
- SMD programs report data and metrics to NASA through annual reports, data calls, Office of Education infrastructure.

Evaluation Shows Gains in Awareness, Knowledge, and Understanding



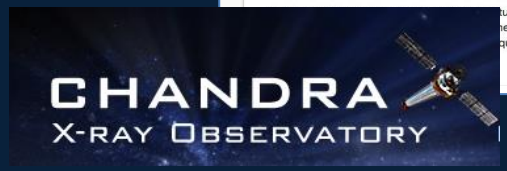


- **GPM-enhanced STEM lessons increased students' understanding of core curriculum concepts** (e.g., water cycle, global energy budget, and hurricanes) equal or better than students in comparison classes. GPM "Survivor" Outdoor Education Module showed **statistically-significant increases in understanding**, facilitators reported students were "highly engaged."

- **High-school teachers** participating in the week-long NLSI Unknown Moon Institute demonstrated **significant gains in content knowledge.**

- McREL learning outcome study shows that **students using STScI's *Planet Impact* would score statistically higher** than a control group on a standardized test.

Development of Skills, Interest, and Engagement in STEM



83% enrolled in or completed a degree program reported majoring or minoring in a STEM subject.

Reinvented my understanding of science. The program has given me the confidence to pursue a career in science.

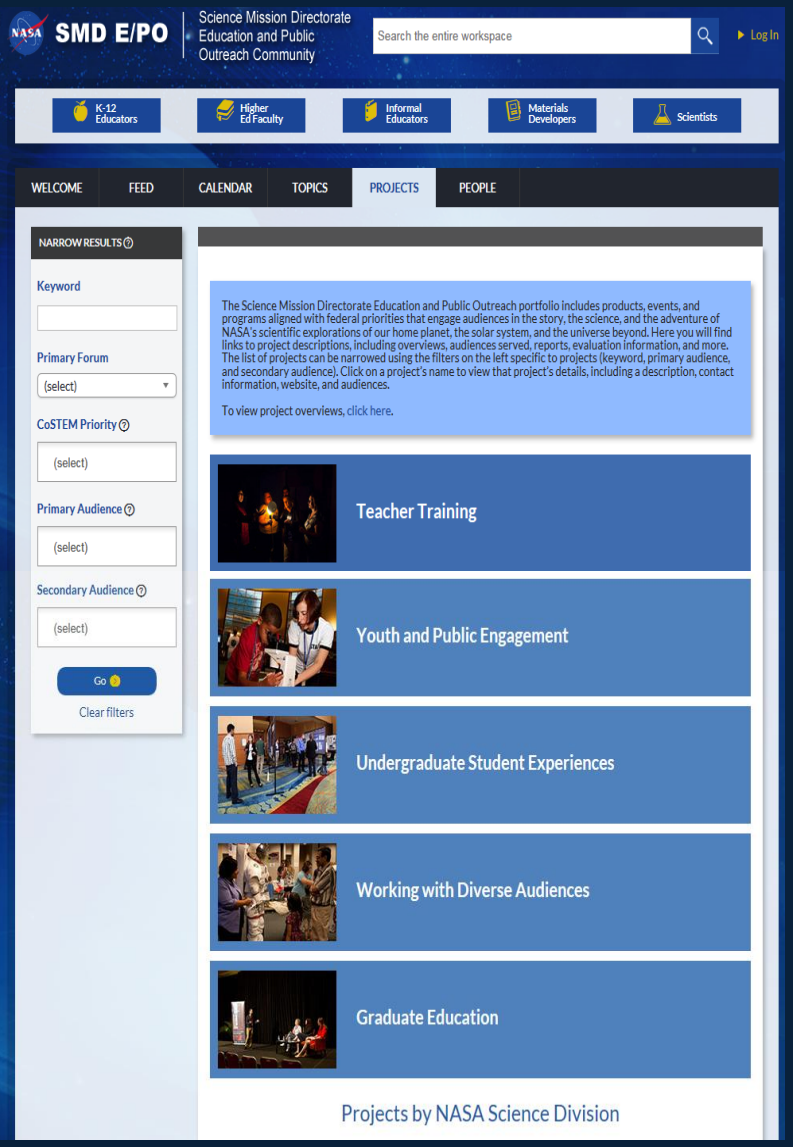
Collaboration with NSF-funded iGETT enables two-year colleges to meet workforce needs for geospatial skills. 90% of faculty remained fully engaged over the three-year project. **70% report increased student interest**; increased interest in enrolling in more geospatial tech courses, and understanding of career opportunities.

