

**Opportunities in Science Mission Directorate Education and Public Outreach**  
**Abstracts of selected proposals.**  
**(NNH08ZDA001N-EPO)**

Below are the abstracts of proposals selected for funding for the Opportunities in Science Mission Directorate Education and Public Outreach program. Principal Investigator (PI) name, institution, and proposal title are also included. 75 proposals were received in response to this opportunity, and 18 were selected for funding.

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**Kimberly Arcand/Smithsonian Astrophysical Observatory**  
**International Year of Astronomy 2009 in the U.S.: Exhibiting Astronomy with the**  
**"From Earth to the Universe" Project**

The International Year of Astronomy 2009 (IYA2009) project "From Earth to the Universe" (FETTU) will bring spectacular astronomical images, including those captured by NASA's armada of space-based observatories, to audiences in "non-traditional" venues. By displaying these images in airports, public parks, and other locations across the country, in addition to more traditional science centers and planetariums, millions of people will be exposed to space science across geographical and cultural boundaries. FETTU intends to engage the American public and inspire them to learn more about the science behind these images through well-written materials and informal educational activities associated with IYA2009 and beyond.

In addition to being a major project for the US IYA2009 efforts, FETTU is a cornerstone project for the IAU IYA2009 efforts. The FETTU project has been tested in several recent events, including a prototype in Liverpool, United Kingdom, from June 2008 and a smaller version at the 2008 Smithsonian Folklife Festival.

Over 35 countries have expressed interest in hosting versions of FETTU. It is our goal to ensure that the U.S. has many prominent locations for FETTU, enabling these images to reach the widest possible audiences. To allow for maximum flexibility and leverage, we are proposing a three-prong approach. Firstly, semi-permanent versions will be established in Atlanta, GA, and Chicago, IL. Secondly, a traveling version, which will be anchored in Boston, MA, will be sent to multiple locations. Finally, a free, downloadable version will be available for any site that can raise the funds for the physical installation.

The impetus for FETTU is for IYA2009, but exhibitions could continue into 2010 and beyond. As detailed in this proposal, the FETTU project strongly aligns with the goals for NASA SMD informal outreach and education activities as well as those for US IYA.

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**S. Barbier/SP Systems, Inc.**  
**Multimedia Toolkit of Space Physics Particle Concepts for Education**

Atoms and sub-atomic particles play a crucial role in the dynamics of our universe, but these particles and the space plasmas comprised of such particles are often overlooked in

popular scientific and educational resources. Even the most basic particle and plasma physics principles are generally unfamiliar to non-scientists. Educators and public communicators need assistance in explaining these concepts that cannot be easily demonstrated in the everyday world.

Active visuals are a highly effective aid to understanding, but resources of this type are currently few in number and difficult to find, and most do not provide suitable context for audience comprehension.

To meet that need, we propose to develop an online reference library - a toolkit - of multimedia resources such as animations, visualizations, interactivities, videos, etc. Each ready-to-use product will be accompanied by a supporting explanation at a reading level matching the educational level of the concept.

We will target primarily grades 9-14, along with the equivalent in informal education and outreach. Products are intended to stand alone, making them adaptable to the widest range of uses. Potential applications include scientist presentations, vodcasts, museum displays, educational websites and CDs, teacher professional development, and classroom use.

Our team of space science and education specialists will determine specific needs, gaps, and priorities by surveying the potential user community and referencing STEM educational standards. Where gaps exist, the team will develop new products, focusing initially on the simplest concepts and gradually moving on to the more complex. Simpler concepts apply to a wider range of space science, from heliophysics and astrophysics to technology and human exploration.

Scientist educators at several institutions from different heliophysics and astrophysics specialties have already expressed great interest in the toolkit. We will concentrate development on heliophysics with the funding requested in this proposal, but advertise beyond that range where appropriate.

