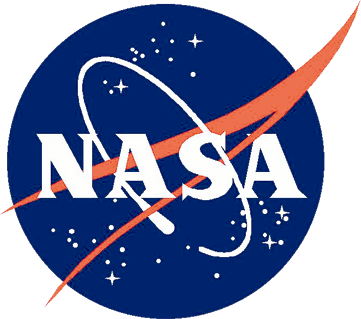
**Magnetospheric Multiscale (MMS) Project**

**Education and Public Outreach Plan**



**National Aeronautics and**

**Space Administration**

**Goddard Space Flight Center**

**Greenbelt, Maryland**

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# Introduction:

The plan highlights the unique science, technology, engineering and mathematics (STEM) aspects of MMS though a variety of activities that address NASA’s three major education goals:

* **Strengthen NASA and the Nation’s future workforce**
* **Attract and retain students in STEM disciplines**
* **Engage Americans in NASA’s mission**

Our approach to informing and educating about MMS science and instrumentation is to place it in the context of our current level of understanding and our ways of understanding. The essential questions listed in Section I will guide our E/PO activities, the resources we develop, and the evidence we collect to assess our processes and outcomes. All of our work aligns with NASA education outcomes as stated in Section II.

The activities and programs included in this plan maximize the cost of our given budget by leveraging and combining resources from a variety of groups, programs and partners. Each has a proven track record of effectiveness, as demonstrated in their respective evaluation processes.

This plan describes the programs and activities coordinated through Goddard. E/PO activities coordinated through SwRI and Rice University are incorporated into this plan in order to show the cohesiveness of the MMS E/PO program as a whole, and this document includes:

1. A detailed plan for each activity aligned to SMD requirements.
2. A justification for the selection of activities.
3. A fully integrated evaluation plan that relates audience and impact.
4. A description of how we will assess the implementation of the plan and its activities.
5. A clearly established timeline and detailed cost for deliverables.

The E/PO Mission Lead will also coordinate with the Goddard Space Flight Center’s Communications Office and make every effort to utilize press releases, press kits and connections to external media to reach greater public audiences.

We are committed to periodic program updates and revisions based upon evaluation metrics that move beyond perception data to monitoring of actual learning in formal or informal environments, as well as the impact of those applications on learning. MMS is working to achieve coherence within the SMD E/PO portfolio and more effective, sustainable, and efficient utilization of MMS science discoveries and learning experiences.

The Project Scientist, Dr. Moore, and Deputy Project Scientists, Drs. Le and Adrian, are actively and enthusiastically involved in the development of this plan.

# NASA Unique Science and Engineering Content

The content for this plan was identified by answering two fundamental questions:

* What is the NASA-unique science of this project?
* What is the NASA-unique technology and engineering of this project?

The answers to these questions come directly from discussions with the science team, flight project and engineering teams, with assistance from the project’s external evaluator.

The MMS mission will use Earth's magnetosphere as a laboratory to study magnetic reconnection, a fundamental plasma-physical process that taps the energy stored in a magnetic field and converts it—typically explosively—into heat and kinetic energy in the form of charged particle acceleration and large-scale flows of matter. The scientific and technical complexity of this mission present a variety of challenges when developing an E/PO plan, while at the same time opening the door to a variety of unique learning opportunities.

We have developed five essential questions about the NASA-unique science, technology and engineering that will guide our efforts throughout the project. Essential questions focus understanding on key educational ideas.

* What do we know about the magnetosphere? (science, math)
* How do we know what we know? (technology, engineering, math)
* What don’t we know? (science)
* How do we find out? (science, technology, engineering, math)
* How will the MMS mission add to our knowledge? (science, technology, engineering, math)
* What will this knowledge contribute? (science, technology, engineering, math)
* Why does it matter? (societal impacts)

## MMS Themes

Based on expressed needs from educators, our overarching E/PO focus will be on magnetic fields and plasma, the center of MMS research. Our MMS themes include both necessary prior knowledge areas and MMS-specific themes. We based these on our concept maps, the GEMS Space Science Sequence and national education standards.

* The Sun generates energy that can be observed, measured, and used on Earth.
* The sun releases massive amounts of energy. Some of the charged particles hurtle toward the earth. The magnetosphere protects the Earth from these particles. When they come into contact with the magnetosphere, a number of dynamic processes occur, including magnetic reconnection between the solar wind and the Earth’s magnetosphere. MMS is studying the reconnection of ionic particles..
* On the dayside, in the magnetopause, the sun’s particles and energy enter into the Earth’s vicinity through the interplanetary magnetic field.
* On the night side, in the magnetotail, there is sunward convection in the Earth’s ionosphere and auroral substorms.
* Life on Earth has developed under the protection of the magnetosphere from the solar winds.
* The Sun’s impact affects life on Earth. The MMS mission will extend the multi-spacecraft exploration of the Earth's boundaries, and magnetic reconnection that is crucial for energy transfer between the Sun and Earth.
* Magnetic reconnection affects life on Earth, our climate, satellites in our atmosphere and spacecraft.
* Earth’s magnetosphere, whose structure and dynamics are controlled by reconnection, is accessible to regular in situ measurement and provides the ideal natural laboratory in which to investigate magnetic reconnection.

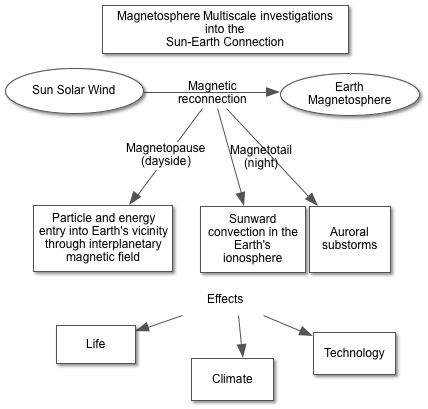
## MMS Science Standards

The National Research Council’s National Science Education Standards (NSES) and the AAAS Project 2061 benchmarks that are addressed by the MMS E/PO plan include the following:

* The sun is the major source of external energy for the Earth (NSES, p.189)
* The Earth is one of several planets that orbit the sun (2061, 4A/4)
* Heating of Earth’s surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents (NSES, p.189)
* Global climate is determined by energy transfer from the sun at and near the Earth’s surface. This energy transfer is influenced by dynamic processes such as cloud cover and the Earth’s rotation, and static conditions such as the positions of mountains and oceans (NSES, p.198)
* To understand the role of the sun it is necessary to comprehend large distances, long time scales, and the nature of nuclear reactions. (NSES, p.188)
* Driven by sunlight and earth’s internal heat, a variety of cycles connect and continually circulate energy and material through the components of the Earth system. Together these cycles establish the structure of the Earth system and regulate Earth’s climate (NSES, p.187).
* The sun, the Earth, and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago. (NSES, p.189)
* Almost all food energy comes originally from sunlight (2061, 5E/3)
* Movement of matter between reservoirs is driven by the Earth’s internal and external [sun] sources of energy. (NSES, p.189)
* The sun is the major sources of energy for phenomena on the Earth’s surface, such as growth of plants, winds, ocean currents and the water cycle. (NSES, p. 161)

## ****Concept Maps****

Science benefits from engineering, and engineering advances science - the two are linked. In fact, the linkages between these topics and the remaining STEM areas (technology and math) are dynamic, highly interconnected, and constantly evolving over time. The MMS team is currently working on an engineering concept map that will outline these connections and provide a foundation to effectively link engineering and technology concepts directly to the activities described in this plan. The development of this map is included in the MMS E/PO Timeline (Section VIII).

