Ariel Anbar/Arizona State University
Mixed-Reality Science Cyberlearning: Experience Boxes to bridge the physical and virtual worlds

Educational tools that combine digital learning and object-based learning can be powerful aids in capturing student interest in science and improving student skills in Science, Technology, Engineering and Math (STEM) disciplines. We propose to link cutting-edge, Web-based Virtual Field Trips (VFTs) with lendable “Experience Boxes” containing activity plans, resources and, most significantly, objects to create unique education resources for elementary-, secondary- and informal educators. The topics of the two proposed VFT-Experience Box pairings are Bizarre Animals: The Ediacara of South Australia and Meteorites: Travelers in Space and Time. To accomplish the proposed work, we have developed a novel collaboration between the NASA Astrobiology Institute (NAI) Team, the Center for Meteorite Studies (CMS) and the Mars Education Program at Arizona State University (ASU), and The Field Museum (TFM), the Massachusetts Institute of Technology (MIT) and the Australian Centre for Astrobiology.

VFTs transport users to remote environments where they can explore terrain and experience what it is like to “do science” in the field. This virtual experience is dynamic, immersive and interactive with 360º spherals that open windows onto Gigapan imagery that allow a user to examine rock faces in close-ups that mimic actual presence at the field site. We will also use new technologies to create virtual objects, or “cyberspecimens,” that can be studied, manipulated and magnified by the user while in the VFT. The virtual objects will enhance the VFT experience by allowing students to interact with science objects in new ways. The proposed work will leverage the availability of a VFT from the ASU NAI Team on early life (featuring the Ediacara fossil biota in Australia) for the Bizarre Animals VFT. The proposed work will create a new VFT to the Barringer Meteor Crater (Arizona) for the Meteorites VFT. The Web-based nature of the VFTs make them accessible to students, educators and the public worldwide.

The Experience Boxes enhance the VFTs by connecting real objects (rocks, fossils, models) with the selected virtual environments. The Bizarre Animals Experience Box will contain specimens such as fossil casts and the Meteorites Experience Box will contain specimens such as meteorites and impact-related rocks. ASU, in partnership with TFM, will develop Standards-aligned content, and acquire and produce hands-on objects.
for the Experience Boxes. Experience Boxes will reside at ASU, TFM and MIT, making them available to three of the 60 largest school districts in the nation.

To extend the reach of the VFTs and Experience Boxes outside of the geographic areas served by ASU, TFM and MIT, TFM will create an inquiry-based digital game focused on content related to the Meteorites VFT and Experience Box. This multi-level Meteorites game will provide students in grades 6-8 with an achievement-based gaming experience. TFM staff will work with ASU to develop accurate, content-rich gaming environments. Students will execute a series of content-related and standards-based objectives in order to advance throughout a series of levels, allowing the student to direct their course of play and for the game and for the game to maintain relevance for a large array of skill levels and learners.

To develop teacher knowledge of the subjects covered by the VFTs and Experience Boxes and to train teachers in their use, a series of workshops will be offered at ASU and TFM. Project assessment will be done by external evaluators and by a small group of teachers who will be involved in the Experience Box and VFT development. By blending immersive digital experiences with the excitement of authentic objects, we hope to improve teaching and learning of STEM topics in elementary, secondary and informal education environments and to increase public engagement in STEM topics.

Paula Apsell/WGBH Educational Foundation

NOVA Labs

WGBH/Boston proposes to build on the success of its award-winning NOVA television series and website with the development and launch of NOVA Labs. NOVA Labs is a new digital platform designed to become the premier online resource for diverse youth ages 13 to 18 to participate in real world scientific problem-solving and discoveries, collaborate with peers, and interact with experts. Developing the first three Labs around NASA SMD content areas will effectively curate existing NASA resources, bringing them to new audiences and combining them with NOVA content in powerful ways. At a time when the United States is struggling to compete with other global leaders in science, NOVA Labs will help expand the pipeline of young people interested in and educationally prepared for careers in science and engineering.

From the creative team behind NOVA, the nation’s longest running and most respected primetime science series, NOVA Labs is part of a three-pronged initiative to create a comprehensive platform for the “best of science” online. Dubbed NOVA 3.0, the strategy is designed to serve three audiences with distinct needs - curious adults, teachers, and science-savvy youth - within a seamlessly integrated digital platform. While targeting the teen audience, the Labs will capitalize on NOVA’s unparalleled reach and reputation, effectively leveraging millions of dollars already invested in high quality content, research and virtual tools that reach 1 million people per month.

NOVA Labs might be thought of as a cross between a virtual San Francisco Exploratorium, TED (for teens), the MIT Media Lab, and Lego Mindstorms. Fueled by their natural curiosity, teens will pursue self-guided learning journeys into STEM subjects using real data, images, and interactive applications. Facilitated learning will be
supported through online mentoring, access to subject matter experts, peer review, and educators’ advice on myriad topics. In addition to making STEM subjects fun, cool, and engaging, the Labs will firmly connect them to the real world. Contextual links and examples will respond to teens’ expressed interest in understanding how subjects they study relate to their lives and inform their decisions about educational and career choices.

Over time, NOVA Labs will become more than a website; it will be an intrinsically social web presence where youth will collaborate with peers, seek expert advice, and easily make inter-disciplinary connections across science, engineering, and technology platforms and subjects. Teens will be encouraged to pose questions, exchange ideas, create content, and contribute to cutting-edge research projects at NASA and beyond. In this way, NOVA Labs will emerge as the “start here first” destination for the best of interactive, educational, and engaging science content for tomorrow’s science leaders.

In sum, the goals of the NOVA Labs are to: 1) Inspire teens with demonstrated interest in STEM to actively engage in scientific research and activities; 2) Draw in youth who may not realize they have core competencies in STEM; 3) Leverage and add value to existing STEM resources and programs; 4) Model best practices in collaborative and cross-disciplinary research; 5) Provide access to and facilitate interaction with subject matter experts, mentors, and industry professionals; and 6) Inspire teens to pursue higher education paths in scientific fields.