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### **Jacqueline Barley/Girl Scouts of The USA**

#### **Girls In Space: A Sustainable Program in After-School Astronomy for Girl Scouts and Their Families.**

Girls In Space is a partnership between NASA, Girl Scouts USA and the Astronomical League to operate Girl Scout Astronomy Clubs (GSAC) across the nation. Our program is designed to leverage sustainable and powerful experiences in astronomy for Girl Scouts nation-wide, in conjunction with International Year of Astronomy 2009. Girls In Space builds on existing partnerships, technology, corporate support and existing networks to engage Girl Scouts and their families in space exploration and career possibilities.

We will:

1. Bring Girl Scout leaders from Girl Scout councils to Goddard Space Flight Center for a one-week content and methods training program in Astrophysics, Planetary Science,

Heliophysics, and Earth Science. Training will include how to set up and run a troop or regionally-based GSAC as well as family activities such as: Family Astronomy Nights; fun astronomy activities and resources; establishment of local support partnerships; and options for conducting authentic research efforts as a single club or in partnership with other clubs.

2. Establish committed partnerships between local GSACs and amateur astronomy clubs through the Astronomical League, the largest amateur astronomy group in the US with over 300 amateur astronomy clubs nation wide.
3. Establish a Girl Scout Robotic Telescope Farm in Arizona in partnership with the Telescopes In Education Foundation (TIE) to provide continuous observation opportunities for Girl Scouts. TIE will provide maintenance and ongoing operational support.
4. Establish partnerships between the GSACs and the After School Astronomy Club (ASAC) network.
5. Use distance learning technology to provide on-going training support.
6. Conduct on-going program evaluation to improve impact.
7. Introduce girls to the vast opportunities in the career pipeline of astronomy.

Girl Scouts will join and participate in their own astronomy clubs run at the troop or regional council level and supported by local amateur astronomers and after-school astronomy clubs.

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**Cynthia Cattell/University of Minnesota  
Involving Parents and Children From Under-Represented Communities in STEM Learning**

We are proposing a program, which is designed to create opportunities for parents to model the learning and enjoyment of science while working with their children. The program provides free and intriguing science, technology, engineering, and mathematics (STEM) activities to parents and their children, in after school and/or community center environments. It has been shown that this type of opportunity can make a difference in the students' interest and achievement in STEM topics. The goals are to help parents view themselves as an integral part of their children's learning, to provide exciting science exploration opportunities for families, to allow parents and children to view themselves as confident co-learners of science, and to help build stronger student attachment to schools and learning experiences. The focus is on families in communities that are economically disadvantaged and that exhibit the greatest disparities in academic achievement. The approach is to develop and present short classes designed to promote critical thinking for both the parent and the child in a non-threatening format. The proposed program is a continuation of a successful pilot program. We will broaden the scope of the program to include NASA SMD content, and to increase the number of events scheduled in each community. The project leverages off existing programs, including PhysTEC and Physics Force. The program will address the stated NASA E/PO goals by increasing interest in STEM fields and NASA science among students and families in communities that are traditionally under-represented in STEM fields, and by improving student retention and achievement. By coordinating with our existing

programs for improving elementary and high school physics teaching, we will improve science teaching, including incorporation of NASA SMD science, and work to expand the reach of our program. The program addresses the critical national need to reduce the disparity in academic achievement and increase the number of students interested in STEM fields.

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**Cynthia Cheung/NASA Goddard Space Flight Center**  
**Inspiring the Next Generation through R&D in Lunar and Planetary Science Exploration**

To realize NASA SMD's strategic goals for scientific exploration, we must prepare the next generation of scientists and engineers to take on the technological challenges. The proposed work aims at inspiring and educating the next-generation NASA workforce by involving students in authentic, mission related R&D activities in lunar and planetary science exploration. We will provide innovative, hands-on experience in: planetary science mission design and simulations, electronics and electro-mechanical systems, command & control, communications, robotics, autonomous and intelligent systems, and dust mitigation experiments, which are among the top priority technologies identified by the science missions in the SMD Solar System Exploration portfolio. The proposed work is an extension of the NASA Academy Internship Program at GSFC with an enhanced focus on Lunar and Planetary Science. Our partners, the faculty and staff in NASA Academy, industry and academia, will complement the GSFC scientist/engineer mentors in the educational program execution, outreach, and curriculum development. The proposed program leverages our past experience with over 500 student interns of diverse backgrounds from colleges nationwide.