At the end of every single day, I felt stronger not only about RS [remote sensing], but also about how to TEACH RS.

Evaluation Shows Knowledge Gains and Curriculum Use in Many Train-the-Trainer Programs

- **Tier 1 teachers** in the MAVEN Educator Ambassador program showed significant increases in their understanding of core curriculum concepts (e.g. gravity, sizes, atmospheric composition, and importance of magnetic fields of Earth and Mars.)
- **Tier 2 teachers** in the Heliophysics Educator Ambassador program indicated that they focus on heliophysics content for an average of 10 instructional hours annually, primarily as a supplemental resource and share heliophysics-related materials and ideas with an average of 141 students in a typical year
- **Students** who participated in the Beyond Einstein Explorers' Program activities showed an increase in understanding of astronomical concepts and the tools used by astronomers to study the Universe.

An Effective Return on Investment



"The NASA Science Mission Directorate programs are to be commended for their close integration with the science missions of NASA and for their use of partnerships to bring educational expertise into their work."

- National Research Council. NASA's Elementary and Secondary Education Program: Review and Critique. Washington, DC: The National Academies Press, 2008

SMD E/PO Projects / Impact

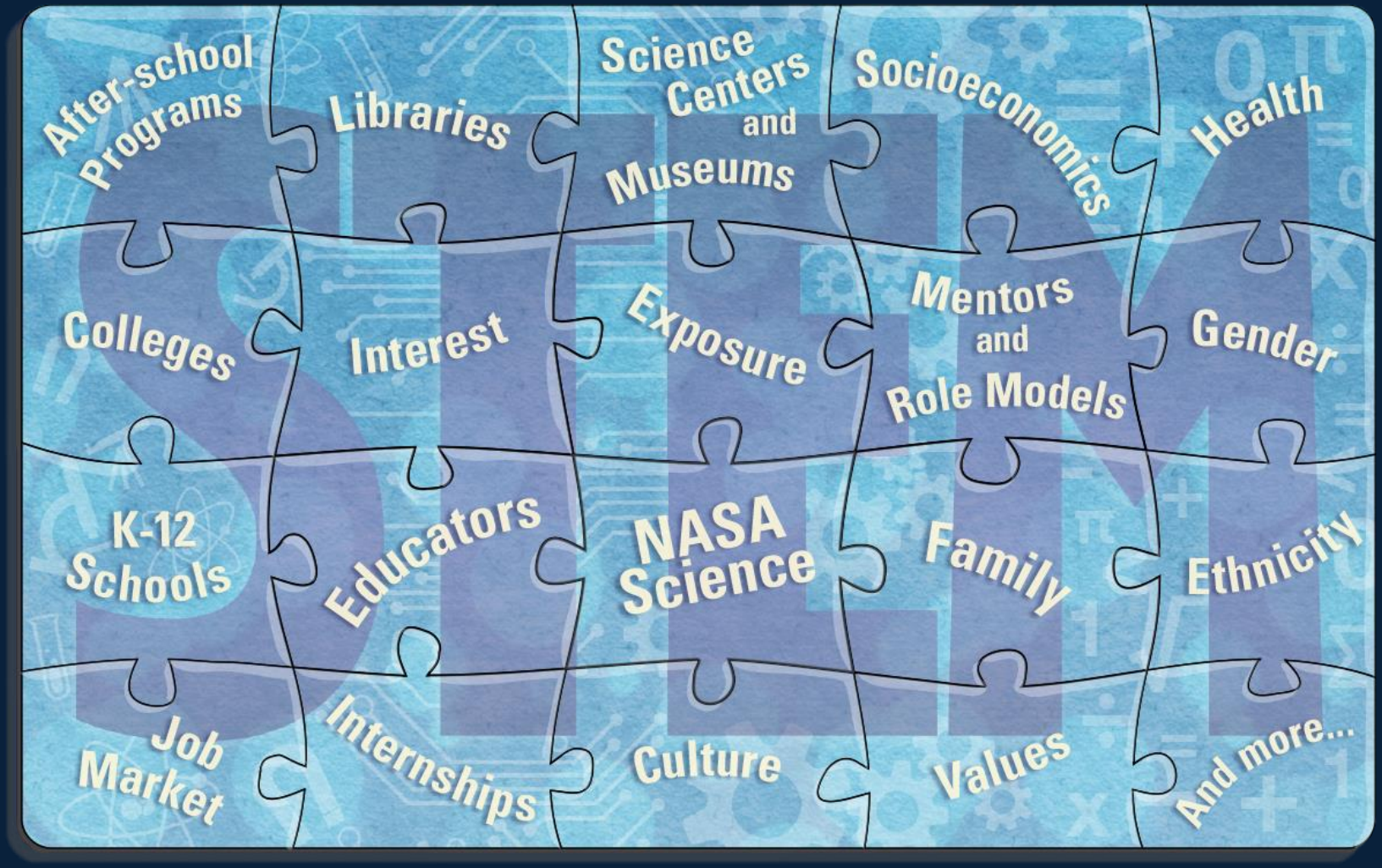
Here are profiles of SMD Education and Public Outreach projects and their teams, expertise and how scientists are involved; evaluation plans and key evaluation results; impacts and significant results; partnerships; awards and recognition, and more.