The basic science concept map to the right was developed to identify key MMS concepts in relationship to each other. It will be used educator audiences and to support the development of activities related to MMS science, technology and engineering.

A more detailed science concept map is under development by the MMS E/PO team and will be used to perform ongoing gap analysis of all MMS education activities. The current draft is available in Appendix A. The development process includes: (a) Develop draft map with MMS Project Scientist (b) Map concepts to the appropriate AAS benchmarks (c) Map identified benchmarks to the appropriate MMS activities (d) Identify any existing content and/or activity gaps.

# Intended Audience(s)

Program audiences range from the general public to middle school students to pre-service and museum educators, including the underserved and other unique groups. For each of the MMS E/PO projects, products, and activities, the audience is the focus of its design. Careful attention has been given to ensuring that each activity responds to specific audience needs as identified by the greater education community. Section V provides a thorough description of each project, including information on the intended audience, the rationale behind its inclusion in the plan, project design and impact, and linkages to other programs.

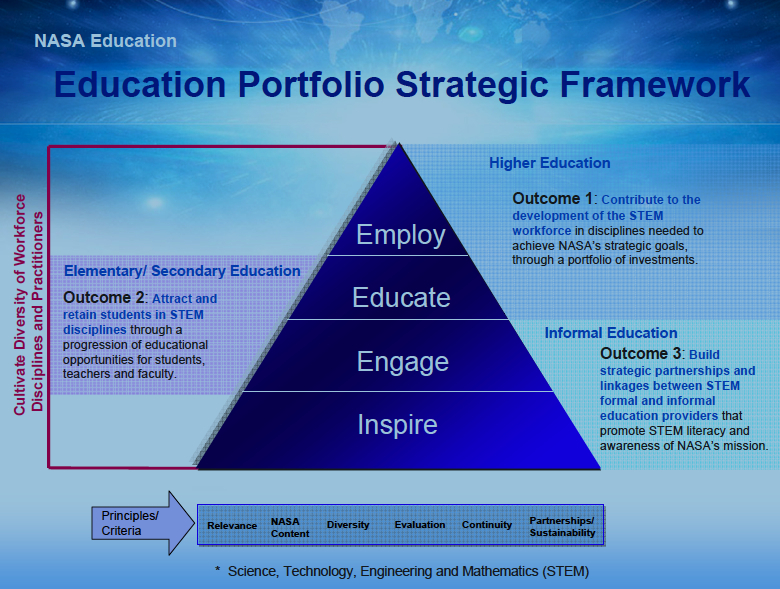
Many of the projects contribute to the involvement, broad understanding, and/or training of underserved and/or underutilized groups and make a demonstrable contribution to attracting diverse populations to careers in STEM. Attention has been paid to providing an appropriate pipeline of opportunities which both draws in new audiences and provides opportunities for continued learning beyond the MMS plan.

Building a strong reputation as a positive and active contributor to STEM education initiatives requires effective and consistent communication with the intended audiences. Several aspects of the plan support this aim. Along with the specifics noted for individual projects in Section V, MMS will work closely with the GSFC Office of Communications and NASA’s existing social media networks to reach the target audiences. The E/PO website will also provide easy access to educational content, including a sustained audio/video podcasting program, allowing educators to incorporate MMS content into their own curriculum and programs.

Of particular interest in our plan is NASA’s new focus on addressing middle school pre- and in-service STEM educator training and support to build STEM competencies and enable teachers to inspire students at a critical time in their education. For the greatest impact, MMS will therefore contribute to teacher professional development opportunities in partnership with national programs with a proven record of accomplishment and sustainability. We will use proven and emerging collaborative technologies to scale and increase educator development and certification programs. Partners in this effort include the Challenger Learning Centers, NASA’s Space Weather Action Centers, the International Society of Technology in Education, and the National Science Teachers Association, each with programs that incorporate elements identified as critical for middle school success, such as strong school leadership, use of data to drive instruction, and interventions in reading, writing, and mathematics.

## Education Portfolio Strategic Framework

This plan is fully aligned with the NASA Education Portfolio Strategic Framework below, which maps NASA’s mission to “Inspire, Engage, Educate, and Employ” our target audiences. By employing a wide yet flexible E/PO strategy, we address all three outcomes and reach audiences by inspiring, engaging and educating. (Graduate education is outside the scope of NASA’s E/PO requirements but is addressed separately by the science team.) By integrating our plan with other missions and groups within Heliophysics, we leverage precious resources and multiply our impact. Given that opportunities for joint action are pursued and can occur at any time, we keep our plan flexible.



# Project E/PO and Activity Objectives - Alignment with NASA

## Overall Project E/PO Objectives:

The following project objectives were developed to focus our overall E/PO efforts.

* Develop teachers’, students’ and public knowledge of MMS science, technology, math and engineering
* Reach under-represented and underserved groups (diversity)
* Support the pipeline of STEM opportunities (workforce and career development)
* Develop customer resources for MMS science, technology, math and engineering
* Increase access to resources (people, content, processes)
* Partner with other organization to extend MMS reach
* Incorporate evaluation processes that ensure program effectiveness

The following are the specific, measurable E/PO and MMS personnel development objectives, drawn from the overall objectives.

**Education Activity Objectives**

The following objectives refer to those activities and projects that are intended to increase learning, to educate students, educators and the general public on specific STEM content areas, and to expand the nation’s future STEM workforce.

* Engage middle and high school students in learning MMS science and instrumentation
* Develop an interest level in MMS that encourages and maintains students’ involvement in STEM careers
* Educate in-service and pre-service teachers (face-to-face) in MMS science
* Educate in-service and pre-service teachers (virtually) in MMS science
* Provide access to MMS data to diverse audiences that contribute to the involvement, broad understanding, and/or training of underserved and/or underutilized groups

**Public Outreach Activity Objectives**

The following objectives refer to those activities and projects that are intended to raise awareness of, or interest in, NASA, its goals, missions and/or programs, and to develop an appreciation for and exposure to science, technology, research and exploration.

* Develop resources to be distributed physically or virtually
* Provide access to resources on the Web
* Engage the public with MMS information through social media and virtual environments
* Develop and provide visual representations that explain MMS science, instrumentation and careers
* Develop and provide audio media resources that explain MMS science, instrumentation and careers
* Engage youth and adults in learning about MMS science

**MMS Personnel Development Activity Objectives**

The following objectives refer to those activities and projects that target the professional development needs of the internal MMS community interested in participating in E/PO and the external NASA E/PO community interested in cooperative efforts.

* Provide professional development opportunities for MMS personnel interested in E/PO related to social media (Facebook, Twitter, Ning, etc.) and virtual environments, classroom involvement and media outreach opportunities
* Promote, provide and encourage sharing and dissemination of E/PO information and opportunities
* Promote, provide and encourage sharing and dissemination of E/PO information with other Heliophysics missions.

## Integration into High Leverage Programs

**Internal and External Programs:**

The activities and programs included in this plan maximize the cost-effectiveness of our budget by leveraging and combining resources from a variety of groups, programs and partners. Many of these programs have been designed to place mission materials into the hands of a of target audiences (Formal, informal, community groups, etc.) at a variety of levels (elementary, middle school, high school, college, general public). Our goal is to leverage these types of programs to drive large audiences to MMS resources such as the MMS website, social media pages and other E/PO resources. Section 5 of this plan contains detailed activity descriptions, objectives and outcomes that specify how MMS will leverage the success of new and existing internal and external E/PO programs while remaining the main driver of its own programs.