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**Anita Davis/Science Systems and Applications, Inc.**  
**Building Climate Literacy for Informal Educators: Expanding the Earth to Sky Partnership**

The intent of "Building Climate Literacy for Informal Educators: Expanding the Earth to Sky Partnership," is to increase the public's understanding of global climate change and deepen its appreciation of the contributions NASA has made to our understanding of the global system. We will accomplish this in partnership with National Park Service (NPS) and U.S. Fish and Wildlife Service (FWS) Interpreters and Education Specialists. We will strengthen our relationship between NASA and NPS, expand it to include FWS, and build a sustainable, inter-agency program that furthers our shared goals of engaging, inspiring and educating the public.

This project directly addresses NASA's Strategic Subgoal 3A: Study planet Earth from space to advance scientific understanding and meet societal needs, and supports the Education Portfolio at three levels.

"Building Climate Literacy for Informal Educators" has several distinguishing features: an inter-agency collaboration, diverse training contexts and modes of delivery, a train-the-trainer and coach/mentor approach, and the potential to reach a large target audience.

Together with training specialists in NPS and FWS we will develop a series of professional development events for experienced interpreters and education specialists beginning with a Training Workshop followed by distance learning, and culminating in a national level course offered at our nation's premier conservation training venue: the National Conservation Training Center.

We are adopting a two-tiered approach, training experienced interpreters and education specialists who in turn train colleagues, resulting in a viable and vital community of practice that fosters knowledge, capacity and commitment to extend climate literacy to park and refuge audiences. We will contribute to NASA's Informal Education Resources, as participants develop informal education products. Including education specialists throughout the effort extends our support of the portfolio to areas of Elementary and Secondary Education.

Effectiveness will be assessed through formative and summative evaluation that examines in what ways, to what extent, and under what circumstances participants master NASA climate science, integrating science into engaging interpretive and educational programs and products.

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**Pamela Gay/ Southern Illinois University**

**The Universal Zoo: Citizen Science from the Moon to the Ultra Deep field**

In the last decade, astronomy, astrophysics and cosmology have witnessed a fundamental change as modern telescopes and space missions have provided a vast wealth of survey and archival data that is waiting to be mined. These untapped reserves of astronomical information provide unparalleled opportunities to study the statistics of populations of millions of objects. The downside of this modern way of studying the sky has been, until now, our inability to consider simultaneously what individual objects have to tell us. The key to unlocking this treasury of discovery is visual inspection of individual images, allowing us to look for the things the eye can see but computers can't automatically identify. In this proposal, we seek funding to create an educational citizen science gateway to facilitate the involvement of the public in the visual analysis of images from NASA archive and ongoing-mission while providing the educational scaffolding necessary to support learning.

We are in the process of creating a versatile web interface to invite the public to explore the universe around them and to contribute to science. Along with helping scientists answer fundamental questions about the distribution of planetary surface features and gravitational lenses, with this proposal we will also be asking the educational question, how does citizen science through informal online venues impact participants' active acquisition of astronomy content? Specifically, we will study how participants move from one citizen science project to another, what online education resources they access through our site, and through motivational studies, surveys and interviews we will ask how their behaviors are changed through involvement in citizen science.

This project is based on the success of Galaxy Zoo, ([www.galaxyzoo.org](http://www.galaxyzoo.org)) which proved the general public, in acting as citizen scientists in clicking through images, have the skills necessary to classify astronomical objects, and that when networked together, people from all walks of life can make meaningful contributions to science. While doing science, Galaxy Zoo participants learn informally about science, and educators are already using Galaxy Zoo to formally teach the scientific method despite a lack of ready-made educational materials.