http://smdepo.org/page/5324

SMD Education Contributes to Federal Priorities

Federal Strategic Plan	SMD Education Programs
Improve STEM Instruction	The SMD community reported working with more than 34,000 K-12 educators in FY12 alone. Including the reach of SMD curriculum support materials and work with master teachers, the impact is far greater.
Increase and Sustain Youth and Public Engagement in STEM	In FY12, the SMD community reported working with over 680,000 K-12 students. Numerous SMD partnerships greatly extend SMD's impact within and beyond the classroom.
Increase Students Graduating with STEM Degrees	SMD materials and programs engage students at critical junctures in the STEM pipeline. Example studies show increased interest in / continued pursuit of STEM.
Better Serve Groups Historically Underrepresented in STEM Fields	SMD programs are designed and implemented in partnership with a wide range of underserved groups.
Enhance Graduate Experiences	NASA's scientific research programs provide direct STEM experience to participating undergraduates, graduate students, and postdocs.

The Bottom Line: NASA Science is an Essential Piece of the STEM Puzzle



To the SMD EPO Community:
Thank You!

Learn More About SMD EPO Program Impacts
http://smdepo.org/page/5324

Find SMD Education Materials
http://nasawavelength.org

Additional Resources

Explanatory Guide to SMD EPO Evaluation Factors

http://science.nasa.gov/researchers/education-public-outreach/explanatory-guide-to-smd-e-po-evaluation-factors/

NASA SMD Education Product Review

http://nasareviews.strategies.org

Science and Science Education Go Hand-in-Hand:

The Impact of the NASA Science Mission Directorate Education and Public Outreach Program

By Smith, Peticolas, Schwerin and Shipp

http://smdepo.org/post/6378

NASA SMD EPO Policy (SPD-18)

http://science.nasa.gov/media/medialibrary/2012/03/01/SPD-18_Mission_EPO_Policy.pdf