**Workshops:**

MMS will leverage local and national outreach opportunities by integrating MMS specific content into existing workshops and seminars conducted through such programs as: the Heliospheric Ambassadors Program, NASA’s Educational Resource Centers, the Space Weather Action Center, ISTE’s Cyber Café, Challenger Centers, NSTA, etc. (See Activity Description in Section 4.3). A series of MMS workshop templates (with recommended materials lists and time tables) will be developed to assist these programs when conducting MMS workshops or when integrating MMS content into existing workshops. Templates will focus on content and activities (described in Section 5) as they relate to MMS Science, Technology, Engineering and Mathematics.

**Office of Communications**

MMS will work closely with the Office of Communications to develop visualization concepts and tools capable of displaying magnetic reconnection and its impact on Earth’s life, climate and technologies. Visualizations will use both real and simulated data, and can make use of MMS data when it becomes available. These resources will be integrated into a variety of existing resources including NASA Edge webcasts and videos, the Space Weather Media Viewer (MMS Careers section, video section, image section), MMS social media (YouTube, Facebook, Twitter, Flikr), etc.

## Objective and Activity Tables:

The following tables provide snapshots of all MMS activities based on the specific, measurable objectives above. In some cases, there may be more than one activity that is designed to accomplish the objective. A detailed description of each activity is provided in Section V.

|  |  |
| --- | --- |
| **MMS Education Activity Objectives** | |
| *Objective* | *Activity* |
| Engage middle and high school students in learning MMS science and instrumentation | **• Models (paper, LEGO, edible) of the spacecraft with educator’s guide**  **• Space Math activities**  **• Model/Mobile STEM Bookmark Activity**  • MMS Transmedia Book (Digital Fabrication)  **• Space Weather Action Center (SWAC)**  • Young Engineers and Scientists (YES)  • SMART EPO |
| Develop an interest level in MMS that encourages and maintains students’ involvement in STEM careers | • Space Weather Media Viewer (SWMV) and mobile app (MMS Careers Section)  • After School Astronomy Clubs (ASAC)  •MMS Career Video Series (NASA Edge) |
| Educate in-service and pre-service teachers (face-to-face) in MMS science | • Cyber Café  • SWAC program and workshops  • NSTA Learning Center  • Master of Science courses at Rice University  • Heliophysics Ambassador program for master teachers  • Workshops at conferences  • Teacher professional development  • Educator guides and resources |
| Educate in-service and pre-service teachers (virtually) in MMS science | • Second Life  • Google Hangouts |
| Provide access to MMS data to diverse audiences that contribute to the involvement, broad understanding, and/or training of underserved and/or underutilized groups | • SWAC  • Tools that enable students to analyze science mission data  • Indigenous Education Institute (IEI) workshops  • Space Camp for the Blind |

|  |  |
| --- | --- |
| **MMS Public Outreach Activity Objectives** | |
| *Objective* | *Activity* |
| Develop resources to be distributed physically or virtually | • Second Life  • SWMV (online and mobile app)  • E/PO print materials  • Audio/Video podcasting  • Press releases, feature articles, press kits (GSFC Office of Communications)  • Space Weather CD-ROM  • Create sonifications from datasets |
| Provide access to resources on the Web | • GSFC web pages on spacecraft and instrumentation  • E/PO web pages  • Magnetic Space website |
| Engage the public with MMS information through social media and virtual environments | • Facebook, Twitter, YouTube, etc.  • Flickr, Pinterest  • Second Life |
| Develop and provide visual representations that explain MMS science, instrumentation and careers | • Video podcasting program (NASA Edge)  • Animations, web shorts and visualizations(OCC)  • Animations for museums and planetarium shows  • Spacecraft and instrument models |
| Develop and provide audio media resources that explain MMS science, instrumentation and careers | • Audio podcasting (Sun-Earth Day)  • Develop audio podcasting activities for educators and general public |
| Engage youth and adults in learning about MMS science | • NASA After School Astronomy Club (ASAC) program  • Citizen scientist opportunities (ISTE)  • NASA Educator Resource Center Events  • Support public outreach events (i.e. Goddard Tweetups, World Science Festival, etc.)  • Sally Ride Festival  • ‘News Writers’ workshops |

|  |  |
| --- | --- |
| **MMS Personnel Development Activity Objectives** | |
| *Objective* | *Activity* |
| Provide professional development opportunities for MMS personnel interested in E/PO related to social media and virtual environments, classroom involvement and media outreach opportunities | • ‘One on One’ training (Face-to-face, Skype, etc.)  • Heliophysics and Astrophysics E/PO Forums  •’Tips and Tricks’ via periodic email, website, and/or Ning updates.  • Periodic email, website, and/or Ning updates.  • Social media ‘Brush-up’ |
| Promote, provide and encourage sharing and dissemination of E/PO information and opportunities | •Weekly GSFC MMS team tag-up meetings  •Monthly MMS E/PO team telecons |
| Promote, provide and encourage sharing and dissemination of E/PO information with other Heliophysics missions. | • Monthly Heliophysics E/PO Forum telecons  • Heliophysics E/PO community online workspace  • GSFC Heliophysics Division meetings  • Weekly GSFC Social Media meetings |

## E/PO Logic Model

To accomplish our goals, a logic model was developed with inputs, intermediary variables, outputs, and process and outcome evaluation. The model defines the critical variables to move from the resources of the team and project (inputs) to activities (outputs) that will lead to accomplishing the outcomes. This model will guide our efforts and will be revised to reflect our activities and lessons learned each year. (See Appendix B)

# Detailed Activity Descriptions

Each of the activities is described in detail below. All projects and activities use NASA content, people, external partners, NASA facilities to involve educators, students, and/or the public in NASA STEM. Careful attention has been given to ensure that each activity responds to the needs identified by the education community and other groups. Many activities were selected due to their ability to enhance the value and/or reach of other chosen activities, with the ‘whole being greater than the sum of its parts’.

Activity descriptions include:

1. **Overview of Activity with Objectives and Outcomes**
2. **Rationale and Impact**
3. **Identified Need**
4. **Intended Audience**
5. **Diversity**
6. **Linkages**
7. **Pipeline**
8. **Dissemination**
9. **Responsibilities**
10. **Evaluation**
11. **Timeline**

## Detailed Description of MMS Mission Level E/PO Activities

### After School Astronomy Clubs (ASAC)

1. **Overview of Activity with Objectives and Outcomes:** NASA ASACs promote mission science through math and science activities and links to NASA resources: <http://afterschoolastronomy.org> . They connect K-12 afterschool programs around the world through science content, activities, organizational resources, and curricula. Clubs can communicate through a Yahoo groups interface (soon to be Facebook) and work together as an online community to share experiences and capabilities in astronomy education.

**Objective:** To identify and feature MMS mission science and club appropriate activities surrounding Earth's magnetosphere, electricity and magnetism, planetary comparisons, and heliophysics.

**Outcome:** ASAC will link to the MMS home page, and provide its participants with direct access to the ASAC network through MMS scientists’ web chats, interviews, mission event descriptions and careers.