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**Kimberly Arcand/Smithsonian Astrophysical Observatory**

**Here, There, and Everywhere: Science Through Analogy, Near and Far**

The "Here, There, and Everywhere" (HTE) project seeks to help the general public make connections between familiar phenomena on Earth and more exotic phenomena in space. The underlying goal of the project will be to communicate that the same physics can apply to both the near and the far, despite differences in distance, scale, and other understandable parameters.

We are proposing this project because it will allow NASA to showcase the wide variety of important and engaging science that the agency conducts. By utilizing imagery from NASA satellites that look down to the Earth as well as those that peer into the cosmos, HTE will create visual analogies of the phenomena with physical similarities and those with important differences.

Analogies have been shown to be effective learning tools in a variety of settings. This project will capitalize on that by developing and producing aesthetic panel displays that can be both exhibited in public spaces like libraries and community centers, as well as be reproduced as inexpensive posters for much wider dissemination. Moreover, collaborators on this project will develop easy-to-implement activities that can be distributed to venues where deeper learning opportunities are available.

This proposal is being led by team members that created the "From Earth to the Universe" and "STOP for Science!" projects, and elements of each of these projects can
be found in HTE. This will allow the expertise gained from the earlier projects to be built upon and enhanced into HTE for a wide-reaching, effective, and efficient outreach project.

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**Kimberly Arcand/Smithsonian Astrophysical Observatory**

**Sustainability in NASA's Year of the Solar System: Recycling "From Earth to the Universe"**

With the upcoming Year of the Solar System (YSS) slated to begin in October 2010, there is a special opportunity to engage the public in the exciting discoveries made by NASA missions. Coming on the heels of the recently concluded International Year of Astronomy 2009 (IYA2009), the YSS has the chance to continue or expand on some of the best programs and other "lessons learned" from IYA2009.

The "From Earth to the Solar System" (FETTSS) is designed to do just that. One of the most successful IYA2009 programs was the "From Earth to the Universe" (FETTU) project that brought dozens of large-scale astronomical images to non-traditional locations such as public parks, metro stations, and art centers.

The same team that conceived and led FETTU have partnered with the NASA Planetary Sciences EPO lead to develop the a related project - using the same model as FETTU -- that will focus on Solar System exploration. Furthermore, a partnership with the Voyage National Program at the National Center for Earth and Space Science Education will leverage even more NASA resources by providing a ready-made network of venues to display the images. By pairing the eye-catching images from FETTSS with the Voyage Solar System models already in place, we believe this will enhance the experience of the general public of both NASA investments in Solar System outreach.

In summary, the FETTSS project would bring together NASA expertise and resources with a track record of proven success. By pooling these people and materials, we believe we can provide NASA with an extremely efficient and low-cost way to promote the YSS.

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**Sarbani Basu/Yale University**

**Solar Cycle Investigations: NASA Science Exploration for Middle School Students and Teachers**

Solar Cycle Investigations: NASA Science Exploration for Middle School Students and Teachers is a program that supports the goals of NASA's Education Strategic Coordination Framework and the Science Mission Directorate's 'Secondary Education' Portfolio Area within the context of SMD's Science Plan and the strategic communication objectives of the Heliophysics Roadmap. It also, secondarily, supports NASA goals in 'Outreach' through museum and planetarium-based activities. Solar Cycle Investigations is an opportunity for middle school students and their teachers, from federally-defined high-needs districts, and aims to enhance significantly their knowledge of, and experience in investigating, physical science topics associated with the Sun-Earth connection and solar cycles in particular. It is a collaboration between the Yale
Department of Astronomy's Leitner Family Observatory & Planetarium (LFOP) and the Yale Peabody Museum of Natural History. External partners include evaluators and the New Haven and Hartford public school districts. Solar Cycle Investigations will be developed within the context of the Peabody Museum's extensive suite of educational activities together with LFOP's ongoing school field trip program. As outlined in NASA's Living with a Star initiative, the origins and fate of life on Earth are intimately connected to the way the Earth responds to the Sun's variations. Understanding the changing Sun and its effects on the Solar System, life, and society is imperative. The program will encompass various aspects of solar cycles including changing magnetic activity and luminosity, around the expected 2012/13 peak of solar activity, and use them to explore light, gravity and the Solar System. The program's content will be aligned with National Science Education Standards and Connecticut State Standards related to these topics and will encourage inquiry-based teaching and learning that is based on real data and cutting-edge research. This three-year initiative will include teacher summer institutes, class field trips, ongoing teacher support, and the production of pre- and post-trip classroom materials that use NASA educational resources and research data in the context of ongoing NASA-sponsored research. The project also includes an informal education and outreach component in the form of associated activities for Museum and Planetarium visitors. Once developed and tested, details of the program (including the materials) will be widely disseminated for use by other formal and informal programs. Specific strategies will be employed to ensure the program serves a diverse audience, particularly groups under-represented in the sciences. Stringent evaluation, including pre-and post-testing of students, will continue throughout the project. The world-class research and faculty at Yale, together with the Peabody Museum's longstanding and sustained relationships and reputation with K-12 students and their schools, mean this program is ideally placed to address the substantial need for high-quality programs to engage students and teachers during the middle school portion of the K-16 STEM pipeline.

Valerie Casasanto/University of Maryland Baltimore County

Beautiful Earth: Experiencing and Learning Science in a New and Engaging Way

Beautiful Earth (BE) is a unique education program based on the successful Bella Gaia Live (BG Live) pilot project, developed and tested throughout 2008, 2009, and 2010. In collaboration with NASA Scientific Visualization Studio, Earth Science, Education, and Public Affairs departments located at the Goddard Space Flight Center, a network of museums and planetariums across the US, and education TV network Channel One, the BE program will inspire and engage large audiences in Earth and Space sciences through BG Live's attention grabbing, immersive audio-visual experience complemented by hands-on education modules that present in-depth science through a whole brain approach to inspiration and engagement (View 1.3 min video posted by NASA http://tinyurl.com/2ckg2rh).

BG Live leaves audiences with a new and profoundly global perspective while also fostering a deeper appreciation of our Home Planet. Created by award winning director and classically trained violinist Kenji Williams, BG Live features a live performance by Mr. Williams against a large-screen backdrop of orbiting visualizations of Earth from
space and scientific visualizations provided by NASA. BG Live employs highly attractive aesthetics that makes science accessible to audiences of all ages by translating scientific information into media languages of the 21st century. GSFC Chief of Public Affairs, Mark Hess, remarking on his personal experience attending several performances of BG Live believes that,"[BG Live] provides NASA with a unique and compelling way to reach new audiences and expose them to information about NASA and how we are working to understand our planet and explore our Universe" (2010, 1).