Today, we have in place a creative team of educators, scientists, and programmers working to build a universal zoo, expanding Galaxy Zoo's mission across the full range of astronomy and planetary science, inviting the public to explore with us new vistas of science and learning. We have provisional agreements to provide data and scientific support from multiple NASA missions, including the Hubble Space Telescope, Lunar Reconnaissance Orbiter, and Mercury MESSENGER, and we have identified Astronomy Education Researchers to build the necessary scaffold of educational resources to make this a program that both generates science data and science learning.

Our web interfaces will allow users to measure and mark features on images, classify objects, and leave comments, as well as contain our proposed educational framework to promote learning. The first application of this web gateway will go live during 2009, the International Year of Astronomy (IYA). The central theme of IYA is, "The Universe - Yours to Discover." Our interface will meet IYA's goal by: 1) allowing anyone online to analyze astronomy data, 2) increasing understanding of the scientific process through training tools and interactive forums, and 3) producing not only excellent opportunities for outreach but also a legacy of published discoveries.

Each project gateway we will develop represents real science done by the people, creating an educational and scientific opportunity for all that promises to leave a lasting impact on both on research and on the public's understanding of science.

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### **Paige Graff/Jacobs Technology, ESCG**

**EXPEDITION EARTH AND BEYOND: An inquiry-based geosciences student involvement program that allows teachers and students to be actively involved in the excitement and journey of exploration, discovery and the process of science.**

Expedition Earth and Beyond is designed to facilitate student-led, authentic research projects that both study the Earth and compare it to other planetary bodies such as the Moon and Mars. Students will actively contribute to research conducted by the Image Science and Analysis Laboratory at the NASA Johnson Space Center using captivating images of Earth. Investigations of Earth, Moon and Mars connect research across Earth and Planetary Science Divisions and strengthen the impact of this program within NASA's Science Mission Directorate.

The purpose of the program is to establish an inquiry-based, geosciences student involvement program to inspire, engage, and educate teachers and students in grades 5-14. This program uniquely combines the following education strategies:

1. Develop standards-aligned, inquiry-based curricular resources.
2. Provide professional development for educators.
3. Connect scientists to classrooms.
4. Facilitate students conducting authentic research.
5. Provide a Virtual Team Results Forum for peer-review of research.
6. Obtain an external evaluation to assess the impact of the program.

The centerpiece of the program is students conducting authentic research. The program entails students submitting proposals, requesting new data, and presenting research. Scientists will connect with participants to deepen their knowledge about planetary processes and mentor students. Curricular activities and teacher professional development will also guide teachers as they engage their students in the research process.

Expedition Earth and Beyond will create a systemic, sustainable, and nationwide impact to science education that will contribute greatly to NASA's three major education goals: First, this program engages students in NASA's mission. Second, the program aims to attract and retain diverse student populations in science, technology, engineering and mathematics (STEM) disciplines. Third, this program help strengthens the future workforce of NASA by enhancing the critical-thinking skills of students and by providing them with authentic experiences that will better prepare them for their future.

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### **Mark Hammergren/Adler Planetarium & Astronomy Museum Touch the Solar System**

The Adler Planetarium & Astronomy Museum proposes for funding "Touch the Solar System", a small exhibit featuring samples of at least four (and likely more) Solar System bodies that visitors could touch directly. The samples, from the Moon, Mars, Earth and the asteroid Vesta (a possible dwarf planet) would be obtained as meteorites from reputable dealers and would be mounted under Lexan domes serving both to magnify the objects and prevent vandalism. Visitors could touch the samples with a bent finger. Simple text and graphic panels will explain how each of the featured worlds fits into the broader context of planetary formation. This exhibit will allow visitors an opportunity to make a physical connection to the other worlds of the Solar System. This direct connection is particularly timely given the upcoming Dawn arrival at Vesta, the planned return to the Moon, and ongoing Mars exploration.