1. **Rationale and Impact:** Afterschool programs allow astronomy to be taught in creative ways that may not be addressed by curriculum requirements during the school day. They are frequently formed in isolation with few resources (Mayo, 2002). ASAC connects >120 school K-12 programs internationally.
2. **Identified Need:** ASAC’s are self-selecting groups of students with a demonstrated interest in astronomy. The amount of time given to space science can be extremely limited. ASAC offers an opportunity for students to extend their knowledge about science and exposure to career choices that are otherwise be missed.
3. **Intended Audience:** K-12 students
4. **Diversity:** ASACs currently represent 13 countries and 30 states in the US
5. **Linkages:** ASAC clubs are provided with links to NASA space and Earth science missions and E/PO activities, including groups such as Solar System Ambassadors, Aerospace Education Specialist Program (AESP), Educator Resource Centers, and the Night Sky Network. ASACs provide:
   1. References to NASA websites containing career information
   2. Periodic telecons on current issues in astronomy, by noted astronomers, IT specialists, and engineers
   3. Information about local college astronomy courses, degree programs, and departments
   4. Information on professional societies that support student interest in pursuing careers in astronomy
   5. Activities that put the student in the roll of active researcher, experiencing first hand, the excitement of discovery
6. **Pipeline:** ASACs provide participants with an emphasis on careers in astronomy. An additional emphasis will be place on careers paths related to the MMS mission. Through a Community Based Astronomy (CBA) model developed by Mayo. et. al, (2000), many resources within families, schools and school districts, civic groups, public science education facilities, local business, government agencies, and universities, are brought to bear on variables of student interest, aptitude, and attitude in and for careers in astronomy.
7. **Dissemination:** Dissemination is accomplished through the ASAC web site, interclub contacts, periodic trainings, and a Yahoo group, soon to be a Facebook page.
8. **Responsibilities:** TheASAC Project Lead, Lou Mayo (GSFC) will work directly with the MMS E/PO Mission Lead and ensure the MMS mission is featured in scientist web chats, interviews, mission event descriptions and ASAC website updates.
9. **Evaluation:** Description of what is provided to whom. Reporting by club leadership on what was used with what audience (web form). Web stats may reflect use by clubs through a spike.
10. **Timeline:** 2011-2014

### Audio Podcasting Program

1. **Overview of activity with objectives and outcomes:** The team will develop a series of online audio podcasts (5-10 minutes each) focused on the latest mission science and education information. The E/PO Mission Lead will work with the Sun-Earth Day team to produce a primary source activity (activity based on MMS content and research) that instructs users on connecting the podcasts with other MMS resources. The series, "Magnetic Space", would be promoted through existing MMS resources. A wide range of content will include scientist interviews, mission highlights, featured activities, website information, multimedia resources, etc.

**Objective:** To produce a series of 24 audio podcasts per year, along with transcripts and links to MMS E/PO materials

**Outcome:** The podcasts will allow listeners to ‘follow the mission’ by providing MMS highlights pre- and post-launch

**Objective:** To develop a ‘Primary Source’ activity.

**Outcome:** The activity will enable users to connect each podcast with existing MMS resources to extend their understanding of MMS research.

1. **Rationale and Impact: There are several distinct advantages to audio-only podcasts: appeals to many listeners, easier content capture, easier editing, easier and faster production, smaller downloads, and cheaper to produce. Due to the linkages and dissemination plan it is anticipated the podcasts would receive at least as many downloads as the >100,000 per year for those in the existing Sun-Earth Day series.**
2. **Identified Need: Audio podcasts continue to have a high impact due to users who prefer to listen when video is inconvenient: in the car, at the gym, during walks, in the classroom, etc.**
3. **Intended Audience: Will reach a variety of audiences by creating separate series such as:** 
   * **‘Follow the Mission’ series, with mission highlights and updates (general public)**
   * **‘The Faces of MMS’ series, with career interviews (formal education)**
   * **‘Sound Seeing Tours’ series, with descriptions of specific mission locations (formal and informal education, hearing impaired)**
   * **‘Storytelling’ series, with MMS-related information shared creatively by professional storytellers (formal and informal education, general public)**
4. **Diversity: Each podcast will have a transcript for the hearing impaired. Content will include interviews with scientists, engineers and educators from a wide range of diverse audiences. Additional links will be provided to ‘career’ sections of the MMS E/PO website and Space Weather Media Viewer (SWMV). (see descriptions for MMS Website and SWMV)**
5. **Linkages:** Users can effectively connect each podcast to mission videos, image galleries, activities, and media tools like the Space Weather Media Viewer (SWMV). Users can begin their own research using MMS information as a 'primary' source. Educators can use the descriptive podcasts to enhance their curriculum with information about space weather, magnetism, plasma and NASA careers.
6. **Pipeline: Content will focus on available MMS E/PO resources such as other multimedia, career resources, activities, programs and mission updates.**
7. **Dissemination:** Links to each podcast would be made available on iTunes, the MMS website, Sun-Earth Day website and the NASA portal.
8. **Responsibilities: The E/PO Mission Lead will work with the media specialist to produce up to two audio podcasts per month. Primary Source activities will be developed by the MMS E/PO team with input from the curriculum specialist from the Space Weather Action Center team.**
9. **Evaluation: Internal and external reviews of podcast plans and produced podcasts. Field tests with hearing impaired. Analysis of how podcasts are connected to other MMS resources. User survey on website to solicit stories of how people are using the podcasts.**
10. **Timeline: 2013, 2014+**

### Challenger Learning Centers

1. **Overview of Activity with Objectives and Outcomes:** Challenger Center for Space Science Education (CCSSE) and its international network of 48 Challenger Learning Centers (CLC) create positive educational experiences that raise students' expectations of success, foster long-term interests in STEM, and inspire students to pursue studies and careers in these areas. The CLCs are the go-to sites for all things NASA in their communities. CCSSE has pioneered a pathway in technology-enhanced immersive simulation-based learning, and has been able to maintain and build upon what it has done best over the past 25 years. At the CLCs, student teams complete activities during simulated space missions, and a recent ROSES grant allows integration of a new space weather theme into four simulations, as well as into the “flight director” training at conferences and teacher workshops.

**Objective:** To promote and disseminate educational content about NASA heliophysics missions (such as SOHO, the Solar Dynamics Observatory and MMS), to an existing and established CLC audience.

**Outcome:** Present MMS mission information at CLC Space Weather educator workshops and conferences that target over 100 informal educators from 30 states.

**Outcome:** CCSSE works with MMS scientist and E/PO team to conduct a live interactive webcast for all CLC-connected teachers and students, and the general public. See: <http://www.challenger.org/programs/ccwebcast.cfm>

**Outcome:** Feature an interview with a MMS team member during a weekly CCSSE space science series podcast. See: <http://www.challenger.org/programs/podcasts.cfm>

**Outcome:** Include information about MMS milestones and educational activities as a part of CLC’s publications to further the reach of MMS E/PO within CLCs multiple networks.