The BE program integrates the BG Live experience while providing supplementary discussions with NASA scientists and hands-on workshops with museum staff and Native American educators who will provide diverse perspectives on relating to Earth systems. Broad student and public engagement will be generated and enhanced using a variety of delivery platforms such as live presentations in planetariums, in-person education workshops at museums based on 3 BE modules that will provide audience members access to NASA scientists, data visualization experts and Native American educators. Links to NASA resources and distributable media generated from BE activities will allow for wide dissemination.

The goals of this program are to:
- Increase student excitement and engagement in Earth Science
- Provide a deeper educational experience through workshops with NASA Scientists
- Increase young people's interests in careers in STEM and at NASA
- Increase student & public recognition of the social & scientific value of NASA research
- Decrease student and public skepticism about the existence of climate change born from lack of emotional engagement and cognitive understanding of Earth Science
- Reach out to underserved communities such as Native American and others.

NASA astronaut Piers Sellers said, "It really felt like I was back in space." A teacher from Mississippi proclaimed, "My students actually got it. They experienced the beauty of the world." A student in Washington State said, "I will never look at the world the same way again." Echoing these sentiments, another student from the Earth day presentation exclaimed, "The view from space was spectacular. It changed the way I look at Earth!" Survey data also attested to the presentation's efficacy in inspiring deeper curiosity about and greater understanding of Earth and Space science.

This proposal describes how the Beautiful Earth program will accomplish educational outcomes set forth in the 2007 SMD Science Plan and NASA-wide educational goals by deepening extant program achievements and increasing audience reach to over 6 million constituents.

Marjorie Chan/University of Utah
Mars for Earthlings: A Terrestrial Analog Approach for Earth and Planetary Science Teaching and Outreach

New, high-resolution NASA data and imagery from Mars united with our knowledge of Earth analogs now offers the rich opportunity for a paradigm shift in how university and
college faculty teach lower-division Earth and planetary science. In the quest to follow
the water to find extraterrestrial life, exploration of Mars requires a solid understanding
of Earth processes that can be applied to Martian landscapes. This is a multi-pronged
education and outreach proposal designed to bridge the gap between the middle school
and high school programs (where Earth science and some planetary concepts are taught),
and the upper division or graduate level where most Mars geology is taught in specialized
higher education programs.

We will develop Mars for Earthlings content of Mars geology from a terrestrial analog
perspective, focused at an introductory college level. We will disseminate this integrated
and interdisciplinary content nationwide to university and college educators and to the
broader public with informal education outreach programs. This will have a critical
effect of strengthening both Earth and planetary sciences nationwide by: 1) attracting and
inspiring the introductory higher education audience where there is a strong likelihood of
enticing students to major in STEM fields; 2) engaging and educating more students to
feed into the pipeline to eventual science employment; 3) stimulating further research
interactions and collaborations between the Earth and planetary science disciplines, and
4) heightening interest and connecting the public to recent and current NASA Mars
missions by understanding our own Earth landscape.

This project has six phases beginning with the development of a pilot higher education,
undergraduate non-majors Mars for Earthlings course (Phase 1) first at the University of
Utah. Simultaneously, through the implementation and feedback of the course, the
project will prepare and promote accessible public website online modules for various
higher education faculty nationwide (Phase 2). The terrestrial analog approaches and
modules will be disseminated through workshop and live webcast venues (Phases 3 and
4), and showcased in sustainable, interactive museum displays (Phase 5) and public
outreach programs (Phase 6).

The ultimate goal of this project is to affect how we teach and reach lower-division
college students through a fundamental shift of blending more Earth science with
planetary science. In the last decade, some planetary scientists who have limited training
in geoscience now find that they need to better understand sedimentary processes in order
to interpret features on Mars. Geologists who specialize in Earth processes now find
their science is more exciting because they apply their terrestrial analog concepts to a
totally new world. It is the merging of these two sciences early in the college curriculum
that can create synergy, and make both sciences more accessible to the public and better
train physical scientists and engaged citizens for the future. Mars for Earthlings
curriculum fills the planetary science gap between high school and upper division college
levels, and can invigorate introductory Earth science courses that are taught at every
major university across the country. This project builds content, engagement activities,
and partnerships in the NASA SMD portfolio areas of higher education and informal
education. We have plans for sustainability and longevity of Mars for Earthlings content
in order to reach large audiences nationally through both higher education classrooms and
outreach opportunities.
Undergraduate researchers represent an important SMD E/PO target. These students have already chosen STEM careers as an area of interest and now are exploring the next steps in their career development. SMD supports many undergraduate researchers through its science programs (e.g., NRA or missions), as well as through its institutions (e.g., the NASA Lunar Science Institute (NLSI) and the NASA Astrobiology Institute (NAI)). In addition, SMD supports undergraduate researchers through a variety of internship opportunities. However, many undergraduate researchers are working, one or two at a time, in relative isolation - a statement particularly true for students at smaller universities and four-year colleges. What can be missing for these students, according to their faculty, is a capstone experience that allows students to communicate their work, to see what other student researchers have been working on, and together, to explore the "real world" of scientific communication.

Here we propose to take advantage of the excitement of the Year of the Solar System (YSS) to celebrate undergraduate researchers. This proposal supports an undergraduate research symposium, held on the Sunday before the Lunar and Planetary Science Conference (LPSC), in each of 2011 and 2012. The one-day poster-based conference with follow-on activities will:

- Support 50 undergraduate researchers from across the country with additional student researchers supported by the NAI and the NLSI,

- Be combined with a series of one-hour panels on 1) Life as a Graduate Student, 2) Alternative Careers in Science, and 3) Women in Planetary Sciences, as well as professional development seminars, and

- Be followed by attendance at the LPSC meeting where students would be partnered (if they chose) with scientists who had agreed to be "Meeting Mentors" for half of one day of the meeting.