To enhance the experience, the Adler would produce short interactive video segments that highlight how these samples came to be on the Earth, what their history and context was on their world of origin and the human story of how they came to be found and recognized as originating on another world. Scientists from the Planetary Science Institute would serve as both consulting experts and on-camera talent for the video segments and text/graphics panels.

The exhibit elements would be designed to be modular and expandable. Once the basic template (mount and graphic panel design, video system details, video script outline and style elements etc.) was completed the exhibit would be easy to expand to include other samples. Particularly intriguing possibilities include possible Mercurian meteorites, if these are confirmed, as well as samples of other asteroid types.

Because the exhibit will be functional as a stand-alone exhibit rather than just a supplement to other exhibits, it will be well suited to replication by small planetaria and science museums. The cost for each copy will be limited to actual materials and labor associated with construction, approximately \$4000 - \$5000 per exhibit station, and so will be affordable under smaller grants or community funding. We will seek out partner institutions and follow-on funding for replicating and distributing exhibits.

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**Robert Herrick/University of Alaska Fairbanks  
Bringing NASA Science to America's Most Remote Communities With a Digital Portable Planetarium**

Rural Alaskan communities are the most remote and isolated locales in the United States. They are primarily of Alaska Native ethnicity and represent an underserved and underrepresented population in the STEM disciplines. This proposal involves utilizing a digital portable planetarium, an exciting new outreach media, in developing a traveling "NASA Day" to engage rural Alaskan communities. Each NASA Day will have three basic components: 1) a presentation during the school day that illustrates fundamental space science concepts within the Alaska state science standards; 2) providing local science teachers relevant educational materials and training with those materials; and 3) a community science night with activities and a planetarium show highlighting NASA science. In addition to stimulating and educating the community during NASA Day, we will establish a permanent connection with local educators. Initially we will utilize off-the-shelf outreach materials and existing imagery in the planetarium programs. As the grant continues we will collect new imagery and develop content tailored to our rural Alaska target audience. We will create a planetarium program that discusses Alaskan analogs to planetary processes (e.g., volcanism, permafrost landforms). As we gain acceptance in rural communities we will interview tribal elders to facilitate intertwining of Alaska Native stories about night-sky phenomena with scientific explanations and NASA imagery. While our community engagement activities will be centered in Alaska, much of the material that we will develop will be broadly useful, and we intend to distribute it nationally. The planetarium programs that we generate will be free, scripted presentations that will be usable by the community of portable and small-dome digital planetarium operators. By engaging an entire community through both informal and formal education in a manner that generates a long-term contact, we can move rural Alaskan children through the different pyramid levels in the NASA Science Mission Directorate Education Strategic Framework. The informal education components of the proposed NASA Day are designed to engage and inspire children in rural Alaska and their support network of parents, families, and tribal elders. This in turn will make the students more receptive to the formal education components of the proposed activities and to science education in general. Sustained contact with participating schools and



teachers will improve STEM literacy in these communities and will increase awareness of NASA's mission. At the national level, digital projection systems will continue to gain popularity for portable and small-dome planetarium venues. Their user communities will be very receptive to downloadable, prepackaged programs that feature exciting NASA-related images.