1. **Rationale and Impact:** Recent findings in several outcome categories (cognitive gains, skills gains, affective gains, and future choice impacts) indicate overall positive gains by students who have experienced a CLC mission. CLCs reach >400,000 students each year and engage >40,000 educators. They work with >6,000 schools in 30 states through programs that enhance and extend classroom teaching and learning. The inclusion of MMS information and resources is a logical extension of CCSSE work.
2. **Identified Need:** Through a CLC mission students increase their understanding, appreciation, and motivation for engaging with space science which, we believe, ultimately positions students for careers in STEM disciplines and impacts their career choices.
3. **Intended Audience:** Middle school students, their teachers and youth group leaders are the focus. CLCs also offer teacher professional development workshops in their communities, and 200 informal educators working at the CLCs also teach and engage students and educators.
4. **Diversity:** CLCs are, by design, located in cities and rural areas, and annual reporting shows that 25% of students are from underserved populations, with some working with almost entirely underserved or minority populations.
5. **Linkages**: As the space weather theme is integrated into our four mission simulations (Encounter Earth, Return to the Moon, Rendezvous with a Comet and Voyage to Mars), students and teachers become engaged with heliophysics missions and the science of magnetic fields and the magnetosphere. The educational resources on the MMS E/PO site make an excellent pre- or post-mission extension, helping students to better understand the Sun-Earth relationship and effects of being outside of the magnetosphere on a voyage to another planet.
6. **Pipeline:** By giving students the experience of what it is like to participate in a NASA space mission in different roles (COM, DATA, NAV, etc.), students entertain ideas for future careers in a STEM discipline.
7. **Dissemination:** Dissemination will be through the CLC network via newsletter and educational publications, at annual conferences, and through a variety of multimedia (webcasts, podcasts, etc.). The program also has a large following on Facebook and YouTube, where viewers are directed to CCSSE webcasts (live and archived), weekly podcasts, videos and other educational resources.
8. **Responsibilities:** Rita Karl, Director of Education, and Carlos Nunez, Mission Support Specialist, will be responsible for this activity with support from the CLC Director of Technology, Muhammad Shazlee.
9. **Evaluation:** End of workshop or webinar evaluations. Analysis of MMS inclusion in CLC publications.
10. **Timeline:** 2011-2014+

### Cyber Café - ISTE

*(MMS/ ISTE Cyber Café: Building 21st Century Skills through Social and Experiential Learning)*

1. **Overview of Activity with Objectives and Outcomes:** The Cyber Café is an online collaborative space where a new way of social and experiential learning can take place. Working with the International Society for Technology in Education (ISTE) and their existing network of professionals, the resources in the Space Weather Action Center (SWAC) program will be used to engage educators from around the world in monthly topics that are relevant to the classroom, school and/or professional arenas. Café participants will begin to tackle key curricular and training areas in education specifically related to MMS STEM content. At the end of each 6-week Café, participants will produce educational artifacts (webinars, curricula, etc.) that will be used and shared in a variety of learning environments. All Cafés are developed around ISTE’s National Educational Technology Standards (NETS) (see Section I.2.2) so participants can connect their work and the necessary 21st century skills needed for their students. MMS and Heliophysics educational content will be acquired through direct communication between ISTE and key MMS scientists and engineers.

**Objective:** To design and develop a Café infrastructure to be housed on the ISTE Learning platform with access from the NASA MMS site.

**Outcome:** Easy-to-use learning experience where a new way of social and experiential learning can take place.

**Objective:** To recruit 25 participant K-12 STEM teachers to examine key MMS concepts relevant to classroom instruction.

**Outcome:** Educators will work collaboratively to examine and make meaningful connections between classroom curricula, MMS content, and NETS.

**Objective:** To engage educators in a social learning and educational artifact development process that examines key STEM issues, produces a tangible tool for classroom use and connects these teachers to a professional learning network (PLN) that can build upon the work that they have produced within the Café experience.

**Outcome:** An educational artifact will be produced and a PLN will be established amongst other interested Café teachers.

1. **Rationale and Impact:** Educators will have a direct social learning experience with colleagues that can assist them with teaching high-level concepts to students in their respective learning environments. This will help them address concepts, produce learning artifacts for classroom use, and give them access to a larger educator network through ISTE, enabling their professional growth. ISTE membership is >20,000 educators internationally.
2. **Identified Need:** Through this project, K-12 educators and students will engage with a range of STEM activities that highlight the importance of both the MMS mission and the relevance of the study of Earth’s magnetosphere. As part of this learning experience educators will have a better understanding of the NETS and their critical role in the development of 21st Century skills and thinking for the next generation of the workforce.
3. **Intended Audience:** K-12 STEM educators
4. **Diversity:** Through ISTE, MMS will have exposure to and engagement with ISTE’s large diverse pool of educators that can assist and shape the Cyber Café experience as it develops.
5. **Linkages:** This project will be hosted within ‘*ISTE Learning*’, the organization’s online professional development platform. Additional content will be accessed through online resources that include the NASA portal, MMS E/PO websites and space weather media tools.
6. **Pipeline:** This project will build a professional development STEM skill-set for middle school teachers that introduces them to social learning, the latest technology skills and content area expertise that will ultimately benefit their classroom environments. As a result, teachers will be able to better prepare students for STEM careers as they advance in school.
7. **Dissemination:** The materials developed through this project will be disseminated through ISTE and NASA social networking sites, the MMS website, the ISTE Learning professional development platform and at annual ISTE conferences beginning in 2012, with ~15,000 participants annually.
8. **Responsibilities:** ISTE and the MMS E/PO team will collaborate to develop the café experience.
9. **Evaluation:** Analysis of educational artifacts for accuracy and support of MMS objectives. Follow up on use through surveys, and/or web stats**.**
10. **Timeline:**
11. Development: July 1 through September 1, 2011
12. Testing: September 1- September 15, 2011
13. Recruitment of teachers: August 1st through September 15th
14. Project starts October 1, 2011
15. Project Ends: September 30, 2012

### Digital Fabrication – Transmedia Book (@ GSFC) – [in development]

1. Overview of Activity with Objectives and Outcomes: Heliospheric Ambassador Program trains teachers in the science of the heliosphere and gives them tools to teach with.
2. Rationale and Impact
3. Identified Need
4. Intended Audience
5. Diversity
6. Linkages (portfolio element and linkage to the mission science and/or technology component)
7. Pipeline
8. Dissemination
9. Responsibilities
10. Evaluation
11. Timeline

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### Heliospheric Ambassadors (@ GSFC, SWRI) – [in development]

1. Overview of Activity with Objectives and Outcomes: Heliospheric Ambassador Program trains teachers in the science of the heliosphere and gives them tools to teach with.
2. Rationale and Impact
3. Identified Need
4. Intended Audience
5. Diversity
6. Linkages (portfolio element and linkage to the mission science and/or technology component)
7. Pipeline
8. Dissemination
9. Responsibilities
10. Evaluation
11. Timeline

### Full-scale ‘Student Built’ Model and Workshop Templates

1. **Overview of activity with objectives and outcomes:** To engage the K-12 community and the public with the MMS mission, the NASA Independent Verification and Validation (IV&V) Educator Resource Center (ERC), the Mountaineer Area RoboticS (MARS) organization, Paw Paw Schools, and the Clay Center for the Arts and Sciences will design a full-scale model of the MMS Spacecraft for both educational and public outreach events, provide a series of educator workshops leveraging the recently produced MMS Educator Guide, and to promote the integration of the MMS career video series into K-12 learning. Several workshops would be held culminating in a training at the Clay Center where the model will be displayed along with the career videos where it can engage thousands of visitors a month.

The NASA IV&V ERC has been designing and delivering Science, Technology, Engineering, and Mathematics (STEM) activities for K-12 educators for over a decade and will organize and deliver the educator trainings. MARS is non-profit organization committed to advancing STEM education in Appalachia by mentoring 5th grade-undergraduate youth in FIRST (For Inspiration and Recognition of Science and Technology) robotics programs. Although Paw Paw Schools is the second smallest combined K-12 school in the state, they are extremely active in STEM activities both during and after-school. Through partnerships with NASA IV&V, teachers and students have collected and forecasted space weather , completed MMS lessons and activities, compete in the FIRST LEGO League and Team America Rocketry Competitions, and in April 2013 will present MMS and space weather forecasting at the National Science Teachers Association (NSTA) conference. The Clay Center for the Arts & Sciences, located in the state's capital city of Charleston, houses the state’s only science center, the Avampato Discovery Museum which comprises two floors of hands-on science exhibits featuring more than 12,000 square feet hands-on science exploration.