The YSS Undergraduate Student Research Symposium represents an important opportunity to support the next generation of Earth and Space Scientists, by allowing them to explore the process of "doing science", particularly as it pertains to community exchange and the intellectual "commons" that academic science conferences represent.

David DeVorkin/National Air and Space Museum/Smithsonian Institution
Astronomy Education and Outreach at the National Air and Space Museum

The major objective of this proposal is to deliver a well-rounded suite of astronomy education and outreach programs for the varied audiences of the National Air and Space Museum utilizing present Museum facilities. The programs are planned to enhance
visitors' experience at the Museum so that they can better understand and appreciate the science of astronomy.

Over the past decade, our major astronomy outreach programs have been supported by intermittent grant funding from both federal and private sources. We propose, during the period May 2011- April 2014, to continue and extend the programs that have proven popular and effective over the past decade. These programs include daily public programming in our Explore the Universe Gallery, school field trips, our Exploring Space Lecture Series and Monthly Planetarium Programming. The programs occur in and around the Museum and are advertised through major media. They will both enhance and complement regular programming in astronomy-related exhibitions and Discovery Stations, as well as in our general planetarium programming, our public observatory and IMAX theater, funded separately.

For more than 30 years NASM has hosted the annual Exploring Space Lecture Series with themes alternating between astronomy and planetary sciences. Its goal has been to present the latest research findings to an adult and student audience. Astronomy educators present hands-on activities and telescope observing to complement each lecture topic, so that the public has a better understanding of the latest research findings in astronomy and planetary science.

The Museum offers live, staff-facilitated planetarium shows so that museum visitors get an introduction to observational astronomy and stargazing and gain a better understanding of the astronomical universe - its beauty and majesty. We propose to continue these regular public shows and reinstate a monthly program incorporating specialized topics in heliophysics, astrophysics, and planetary science as practiced by astronomers and physicists at the Smithsonian Astrophysical Observatory and by geologists at the Museum’s Center for Earth and Planetary Studies. These will be both informative and enjoyable for family groups.

We will update existing electronic interactive exhibits in the Explore the Universe gallery to incorporate the latest appropriate technologies to increase reliability and reduce response time, for an improved visitor experience. We will also upgrade and improve our continuing cell phone feature in the gallery whereby visitors can phone in and receive answers from experts to frequently asked questions.

We share NASA/SMD's vision for Education and Public Outreach, and in support of it plan to enhance visitor understanding of the heliophysics, astrophysics, and planetary science presented in the Museum's public spaces, notably recent Explorer-class missions that have made an impact in cosmology.

Our programs typically reach millions of visitors each year from across the country and internationally. We know from experience that many among these millions have never encountered such in-depth opportunities to explore the universe and enjoy the fruits of their 'investment in NASA's scientific research.'
Teaching Inquiry using NASA Earth System Science (TINES): Preparing Future and Current Educators to Use Observation and Inquiry in the K-12 Classroom

Teaching Inquiry using NASA Earth-System Science (TINES) is a comprehensive proposal to train and support pre-service and in-service K-12 teachers, and to provide them with an opportunity to use NASA Earth Science mission data and Global Learning and Observations to Benefit the Environment (GLOBE) observations to incorporate scientific inquiry-based learning in the classroom. Using an innovative professional development model known as a backwards-faded scaffolding (BFS), as developed by Slater et al. (2008), this project seeks to provide professional development for pre- and in-service teachers in which inquiry is presented as a process for developing participant competencies in analyzing data, asking scientific questions about those data, strategizing about which additional observations could answer those questions, and only then presenting tools with which to make the necessary observations and/or access NASA mission data relevant to those questions. While this approach has been successfully applied to planetary science and deep-space science, this project will demonstrate that BFS is ideal for delivering inquiry for Earth System Science using NASA Earth Science missions and GLOBE observations related to inquiry in the atmospheric and hydrologic sciences. Through ongoing peer mentoring with an online learning cohort, support from project personnel, and grants to encourage participating teachers to employ inquiry regardless of the resources available to buy equipment, we feel that this will serve as a sustainable approach for delivering NASA educational resources. In the end, the primary goal is to engage teachers that will both encourage and support them to remain active in engaging earth science inquiry in their classrooms. And finally, this project is an ideal test bed for this model of professional development because of the experience of the personnel with NASA data, GLOBE protocols, and the CloudSat Educational Network and because the partner institutions are recognized as excellent programs for training pre- and in-service earth science educators.

Enhancing Public Participation in NASA's Search for Habitable Worlds.

The Smithsonian Astrophysical Observatory--in partnership with the Space Telescope Science Institute, Jet Propulsion Laboratories, and the University of California--proposes to develop a citizen-science portal to NASA's habitable worlds programs that invites the public to detect transiting exoplanets for themselves and to create a portrait of what these worlds might be like. The project will access the network of MicroObservatory online telescopes and will create a suite of engaging, interactive learning tools that help participants move from a single pixel of light to a portrait of another world. Our aim is to foster a large public community of observers who closely follow developments in NASA's search for habitable planets, and who see themselves as members of the larger community of NASA space science explorers. This direct participation will prime the public to better understand why the quest for other worlds has moved from the ground into space--and will provide a logical pathway to connect NASA's many relevant resources in astrophysics and astrobiology.
The project will create technical and programmatic pathways that encourage participants to move seamlessly between the Portal and other NASA EPO programs. In addition, the project will provide professional development workshops for a diverse group of informal educators, designed to widen the project's reach and encourage public audiences to become exoplanet explorers. Linkages to existing and planned classroom curricula will further expand the community of participants.

This project builds on substantial research showing the benefits of citizen science projects in which participants are empowered to gather, display, and interpret their own, authentic data. It provides a significant resource to the NASA education community that is not currently available and that complements existing education and outreach materials. And it addresses the most asked-about topic in space science: the search for habitable worlds. The project is leveraged by the SAO's pilot work in this area, which has proven the realism of the proposal by achieving universal telescope access (no limit to the number of users); successful detections of exoplanets by novices; and creation of a community of observers.