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**Donald Lubowich/Hofstra University**  
**Music and Astronomy Under the Stars**

This proposal is to create a public astronomy outreach program at twenty-five community parks during and after seventy free summer music concerts and outdoor family movie nights attended by approximately 280,000 people per year (500 - 5000 people attend each event). While there have been many astronomy outreach activities and telescope observations at city sidewalks and parks, this program targets a completely different audience - music lovers who are attending free summer concerts held in community parks. The music lovers who may never have visited a science museum, planetarium, or star party will be exposed to telescope observations and astronomy/space science information. This program will permit the entire community to participate in telescope observations, view astronomical information (video and from an exhibit) and will enhance the public appreciation of astronomy. This program will also reach underserved and underrepresented groups. The population base for the initial target audience (Nassau and Suffolk Counties, New York) is 2,500,000, which is larger than combined population of Boston, Denver, San Francisco, and Washington, DC. Approximately 100,000 people will become inspired about astronomy out of the 140,000 people expected to attend the "Music and Astronomy Under the Stars" events. The partners for this project are the Amateur Observers' Society of New York and the Towns of Oyster Bay, Hempstead, North Hempstead and Huntington. This IYA2009 activity can be expanded to other communities throughout the US.

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**James Manning/Astronomical Society of the Pacific**  
**Sky Rangers: Creating a National Program of Astronomy Professional Development Opportunities for Park Rangers to Increase Sky Interpretation Capacity in U.S. National Parks and Nature Centers.**

Based on a demonstrated need and desire among national parks and nature centers to increase capacity to interpret the sky as one of the natural resources preserved in these natural venues, the ASP, in cooperation with the National Park Service (NPS), the National Association for Interpretation (NAI), and the Association for Science-Technology Centers (ASTC), proposes a three-year program to develop, test, and disseminate an in-person and online program of professional development in astronomy education and outreach for park rangers and nature center interpreters. The effort will be informed by the findings and results of the ASP's NSF-funded program "Astronomy from the Ground Up" to develop astronomy education capacity in small and medium-sized museums, as well as its work in developing the NASA mission-supported Night Sky Network to provide resources and training to amateur astronomers to increase public outreach efforts. NASA science and scientists will be richly integrated to demonstrate

how the Agency also interprets the universe through its scientific investigations and to encourage connections to NASA science and education for the interpreters and their target audiences. Initial development, pilot testing and formative evaluation will be timed to coincide with the International Year of Astronomy to provide an avenue for national parks and nature centers to actively participate in the national effort to increase awareness of astronomy and space science and provide the public with opportunities to establish a personal connection with the sky and our explorations of it. Subsequent refinements, wider dissemination, and the establishment of a support network of resulting "sky rangers" will focus on sustaining the interest generated in IYA to create a long-term culture and practice of sky interpretation as NASA science-rich part of the natural repertoire of the interpretation programs of national parks and nature centers.

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**Robert Nemiroff/Michigan Technological University  
Support for the Astronomy Picture of the Day Website**

We propose to continue the successful and cost-effective Astronomy Picture of the Day (APOD) website. World-wide, APOD is one of the most popular websites related to science, and one of NASA's top three websites. APOD's simple, single picture and hyperlinked text format is geared toward outreach, while its creation, using only the part time attention of two astronomers, makes it cost effective. In comparison, many other science and NASA web sites are supported by large teams of people that attract far fewer visitors. APOD successfully reaches science-oriented middle and high school students, encouraging their interest in careers in science, and engages people of all ages and from all walks of life in NASA's mission. To enhance APOD's appeal and better reach the underserved, we additionally propose to create an Evaluation and Advisory Committee that focuses educators, writers, amateurs, astronomers, and other APOD participants on evaluating, analyzing and interpreting APOD's current and potential viewing public's interests and needs.

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**Annette Schloss/University of New Hampshire  
Digital Earth Watch: A Program to Promote Environmental Monitoring by  
Students and Citizens through Remote Sensing and Digital Photography**

A PicturePost is an easy-to-use and inexpensive tool for students and citizens to monitor change-over-time in their local environment. It provides a platform for repeatedly taking digital photographs as a standardized set of images of the landscape, which then can be shared over the Internet. This simple concept has generated considerable excitement among formal and informal educators, citizen groups, government agencies and researchers. Many have recognized its potential for providing a wealth of information and data to monitor changing environmental conditions, which is important for a society grappling with the effects of climate change. PicturePost was an original concept developed for our NASA REASoN project Measuring Vegetation Health (MVH), which is in its fifth and final year. As a direct outgrowth and an enhancement of MVH, this proposal will extend the PicturePost concept and leverage MVH tools to create the Digital Earth Watch (DEW). The goals of DEW are to (1) create a network of teachers, informal educators, non-profit organizations and community groups that install

PicturePosts and regularly monitor and share their data and findings, (2) to interpret and evaluate this data, and (3) disseminate information about DEW to formal and informal science educators through the Internet and at state and national science teacher meetings, workshops, national conventions, local fairs and other community-based events.