**Objective:** To design a full-scale model of the MMS satellite

**Outcome:** Middle and high school students at the Paw Paw School (PPS) will construct and assemble a full-scale model of one MMS satellite. This will be accomplished under the guidance of MARS students and mentors who have successfully designed LEGO versions of the MMS spacecraft and supervised by teachers Chris Poniris (Technology Education) and Carol Coryea (Science Education). The model will be built primarily with lightweight plywood and foam core covered in mylar, and painted to match the look of the spacecraft. Functioning solar panels will also be used, allowing the model to both have a more realistic appearance, and to be used in science experiments exploring power generation. The model will be used in several teacher workshops and transported to the Clay Center for the Arts and Sciences, where it will be put on temporary display. The display will also integrate the recently developed MMS STEM career video series. This outcome will be led by Dr. Earl Scime (MARS), Chris Poniris (PPS), Carol Coryea (PPS), and Lewis Ferguson (Clay Center).

**Objective:** (a) To deliver a series of educator workshops based on the newly developed MMS Educator Guide including LEGO models, the full-scale MMS, and the STEM career video series. (b) To develop educator materials and online workshop templates that will allow NASA education specialists to replicate educator workshops.

**Outcome:** The NASA IV&V ERC delivers approximately 100 educator workshops per year, impacting over 1,000 classroom teachers, preservice teachers, and informal educators. The ERC will recruit educators from the Eastern Panhandle of WV and near-by Maryland and Virginia to attend a MMS training held at Paw Paw Schools soon after the full-scale model is completed. The model will then move to the NASA IV&V Facility in Fairmont, WV where it will be on display and a second workshop drawing from North/Central WV will be conducted at the ERC. Finally, the model will be moved to the Clay Center for the Arts and Sciences in Charleston, WV where a third educator workshop will be conducted drawing educators from the southern part of the state. All presentation materials, handouts, material lists, etc. will be documented and provided to Troy Cline (MMS Education Lead) for inclusion on the MMS education web-portal to empower other ERC’s and NASA education specialists across the agency to lead workshops. This outcome will be led by Todd Ensign (NASA IV&V ERC).

**Objective:** To support K-12 students in the presentation of MMS educational materials and space weather forecasting at the annual National Science Teachers Association (NSAT) Meeting in San Antonio, TX, April 12, 2013.

**Outcome:** Troy Cline (NASA, MMS), Todd Ensign (NASA IV&V), Carol Coryea (PPS), and several Paw Paw students have been accepted to deliver a hands-on workshop at the NSTA meeting. This opportunity for national exposure of MMS materials will be supported with some travel support for the students and their teacher. Mrs. Coryea has already secured airfare and hotel accommodations for her and the students, but transportation to and from the airports and meals are necessary to permit them to participate in this workshop.

1. **Identified Need:** Science and technology are critical to the future prosperity and security of the United States and it is essential our economic vitality to produce a scientific and technologically literate electorate. Through this project, K-12 educators, students, and the public will engage with a range of STEM activities that highlight the importance of both the MMS mission and the relevance of the study of Earth’s magnetosphere.
2. **Intended Audience and rationale:** The full-scale model educational materials will be designed for the K-12 community with the goal of inspiring the next generation to pursue careers in STEM fields and continue to expand our understanding of the universe around us.
3. **Diversity:** This project will be hosted in West Virginia, lightly populated and intensely rural state with many counties of populations under 5,000. In such counties, local high schools routinely graduate fewer than 50 students per year, opportunities for advanced classes in mathematics and science are rare, and statewide only 16 percent of students who enter WV high schools complete any type of post-secondary education. Participation in this project has the potential to increase the proportion of first-generation college graduates pursuing degrees in the STEM fields.
4. **Linkages (portfolio element and linkage to the mission science and/or technology component):** This project will link to NASA Education through the portal, MMS E/PO website, and will receive national distribution through the NASA Educator Resource Center Network the NSTA presentation. The full-scale model will be on display for tens of thousands of visitors annually at the Clay Center.
5. **Pipeline:** The youth members of MARS who participate in FIRST and related projects such as this one will graduate high school and enter college in a STEM discipline at three to four times the national rate. Paw Paw students will gain invaluable insight and experience in the construction of the MMS full-scale model.
6. **Dissemination:** The materials developed through this project will be disseminated through the MMS website, social networking, ERC’s across the nation, and at the Clay Center.
7. **Responsibilities:** Paw Paw schools will be responsible for the delivery of the full-scale MMS model, but guidance for this component will be provided by Dr. Earl Scime and MARS students and mentors involved in the LEGO model project. Todd Ensign and NASA IV&V will be responsible for delivering the 3 educator workshops and will serve as the led for the NSTA presentation. The MMS E/PO Mission Lead, Troy Cline, will provide content and MMS mission point of conact.
8. **Timeline:** Paw Paw schools will complete the full-scale model by June 1, 2013. Teachers workshops will occur in the summer of 2013 in Paw Paw, in the fall of 2013 at the NASA IV&V Facility (in concert with the move of the full-scale model to NASA), and the spring of 2014 at The Clay Center (in concert with the move to the Clay Center).

### iBook Teacher’s Companion to the NASA MMS Transmedia Book

1. **Overview of Activity with Objectives and Outcomes:** The International Society for Technology in Education (ISTE) seeks to develop a companion to the student MMS Transmedia book (TBook) that is targeted to teachers. The TBook, developed by David Slykhuis and Troy Cline, focuses on experiments that help students understand the foundational scientific principles of the magnetosphere and engineering principles of the MMS satellite design. The companion resource will be a mobile multimedia iBook embedded with self-paced professional development tools, information, and resources for teachers:

**Objective:** To develop and publish a companion iBook that complements the TBook for teachers an instructional guide.

**Outcome:** The iBook will be a digital age teacher’s guide for the TBook that embeds: dynamic, interactive MMS content from NASA’s Space Weather Action network website (pending permission from NASA); lesson and experiment extensions that are aligned to the Next Generation Science Standards and the NETS; and self-paced professional development for teachers seeking to enhance their digital age teaching skills.

**Objective:** To incorporate digital age tools that teachers can use with TBook instruction.

**Outcome:** The tools will permit larger scale collection of data for analysis and allow multiple classrooms from across the globe to simulate a citizen science approach to discovery; leverage social media and web 2.0 tools as a classroom tool for disseminating information and collaborating with others.

ISTE will disseminate this resource widely via member channels, publish in iTunes U, and submit to NASA’s product review process for publication on NASA Education and MMS websites.

1. **Rational and Impact:** The iBook design adds a new just-in-time, multimedia dimension to learning by allowing users to explore tributary information that supplements knowledge and understanding of content. IBook authors create rich learning content embedded with text, audio, and video that is well-suited for complex concepts or demonstrations. ISTE will create a teacher’s companion that leverages the power of iBook technology with the experiential learning activities in the TBook. The companion will provide teacher instructional resources to help students meet the standards. As written, the TBook includes experiment instructions, data collection tables, reflection activities, and QR codes linking to MMS content. The teacher’s companion would develop digital age instructional strategies aligned to (NETS) standards and extension activities with appropriate technology integrated into the activities. ISTE will align the content to the Next Generation Science Standards that are expected to be released in December 2012 and build extensions that align to the NETS for Students.

ISTE will also demonstrate how to modify extension activities for students with various backgrounds and experience. This will broaden the range of student ages suitable for this instruction—making learning activities simpler for younger students and more complex for students who excel at the STEM disciplines.