The project's co-investigators and collaborators have been chosen to ensure continuity between the NASA Other Earths Portal and existing and planned NASA EPO resources. A strong plan for professional development for informal educators builds on the SAO's significant success in this area. Along with the toolkit for educators seeking to customize the Portal to their needs, the project promises sustainability long after the period of performance. The planned content for this project includes core STEM concepts that are needed for the search for habitable worlds and that are widely useful in science and engineering. The informal education institutions partnering with SAO have been chosen specifically to work with diverse and underserved communities, and the project itself builds on extensive prior work with diverse audiences. While not explicitly addressing pipeline issues, the project is expected to inspire greater interest in career paths to the space sciences. A strong formative and summative evaluation plan will document progress towards the project's objectives.

James Harold/Space Science Institute
Building Alien Earths: Reaching New Audiences with NASA Origins Science

The search for life beyond earth is one of the most fundamental and exciting endeavors of modern astronomy, and is a key element of the NASA Science Mission Directorate's (SMD's) strategic goals. It encompasses a wide variety of core concepts in astronomy, including galactic structure, stellar evolution and lifecycles, planetary formation, and habitability and "habitable zones." Surveys of museum visitors indicate a general interest in these topics, but most people have given them little in-depth thought. These visitors often have no clear idea how stars and planets are formed, or where the material for that formation comes from.

Our proposed program incorporates these core concepts in an engaging, integrated gaming environment by enabling visitors to build their own planetary systems to
ultimately support life. The Alien Earths Game (AEG) will include the entire life cycle of a star -- from birth to death -- in addition to planetary system formation, the significance of habitable zones, and the evolution of life. The game itself will be disseminated both as a standalone web site and as an application for the Facebook social networking platform, and will incorporate specific design elements to leverage the power of social networking. Designed as a "sporadic play" activity, the game will run in scaled real time (one million years per minute). Over the course of days and weeks, players will be able to explore the evolution of their star, its planets, and any resulting life. Players interact periodically and repeatedly with the system, which drives return visits and increased exposure to the concepts. Successful game play is rewarded by the ability to create new systems, expand your collection of systems, and interact with other players. The game encourages networking with your Facebook friends, which in turn adds new players and thus new audiences for NASA.

This activity specifically addresses SMD's E/PO goal of engaging Americans in NASA's mission through hands on, interactive educational activities, while contributing to NASA's E/PO outcome to "attract and retain students through a progression of educational activities." Use of Facebook provides the project with a variety of strategic benefits, including access to a wide and evolving demographic not necessarily reached by traditional NASA education and outreach efforts.

The proposed work has four overarching objectives:
1) To reach new audiences with NASA science;
2) To create new pathways for the public to existing NASA materials;
3) To provide an engaging contextual framework to aid the public in understanding NASA Origins science;
4) To explore the effectiveness of disseminating NASA's message through social networking environments.

Jorg-Micha Jahn/Southwest Research Institute
Experience the Northern Lights: Interactive Space Science for Hearing-Impaired Students

Teaching hearing-impaired students creates a unique set of educational challenges that can hold important lessons for typical mainstream classrooms. We partner with San Antonio’s Sunshine Cottage School for Deaf Children to utilize and extend NASA space science E/PO resources in the elementary classroom. We extend the value of existing NASA resources by developing an interactive research campaing where students directly interact with scientists and participate in a research-grade space science measurement campaing. The unique aspect of partnering with Sunshine Cottage lies in Sunshine’s approach of auditory-verbal communication. Aided by technology (hearing aids, cochlear implants), a diverse student body with students of all levels of hearing loss (moderate through profound) is taught in an entirely auditory-verbal environment. Bringing these students into early contact with NASA work can lay the foundation for future careers in the STEM field that normally they might not consider. It can likewise act as an amplifier in their interest and abilities in the STEM fields. However, impact of such work is not
limited to special education classrooms. Lessons learned from teaching these students space science related topic can be flowed right back into mainstream classroom settings.

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Michael Kavic/The College of New Jersey  
Fertilizing ROSES through the STEM: Interdisciplinary Modules as Pre-service Research Experiences for Secondary STEM Educators (IMPRESS-Ed)

The primary objective of this proposal is to provide an enriching STEM oriented summer research experience in the space, earth, and atmospheric sciences for underrepresented pre-service K-12 educators at The College of New Jersey (TCNJ). TCNJ has since its inception been a recognized leader in the training of pre-service K-12 educators. Part of TCNJ’s core mission of producing quality K-12 educators is a large-scale, long-standing focus on STEM education. This has led to the establishment of an on-campus STEM education center. Physics faculty members at TCNJ are currently active researchers in astrophysics, tectonophysics, and atmospheric science, all of which have clear connections to currently active NASA missions. TCNJ currently operates a summer research program, Mentored Undergraduate Summer Experience (MUSE). This is a campus-wide summer research program which includes both internally and externally funded projects. We propose recruiting underrepresented pre-service K-12 STEM educators to participate in summer research related to NASA programs, mentored by TCNJ physics faculty, supported by the STEM resources on campus and incorporated into the MUSE program.

The program will take place over three summers with recruitment occurring during the preceding academic years. Recruitment would take place on TCNJ’s campus in coordination with the school of education. Specific attention would be paid to attracting talented pre-service K-12 education majors from underrepresented backgrounds. The program will be divided into a common core experience and an individual mentored research experience. The common experience will consist of three modules focusing on astrophysics, tectonophysics, and atmospheric science, respectively. The astrophysics module will feature training sessions in an on-site, state of the art planetarium. Participants would be given the opportunity to utilize the available facilities for educational purposes after graduation. The common core will also include participation in NASA’s Radio JOVE project at an on-site radio antenna installation. The individual mentored research experience entails each participant choosing a member of the TCNJ physics faculty with whom they will to participate in active research in astrophysics, tectonophysics, or atmospheric science.

This proposal touches on multiple primary goals laid out in the ROSES E/PO solicitation. Given that this effort directly enhances the education of undergraduate students in space and earth sciences the connection to higher education is manifest. Moreover, incorporating this type of effort as part of training of pre-service K-12 educators has a direct impact on K-12 education particularly centered on STEM. Finally this proposal incorporates through training at and future use of a planetarium, which could be used for a critical type of informal education.
Research projects led by Margaret Benoit would rely on data from GRACE and LAGEOS to study unresolved questions in tectonophysics and solid earth geodynamics. Nathan Magee would use data from CALIPSO, AURA, and GLORY to guide students in research on the microphysics of clouds and aerosols the upper troposphere and lower stratosphere. Research projects led by Michael Kavic would perform simulations to investigate the possibility of detecting superconducting cosmic strings using observations made by the Fermi Gamma-ray Space Telescope as well as the potential for detection of black hole/neutron star binaries by LISA. Paul Wiita would supervise projects on active galaxies, particularly radio galaxies and blazars, using data from the RXTE, Fermi and XMM-Newton satellites.