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**Stephanie Shipp/Lunar and Planetary Institute**

**MyMoon: The Public's Portal to Lunar Science Exploration through New Media**

Our scientific exploration of the Moon, coupled with the public's interest in the Moon and innovative social networking approaches, can be leveraged to engage a fresh adult audience in lunar science and exploration.

The Lunar and Planetary Institute (LPI) will develop a lunar education new media portal, MyMoon, and collaborate with lunar scientists, educators, artists, and the public - to populate it with science content, diverse media exhibits, events, and opportunities for involvement. Through MyMoon, the general public, with a focus on adults ages 18-35, will interact with lunar content that will inform them about NASA's lunar science research and missions, and engage them in future plans for lunar exploration and eventual habitation.

The MyMoon Development Team will

- 1) Develop a dynamic, new media learning portal, MyMoon.
- 2) Host a growing, active audience that becomes further involved in NASA's lunar exploration by sharing their ideas about lunar topics, creating their own materials, and participating in events and experiences.
- 3) Build a community of enthusiasts through social networking media.
- 4) Create a model for future NASA projects to engage audiences 18 to 35, and provide detailed evaluation data on best practices and strategies for success.

New media technologies are changing the way that people interact, work, and learn. They provide opportunities for reaching an audience of adults that is not accessed by, or accessing, NASA. Currently, there is no analysis of which types of new media are effective. This project will evaluate the effectiveness of Web conferences, interactive displays, on-line competitions, discussion groups, presence on different new media platforms, and the requirements of creating and maintaining a community. Project evaluations will serve as resources for future NASA activities.

Scientists and engineers are invested in our next steps in lunar exploration, and the public is ready to be engaged as active participants.

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**G. Jeffrey Taylor/University of Hawaii at Manoa**

**Recruiting Undergraduates to Space Science through the Wonders of Cosmochemistry**

Like trace elements, cosmochemists are rare. We need more of them, with the flourishing state of planetary exploration. Cosmochemical analysis and insight are necessary for

ongoing and future NASA programs: sample-return missions, new meteorite discoveries, orbiting and landed geochemical instruments, and future human lunar and martian geological studies. We propose to encourage students to pursue cosmochemistry and related planetary geoscience fields by creating engaging, well-illustrated cosmochemistry content for geochemists to use in upper-level undergraduate classes. Students taking such classes are already committed to science careers, and are ripe for enticement into cosmochemistry. We will: (1) Create short, modular PowerPoint presentations, with accompanying explanatory notes, covering the range of cosmochemical research. These modules will present cosmochemical examples of topics traditionally taught in low- and high-temperature geochemistry, petrology, and sedimentology. Online availability will allow professors to choose appropriate examples for their course syllabi (e.g., martian aqueous alteration for low-T aqueous geochemistry). Alternatively, non-expert geochemists interested in extraterrestrial materials could use the entire set as a full cosmochemistry course. (2) Create a subset of class-length presentations for instructors wanting to spend an entire class on a cosmochemical topic. Example quantitative discussion topics will also be developed for those wishing to put geochemical calculations into new context. (3) Create Cosmochemistry Illustrated, a searchable, online database of images and graphics pertinent to cosmochemistry. Our evaluation plan contains multiple review cycles to monitor progress in creating technically accurate, well-designed, useful materials. We will market the final products via presentations at national meetings and advertising in appropriate trade publications. These products are primarily intended to recruit young scientists towards research, exploration and education in planetary geoscience fields, but they should also improve faculty instructional capabilities in planetary science and give cosmochemists convenient access to NASA SMD materials appropriate for teacher education courses or public talks.