In addition to the instructional strategies, ISTE will build in self-paced professional development for teachers to develop 21st century teaching skills. ISTE will produce relevant tutorials, reference the use of engaging Web 2.0 tools, integrate multimedia resources, and provide tools and templates that teachers can use in their classroom instruction. One key section of the professional development will be a training series designed to help teachers create digital data collection sites that their students can use for collecting and sharing experiment data. By building their own digital data collection sites, a teacher can have all their students submit data into one database. These students will have access to their own and their student colleagues’ data permitting them to analyze a larger data set, finding trends and outliers, and drawing conclusions. However, the data collection sites do not have to be limited to one class or one teacher. Teachers can design a data collection site that can be shared widely via social networking sites, permitting the collection of even larger sets of data. The digital data collection site allows the potential for a citizen science simulation, whereby a large number of students can work together virtually to analyze and evaluate data, and collaborate on solutions for the TBook design challenges.

As our world gets digitized, data is being generated at an exponential rate. It is increasingly important for students to become skilled in data analysis and be able to represent data in digestible, understandable forms. ISTE has been working with the National Science Foundation to publish teacher resources to help their students understand and practice computational thinking, which includes data collection, data analysis, and data representation. The iBook will include data representation activities for students to create infographics, rich media presentations, videos or other representations of the data and evidence of their learning. The MMS mission will generate an enormous amount of data about space weather and magnetic reconnection. If NASA configures a data stream from the satellites that can be used by K-12 education, students will have access to real-world data to make learning about the magnetosphere relevant and exciting.

ISTE will embed demonstrations on using social media as a classroom tool for collaborating with others and disseminating information within and beyond student projects. The NETS for Students prioritize communication and collaboration as one of six student standards. This component will demonstrate what teachers can do with students to disseminate their projects via social networking sites used by school districts and on key NASA social channels like MMS Facebook page.

1. **Identified Need:** Several trends make this project both essential and timely. Forty-five states have signed on to accept the Common Core Standards in math, English Language Arts, and the next generation science standards. These new standards focus student skills on higher order thinking, including analysis, abstraction, and problem solving. Schools are required to implement the standards by 2014 and districts are looking for resources to help them meet the standards. In addition, the U.S. Department of Education has invested considerable effort to promote STEM education and build students’ skills in the STEM disciplines. Both of these national initiatives are creating a growing need for quality resources that can be used by teachers in the classroom.

Intersecting the need for content is a rapidly increasing use of mobile technologies. Mobile technologies open a wide range of possibilities for teachers to differentiate the learning experience of their students, create authentic learning and assessments, deploy project-based field learning, and much more. Mobile learning is quickly joining other educational technologies to increase student engagement. According to Apple, it sold 1 million iPads to K-12 and higher education institutions from April to June 2012 alone (7/25/12, Campus Technology). If mobile starts to dominate K-12 education, schools and districts will need to provide professional development for their teachers to deploy mobile learning and have resources designed for mobile learning.

IBook technology was released in January 2012. Developing an iBook with NASA’s content before the 2014 mission would provide a timely digital age resource for teachers who want to access, explore, and experiment with the content in their classrooms in advance of the launch. The iBook will blend professional development for teachers and tools they can use with their students to extend the content and experiments published in the TBook.

1. **Intended Audience:** The most relevant audience for the iBook is educators who are using the NASA MMS TBook, as a companion resource for extending student learning. However, ISTE does not want to limit the iBook to only those teachers using the TBook, in schools that have access to 2-D and 3-D fabricators (e.g. AutoDesk, Google SketchUp, Blender, etc.). Through the iBook, ISTE will transfer the understanding and skills embedded in the design challenges to activities that can be done without the fabricators allowing for any math, science, engineering, and computer science teacher to use the iBook to apply their content to authentic, digital age learning activities. The iBook will also serve as a model of how science teachers can convert their own lab or inquiry activities to build their students’ NETS skills.
2. **Diversity:** This project will develop a resource that will be promoted through various ISTE channels to reach a diversity of educators around the world including 20,000 individual members, 80,000+ affiliate members, and non-members looking for high quality STEM resources that are aligned to the NETS. Each month, more than 50,000 individuals visit NETS web pages and download the standards and NETS resources for use in their classrooms, for technology planning, and for school improvement plans.
3. **Linkages:** After going through NASA’s review system, this resource will be promoted via NASA Education, MMS E/PO website, and will be nationally distributed through the NASA Educator Resource Center Network.
4. **Pipeline:** As a teacher companion resource to the TBook, ISTE’s iBook will reinforce the scientific and engineering learning concepts set out in the TBook, as well demonstrate and teach how educators can use technology effectively in designing and deploying digital age instruction and facilitate higher order student learning. ISTE’s iBook will be a high quality educational artifact to build knowledge and skills, especially among science teachers, to reach students and increase their engagement in STEM disciplines.
5. **Dissemination:** Our goal is to promote the iBook through a wide array of digital media venues. In advance of a NASA review, ISTE will make the iBook available on iTunes U and promote it through a number of ISTE’s channels, including ISTE’s Learning & Leading member magazine, ISTE Update (ISTE’s online newsletter), at the 2013 ISTE conference, and through ISTE’s social media sites. ISTE will submit the iBook through NASA’s review process during the summer submission cycle. Through the social networking training series, ISTE will also encourage and promote teachers to have their students blog, comment on, or post information about their projects on school, NASA, and relevant social networking sites and channels, like Twitter. While not directly promoting the iBook, students will heighten awareness of MMS content and the mission, as well as their own discoveries through use of the TBook.
6. **Responsibilities:** ISTE and NASA MMS will be responsible for working together with MMS E/PO Mission Lead, Troy Cline, to ensure that the iBook content accurately reflects NASA key messages and scientific information. In addition, ISTE will seek permission from NASA to embed multimedia from the Space Weather Action Center and from its website resources into the iBook. The ISTE project team will design, develop, and build the iBook for the summer 2013 product review cycle. ISTE team members include: Carolyn Sykora (ISTE), Ben Smith (Red Lion Area High School Physics Teacher, EdTechInnovators consultant), Jared Mader (Director of Technology for the Red Lion Area School District, EdTechInnovators consultant)
7. **Evaluation: Analysis of products for accuracy and contribution to MMS content objectives. Collection of data on field testing by product developers. NASA Product Review process.**
8. **Timeline:**

* **Content development based on the TBook: October through December, 2012**
* **IBook development and design: January through March 2013**
* **Dissemination: March through June 2013**
* **Submission into NASA review process: June 2013**

### LEGO Models and Education Resources

1. **Overview of Activity with Objectives and Outcomes:** To engage the K-12 community and the public with the MMS mission, the NASA Independent Verification and Validation (IV&V) Educator Resource Center (ERC) and the Morgantown (WV) Area RoboticS (MARS) organization will develop a number of E/PO products, including multiple Lego models of the spacecraft, an educator guide, and a poster, and they will provide input to Space Math activities (See Section 5.1.12). The goal is to inspire students to pursue careers in STEM fields. The NASA IV&V ERC has been designing and delivering STEM activities for K-12 educators for over a decade and will provide guidance and expertise to the developers of the educational products.

**Objective:** To design two scaled Lego models of the MMS satellite

**Outcome:** MARS members will design a low-cost (below $35) model using a minimal number of parts and difficulty to be used with the educator guide and poster. A larger and more accurate second model will be designed and built by the team, with the plans submitted to Lego for possible boxing and distribution at a target cost <100. This outcome will be led by MARS directors Dr. Earl Scime and Phillip Tucker.