Elaine Lewis/Goddard Space Flight Center
Sun-EDGE: Using the Transit of Venus to Engage the World in SMD Science

Sun EDGE: Using the Transit of Venus to Engage the World in SMD Science will take advantage of the excitement, historical, and cultural connections of the Transit of Venus as an opportunity to engage educators, students and the public in an event highly relevant to NASA. The transit provides an excellent opportunity to inform the public of every SMD research area: the Sun; Venus as a planet; transit as an astronomical tool for extra solar planet detection; and Venus atmosphere as a runaway greenhouse for global warming. This is a rare event that will have great public interest. Since the advent of telescopic astronomy in the early seventeenth century, there have been but six transits (in pairs) of the sun by Venus, those of 1631/1639, 1761/1769, and 1874/1882. The seventh occurred in 2004 with its pair in 2012. Sun EDGE will use the talents and expertise of two well established programs and award winning teams, NASA Sun-Earth Day, and NASA EDGE, to produce a “last-in-a-lifetime” live webcast for the June 6th, 2012 Transit of Venus from Mauna Kea. We will work through an established partnership with the University of Hawaii Institute for Astronomy to provide the best spot in the world to view the Transit of Venus. The event will not be visible from the continental U.S. in its entirety and a mountainside Visitors Information Station near the observatories in Hilo, Hawaii will give a wonderful view of the transit with little chance of cloud cover to a worldwide audience. In addition to the live webcast, we will produce a new series of video podcasts or vodcasts that can be used in schools, museums and public outreach events to enhance science knowledge and understanding of the Sun, its mysterious history and terrestrial events.

Central Objectives:
1. Provide an exemplary, highly-leveraged and cost-effective framework to enhance the proposed efforts to improve the effectiveness of heliophysics mission Education and Public Outreach (E/PO) and help them tell an integrated, science-driven story of exploration and discovery.
2. Drawing on the excitement and uniqueness of NASA, motivate, and educate students to pursue STEM careers by enhancing Science, Technology, Engineering, and Mathematics education with heliophysics resources aligned to National Science Education Standards.
3. Inspire and inform the public in general with the dynamic science of the Sun and its profound
influence on the Earth and space environments and the lives of all who live in them.

Perceived Significance of the Proposed Work:
Sun EDGE is fully aligned with the NASA Education Portfolio Strategic Framework. In particular to I) Strengthen NASA and the Nation’s future workforce, II) Attract and retain students in STEM disciplines, and III) Engage Americans in NASA’s mission. Our programs target formal education audiences from pre-Kindergarten (pre-K) through Undergraduate (UG) with special emphasis on attracting and retaining underserved populations through targeted partnerships with minority and underserved groups, colleges, and professional societies. In addition, there is a strong career focus that allows children/students to access information on careers through podcasts/vodcasts, distance learning, live and recorded scientist interviews, as well as having authentic research opportunities.

Methods/techniques to accomplish key objectives; The key components/objectives are:
1. Coordination of year-long activities around a given theme;
2. Capturing students’ interest through inspirational experiences;
3. Providing content preparation to emphasize “Engaging Americans in NASA’s Mission”;
4. Collaboration with partners such as museums, universities, amateur astronomers, etc.
and,
5. Focus on a high-leverage culminating celestial event such as eclipse, and transit of Venus.

Helen Matsos/NASA/GISS
X-Treme Astrobiology-2

Astrobiology Magazine (AM) [www.astrobio.net] is a leading source for news about the mysteries of life in the universe and the origin of life on Earth. With ~ 1 million page views per month and over 30 million bookmarks, AM is one of NASA’s most effective outreach tools and leverages across a wide range of NASA sites by providing content that features on many other NASA front pages. AM also has extensive syndications with popular new sites to broaden its outreach potential. AM attracts a regular audience of students, teachers, civilian scientists, and scientists within NASA. Our demographics include a more diverse audience that other NASA sites, providing outreach to underrepresented communities in STEM disciplines.

AM is seeking support to continue our mission to provide high caliber news, outreach and educational tools that highlight programs at NASA by providing engaging content across the range of SMD activities. Support will also allow for innovative and exciting new programs to broaden our audience and target underserved communities.

New multimedia sections on the updated astrobio.net allow us to further utilize outreach products like videocasts and podcasts. This will help us extend coverage of NASA Expeditions and provide adaptable content to target specific audiences. The AM "gURLs in Space" project will feature virtual, interactive modules where young women can interact with established women scientists across the field of astrobiology and SMD research. A quarterly "gURLs in Space" Videocast will be produced, and will feature the work of one of the many women engaged in astrobiology research. Updates to our
Climate Hot Topic page and Climate blog will be co-developed with leading scientists from the Goddard Institute of Space Studies. Climate change is one of the hottest topics in modern science, and bears particular relevance for today’s audience. AM will also provide further access for our international and multilingual audiences by producing an updated Español Edition with regular, high quality Spanish translations of AM content. With the Denver Museum of Nature and Science, AM is developing a new podcast hosted by David Grinspoon, Curator for Astrobiology, that will provide opinions and insights on the latest astrobiology news and developments in both current research and missions. A new AstroCulture blog will feature cultural and social aspects of astrobiology. Tech-savvy young people will be targeted by utilizing social networking sites like Facebook and Twitter. Cutting-edge platforms featuring ‘digital story-telling’ will also be developed with graduates from The Columbia School of Journalism. This integration of text, still images, video, audio and music will present SMD programs in a modern and innovative way for viewers. A regular cartoon series will be created to relate developments in NASA missions and science in a way that is accessible to a broad audience. A section of AM will also be developed to host EPO educational materials for informal education, leveraging content from existing EPO programs and distributing materials that NASA has already invested in to our diverse audience.