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**Traci Wierman/University of California/Berkeley**  
**Advancing Mentor and Novice Teachers in Space Science (AMANTISS)**

In response to the need to create the next generation of NASA explorers and to promote a space science literate populace, space scientists and science educators at the University of California, Berkeley's Lawrence Hall of Science (LHS) and Center for Science Education at the Space Sciences Laboratory (CSE@SSL), with the University of Wyoming's Cognition in Astronomy, Physics, and Earth sciences Research (CAPER) Team, propose to collaborate on Advancing Mentor and Novice Teachers in Space Science (AMANTISS). This collaboration will address underserved audiences and identified customer needs through two primary goals: (1) Help future teachers and their mentor teachers engage in and educate students in space science, utilizing innovative instructional strategies, effective curricular resources, and engaging content. (2) Promote coherent use of NASA resources and content in the preparation of future teachers and experienced teachers who mentor them. Six science teacher educator collaborators will assist with national recruitment of mentor teachers and advise the project. They represent: University of Nevada, Las Vegas; Western Kentucky University, Bowling Green; California State University, Long Beach; State University of New York, Fredonia; University of California, Davis; and Florida State University, Tallahassee. AMANTISS will provide content-rich, sustained professional development for 40 middle

school mentor teachers, focusing on mentoring and supporting pre-service teachers in teaching space science, through use of the NASA-developed GEMS Space Science Sequence for Grades 6-8. Over the course of the four-year project, these 40 mentor teachers will in turn, lead, support, and coach 90 novice teachers in teaching essential space science concepts to students. We estimate that more than 13,000 middle school students will be reached through the efforts of AMANTISS. AMANTISS will include a final-year symposium that highlights mentoring models that integrate standards-based space science content, NASA-developed resources, and effective science teaching methods.

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**Donald York/The University of Chicago**

**GR/XR: Gamma-Ray and X-Ray Astronomy Online Learning Modules**

The Chicago Public Schools | University of Chicago Internet Project (<http://cuip.uchicago.edu>) at the University of Chicago proposes to develop GR/XR: Gamma-ray and X-ray Astronomy Online Learning Modules. GR/XR will consist of 3 online modules presenting standards-aligned lessons, interactives, and curriculum supplements for high school students that will reinforce basic physics concepts through learning about the science, history, tools, and impact of Gamma-ray and X-ray astronomy on our understanding of the Universe. GR/XR will include a physics concepts module, a Gamma-ray astronomy module, and an X-ray astronomy module. Each of the modules will present 3-4 story-based lessons, virtual interactives, and feature images, illustrations, and simulations from NASA's Gamma-ray and X-ray missions, thereby providing an instructional context for the study and interpretation of NASA's body of publicly available materials. The lessons, interactives, and curriculum supplements will be developed by a curriculum team of Chicago Public Schools teachers, scientists at the University of Chicago, and an experienced project staff.

The primary goals of this project are to introduce students to the science, technology, and history of astrophysical research focusing on Gamma-ray and X-ray astronomy; to involve educators and students in underserved communities in the development and evaluation of these materials; and to promote the use of NASA's astrophysical research for reinforcing basic physics concepts to high school students and engaging their interest in pursuing careers in astronomy and astrophysics. GR/XR addresses the articulated need for projects that provide curricular support resources that use NASA Science Mission Directorate (SMD) content to a) enhance student skills and proficiency in STEM disciplines; b) inform students about STEM career opportunities; and/or c) communicate information about NASA's mission activities. GR/XR specifically addresses Strategic Subgoal 3D: Discover the origin, structure, evolution, and destiny of the Universe and search for Earth-like planets.