With further efforts to leverage across programs at NASA and by implementing novel initiatives to attract new viewers, AM is striving to widen our audience demographic and increase viewer numbers. By delivering unique content across multiple technology platforms, AM fills a gap in NASA’s public outreach that is not being covered by any other NASA site. We aim to provide NASA with the best possible resource for distributing news and educational products concerning SMD research and missions.

Kenneth McGwire/Desert Research Institute
Integrated Math and Geo-science Education (IMAGE): Improving STEM Education in Nevada with Compelling Earth Science Imagery

In recent years, NASA and other public and private entities have generated an abundance of Earth observing satellite imagery that is visually striking and uniquely informative. The IMAGE project will build a set of interactive computer exercises around examples of this compelling imagery that will keep students motivated as they build their skills in the content areas that are laid out in Nevada’s math and science standards. Nevada has a high proportion of ethnic groups who are underrepresented in the STEM disciplines. Satellite imagery from NASA will provide a unique way to engage young minds and to generate excitement about the opportunities that would be possible with STEM-related careers. IMAGE will be a collaborative effort between Nevada’s System of Higher Education and the Northwest Regional Professional Development Program (NWRPDP) that provides professional development for teachers in elementary schools of northwestern Nevada. IMAGE will provide 6th grade teachers with subject training and educational software that will improve both math and Earth science education in Nevada public schools. Three training seminars will be performed with ample opportunity for teacher feedback to improve the software and methods. Participation will earn the teachers in-service credit.
towards their recertification requirements. The effectiveness of the IMAGE project will be assessed using pre and post testing for both quantitative knowledge of educational content and qualitative attitudes, knowledge, and misconceptions about STEM fields. The existing efforts of NWRPDP will enable the IMAGE project to select teachers who are known to be motivated participants. These “keystone” teachers will be able to pass training on to colleagues at their schools and to broadcast the effectiveness of this approach at a state-wide level. The modules developed by the IMAGE project will be promoted nationally and made available for adoption elsewhere.

Bryan Mendez/University of California at Berkeley
Calendar in the Sky: Engaging Latinos in NASA Science and Maya Astronomy

Calendar in the Sky will engage the American public (with a specific focus on Latinos) in NASA science via the broad interest in Maya astronomy. We will develop a website about Maya astronomy that connects the ancient knowledge of the Maya to modern NASA science. The website will have a special emphasis on Maya calendars and will address misconceptions about Maya astronomy. It will also use NASA resources to inform about the real science in 2012 doomsday prophesies to provide evidence and reasoning for why these prophesies are unlikely or completely false. We will provide professional development to museum communities on the website content and resources for them to integrate Maya astronomy with NASA science into their programming. We intend to build on existing NSF and NASA-funded networks of science and cultural museum institutions that are interested in reaching Latino audiences with programming around this topic. The outcomes that we expect as a result of Calendar in the Sky are: the public visits/views and is informed by our website and seeks further reputable and evidence-based information on NASA science and Maya astronomy; museums develop programming using NASA and other content and resources provided in our professional development; lasting partnerships are forged between NASA E/PO, science museums and cultural/art museums; and Latinos become more interested in NASA science as a result of their experiences with our website, and attending programming of museums that participated in our professional development.

Carolyn Ng/NASA
Space Weather Living History

We propose to interview pioneers in space weather research and leaders in intern/national efforts to advance the studies of heliophysics. The goals are to capture, document and preserve the living history of space weather, and to inspire the next generation of scientists. In particular, the leadership and involvement of NASA will be highlighted. Using new and innovative multi-media platforms including iPad, we will make available an interactive timeline that includes 1) Supporting podcasts (interviews and content), 2) Activities to integrate new resources into an educational environment, and 3) NASA Career Path resources. A series of podcasts will reach tens of thousands of subscribers who are interested in NASA science. Activities and resources will aim to engage students in middle schools and above. Since NASA Headquarters and GSFC have many discipline experts as well as a repertoire of videos, we will consult with program
scientists and utilize existing resources in the project. In year 1 we propose to gather existing information from NASA, NOAA, the U.S. Air Force, the Smithsonian and libraries, and make arrangements for new interviews. In year 2 we will build and deliver an interactive product. In year 3 educational activities will be built to promote the use of the interactive product. In summary, the end products will include an interactive media viewer that can be displayed on different platforms and linked from multiple websites, a series of podcasts for existing and new subscribers of heliophysics programs and missions, and educational activities for students.

Ruth Paglierani/University of California
Energy from the Sun--in Space and on Earth

In recent years, there has been a surge of interest in educating students about renewable energy. In California, utility companies throughout the state are installing demonstration solar panels on school grounds, and through teacher professional development workshops, are introducing curriculum about the Sun and solar energy. High schools are developing Green Academies which support learning in solar energy and technologies. Students at these schools are learning about solar energy, and are primed to engage more deeply with the science and adventure of NASA explorations of the Sun.

Heliophysics E/PO Programs are uniquely positioned to provide teachers with the knowledge of and training in the use of NASA K-12 tools and materials to assure deeper science engagement. Teachers involved in solar-oriented schools have indicated a desire for greater scientific understanding of the Sun as an astronomical body as well as information on NASA's most current solar research. It is in the context of student interest and teacher need that we propose the Energy from the Sun--in Space and on Earth (ESSE) project.

Through the ESSE project, UC Berkeley's Center for Science Education at the Space Sciences Laboratory will bring together experienced heliophysics professional development providers, scientists and engineers from heliophysics missions, classroom teachers, highly experienced solar energy educators and utility districts supporting their own robust solar-focused education programs. This team will identify NASA resources and programs that can be used by educators already teaching solar energy to provide students with 1) a basic understanding of the Sun and its connection to us here on Earth, 2) the excitement of NASA missions that support heliophysics research, 3) knowledge of the many NASA satellites powered by the Sun, and 4) interactions with scientists and engineers to increase awareness of STEM (Science, Technology, Engineering and Mathematics) careers. The ESSE Team will conduct a series of multi-day teacher professional development workshops for solar schools throughout California, and create a replicable workshop model to share nationally.

Our key objectives are to: 1) train teachers in California using existing, high quality, standards-aligned heliophysics E/PO materials; 2) increase student interest in STEM careers through contact with science undergraduates and scientists; 3) partner with utilities to integrate heliophysics content into utility-sponsored trainings and; 4) leverage
solar school networks to bring NASA materials and programs to a new audience of educators.

We will disseminate our findings, highlighting best practices for and lessons learned from creating a collaborative workshop; the most effective NASA heliophysics STEM resources for use in solar energy-oriented classrooms; and those solar resources which increase student interest in heliophysics and help make it accessible to a greater range of students. We will present our findings broadly both to educators at CSTA, NSTA and utility-sponsored workshops, and to NASA E/PO personnel and utility districts wanting to replicate our workshop as part of their education programs.

We will contribute to SMD STEM goals for formal education at both the elementary and secondary level, by utilizing existing heliophysics E/PO materials to equip educators with skills, confidence, and competence in teaching. In support of SMD goals for outreach, we will increase student interest in careers in STEM.

Our key deliverable for Energy from the Sun--in Space and on Earth (ESSE) is a model of teacher professional development that integrates solar energy with heliophysics content. This project comes at a time of increasing interest nationwide in solar energy, alongside spectacular successes in NASA Heliophysics missions. In three years, our fully-tested, mature workshop model will be ready to expand to schools studying solar energy nationwide.

Daniella Scalice/NASA Astrobiology Institute
NASA and the Navajo Nation 3: Continuing the Partnership

NASA and the Navajo Nation 3: Continuing the Partnership will leverage the unique educational materials produced through prior NASA-funded efforts which bring together science and cultural knowledge into 1) professional development experiences for Navajo K-12 educators and 2) summer enrichment experiences for Navajo middle and high school students. On the other end of the pipeline, the project will also continue collaborations with local tribal colleges begun under prior awards that create sustainable connections with NASA and in NASA-related fields.

The proposed activities build on lessons learned from past NASA and the Navajo Nation projects, and continue forging an important partnership with the Navajo Nation by increasing NASA’s reliable and inspirational presence in and service to this community. All our efforts will cultivate sustainability as well as opportunities to exchange information on emerging educational priorities within the Navajo Nation and NASA. Evaluation will permeate the project; progressions and lessons learned will be shared with the NASA E/PO community.

The overarching goals of the project are:

Inspire and engage Navajo youth in schools and communities on the Navajo reservation to become more culturally and scientifically knowledgeable;
Promote culturally appropriate collaborations of mutual benefit between NASA and the Navajo Nation;
Ensure both NASA and Navajo perspectives are incorporated into all aspects of the project;
Promote a sustainable partnership between NASA and the Navajo Nation.

The specific objectives of the project are:

Teacher Workshops and Student Enrichment Programs
Effect a “dual-learning environment” in the teacher workshops and student programs that allows NASA science and Navajo knowledge to co-exist;
Effect an increase in both the scientific and cultural knowledge of program participants;

Tribal College Collaboration and Support
Connect tribal college students with NASA-related opportunities;
Foster sustainable collaborations between NASA and tribal colleges which increase the infrastructure and capability of the colleges in NASA-related fields.

Gregory Schultz/Astronomical Society of the Pacific
Galileo Educator Network (GEN): Advancing Science Literacy through Astronomy and Teacher Professional Development

In response to the need to create the next generation of NASA explorers and promote a science literate populace, scientists and educators from the Astronomical Society of the Pacific (ASP), the National Earth Science Teachers Association (NESTA), the National Optical Astronomy Observatory (NOAO), and the New Jersey Astronomy Center for Education (NJACE) propose the "Galileo Educator Network (GEN): Advancing Science Literacy through Astronomy and Teacher Professional Development" project. GEN will create distributed and leveraged professional development (PD) nationwide with the primary goals to:
(1) Help teacher educators and teacher professional development providers engage and educate teachers of astronomy (and general science), especially in grades 3-9, using effective instructional strategies and educational resources, with engaging and inspiring content. (2) Promote the effective use of NASA-developed and NASA-supported resources by teacher educators and teacher professional development providers, through integration of astronomy/space science content with Galileo-inspired science inquiry and exploration.

In addition to the ASP partnerships with NESTA, NOAO, and NJACE, the Galileo Educator Network (GEN) will partner closely in Year 1 with four other regional sites from ASP's Project ASTRO National Network: West Chester, PA, San Diego, CA, Cincinnati, OH, and Boulder, CO. Early on, leaders from each of the partner organizations/sites will attend a 2-day GEN Partners Institute, with goals to include (a) examining key NASA resources, and (b) developing a model for a 2-day GEN workshop aimed at teacher PD providers. This resulting model will be implemented (and iterated on) in two GEN Professional Development Institutes (PDIs), in Years 2 and 3. Each year, we will recruit both individuals and pairs of professional developers from 18 sites around the country, provide each site GEN-related materials (including NASA Night Sky
Network toolkit materials and Universe at Your Fingertips 2.0 DVD-ROMs), and expect each site to deliver at least one 15-hour GEN PD offering for at least 15 local classroom teachers, using the training and materials they receive at the national PDI. All those trained through the PDIs (as well as those through the original GEN Partners Institute) will become certified by the project as NASA Galileo Educator Fellows. Worth noting is that in the months following the original Partners Institute, ASP and each partner site will develop and implement their own 15-hour GEN PD program for 15+ teachers in their region -- or in NESTA’s case for teachers who start their GEN PD at a NESTA-run NSTA short course, with follow-up sessions in NESTA-developed PD webinars. In all cases, upon completion of the 15-hour PD, teacher participants will become certified by GEN as NASA Galileo Educators. Throughout the project, ASP and partners will support the Galileo Educator Fellows and Galileo Educators, and grow a GEN community of practice through (a) regular communications, (b) face-to-face gatherings and networking opportunities, and (c) dynamic online forums and web content.

Including the 8 organizations participating in the Partners Institute, GEN in sum will develop 44 sites to each implement 15-hour PD opportunities for classroom teachers. With one or two staff trained per site, we will thus develop 44 to 88 NASA Galileo Educator Fellows. With each site subsequently recruiting at least 15 teachers, the project will result in at least 44x15 = 660 classroom NASA Galileo Educators, each having engaged in at least 15 hours of high-quality professional learning.