**Objective:** To develop an educator guide to accompany the models and engage the K-12 community in the study of Earth’s magnetosphere

**Outcome:** The guide will include directions to produce the models and activities in the areas of spatial skills, earth science, and math. It is anticipated that this product will contain at least 3 lessons, be 10-20 pages in length, and will be submitted for NASA Education Product Review. This outcome will be led by Dr. Margorie Darrah.

**Objective:** To develop a series of Space Math activities based on MMS science

**Outcome:** Dr. Majorie Darrah, associate professor of mathematics at West Virginia University (WVU), will work with the Space Math project PI, Dr. Sten Odenwald, to assist him in developing authentic mathematic problems that MMS scientists and engineers face.

**Objective:** To develop a new MMS Boomark/Activity connecting the models, educator guide, and Space Math activities

**Outcome:** Todd Ensign, NASA IV&V ERC Program Manager, will work with the MMS E/PO Mission Lead, Troy Cline, and Graphics Designer, Sterling Spangler, to produce an educational bookmark/activity that has the appearance of an engineering technical drawing. It will encourage students to create a paper MMS mobile that could be displayed in classrooms, and it will include text and links to additional activities including the new guide, paper model and Space Math activities.

1. **Rational and Impact:** “Youth engineering design challenges are sweeping formal and informal education worldwide. Just one of these events, the First Lego League (FLL) expects over 200,000 9-16 year olds from over 55 countries to participate in this year’s completion alone. NASA’s MMS project will capitalize on this inertia by developing Lego models of the spacecraft along with supporting educational activities and related Space Math problems. The impact of this project begins with approximately a dozen middle – college age students who will design the models under the guidance of research physicists, robotic and engineering experts, and NASA education specialists. The models will be provided for free to approximately 100 educators who will be trained by the NASA IV&V Educator Resource Center (ERC) in workshops conducted across the state of West Virginia who have the potential to implement the materials and use the models with up to 1,000 K-12 students.
2. **Identified Need:**  This project will provide hands-on materials for immediate classroom use with an emphasis on engineering and math.
3. **Intended Audience:** K-12 community. The educators guide will targeted middle school teachers with extensions into the high school level.
4. **Diversity:** This project will be hosted in West Virginia, an intensely rural state. Local high schools routinely graduate <50 students per year, opportunities for advanced classes in math and science are rare, and only 16 percent of students who enter WV high schools complete any type of post-secondary education. Participation in this project has the potential to increase the proportion of first-generation college graduates pursuing STEM degrees.
5. **Linkages:** K-12 educators and students will engage in STEM activities that highlight the importance of both the MMS mission and the relevance of the study of Earth’s magnetosphere. Activities developed for this project will specifically emphasize the connection between engineering and mathematics. All activities will be hosted on the MMS website with additional links to the growing gallery of images of MMS instruments and spacecraft construction.
6. **Pipeline:** MARS is non-profit organization committed to advancing STEM education in Appalachia by mentoring 5th grade-undergraduate youth in FIRST (For Inspiration and Recognition of Science and Technology) robotics programs. The youth members of MARS who participate in FIRST and related projects such as this one will graduate high school and enter college in a STEM discipline at three to four times the national rate.
7. **Dissemination:** The LEGO instructions, educators’ Guide and Space Math activities will be promoted on the MMS Website, Sun-Earth Day website, Space Math website, Lego website, NASA Edge programs and social networks and ERC’s across the nation. Additionally, the IV&V ERC will make instructor training available to all ERC’s in the nationwide ERC Network and the model directions will be published on the Lego website with kits available for purchase by the public.”
8. **Responsibilities:** MARS and the NASA IV&V ERC will deliver the educational materials to the MMS team and assist in submission to the NASA Education Product Review process. The MARS student team will receive technical support from MARS Project Coordinator, Dr. Scime, who is a leading heliophysicist with significant experience analyzing NASA magnetospheric satellite data. The curriculum and math content expert is Dr. Margorie Darrah, an Associate Professor of Mathematics at West Virginia University (WVU) with significant experience in math education projects. Sten Odenwald, Space Math PI, will ensure linkages between the LEGO project and NASA’s Space Math project.
9. **Evaluation: Analysis of products for accuracy and contribution to MMS content objectives. Collection of data on field testing by product developers.**
10. **Timeline:**
11. MARS will deliver the two Lego models by Oct. 1, 2011.
    1. Low res version by October. 1, 2011
    2. High res version by December 1, 2011
12. The educator guide activities will be completed by December 1, 2011.
    1. Draft Guide: October 15t
    2. Teacher Testing: November 15t
    3. Final Product (ready for print): February 1
13. The Space Math activities will be completed by December. 1, 2011.
14. The STEM Bookmark/Activity will be completed by Sept. 1, 2012.

### MMS E/PO Websites

1. **Overview of Activity with Objectives and Outcomes:** The MMS website and social network will host a growing collection of lesson plans, activities, games, Interactives, podcasts, video clips and social media links, while highlighting the contributions, accomplishments and career paths of mission personnel. As the mission progresses, it is anticipated that current E/PO section of the MMS website will require a web space specifically designed for number of MMS E/PO audiences.

**Objective:** Phase I - To develop and maintain an E/PO section on the existing MMS website

**Outcome:** The E/PO Mission Lead will work with the E/PO Science Lead to coordinate and maintain the E/PO section. Appropriate links to resources on the Rice University website at <http://mms.rice.edu/MMS>

will be included where appropriate.

**Objective:** Phase II - To migrate materials from Phase I into an expanded website, “Magnetic Space”, specifically designed for E/PO audiences

**Outcome:** “Magnetic Space” will be closely linked to the current MMS website but designed to enhance the experience of targeted E/PO audiences. The site will focus on MMS science (magnetism and plasma) and engineering (design and systems).

1. **Rationale and Impact:** E/PO materials included on the MMS E/PO website (Phases I and II) will be designed with the goal of inspiring the next generation to pursue STEM careers. By linking directly to existing NASA websites and programs, the expanding list of MMS E/PO online resources will be available to audiences around the world.
2. **Identified Need:** The MMS E/PO team is required to maintain and create content for MMS NASA websites, coordinate the web page management and graphic design, and ensure that its websites meet usability and other compliance standards. The team must also develop and represent MMS content for non-NASA online informational and social media networks (tools such as Wikipedia, Twitter, Facebook, YouTube, etc.).
3. **Intended Audience:** Activities and programs included on the E/PO section of the (Phase I) website focus primarily on formal education with attention given to public outreach programs. The (Phase II) ‘Magnetic Space’ website will provide and additional focus on audiences that include scientists (interested in E/PO), museums, and community groups (amateur astronomers, Girls Scouts, etc.).
4. **Diversity:** The variety of activities and programs featured on the MMS website leverage some international programs that engage a large diverse pool of students, educators and general public (i.e. Sun-Earth Day, NASA Edge, NASA Space Day, etc.). Many of these stakeholders include education, science, and minority professional societies such as the NSTA, the Association of Science and Technology Centers (ASTC), Challenger Centers, Girl Scouts (GSUSA), AESP, the Astronomical League, the National Society of Black Physicists (NSBP), the Bureau of Indian Education (BIE), and many more.
5. **Linkages:** Links to high-impact websites and programs include: NASA portal, NASA Edge, Sun-Earth Day, Challenger Learning Centers, science centers and museums, and universities (Rice, UC Berkeley, Stanford, WVU, etc.). Links to online resources include the Space Weather Media Viewer, Second Life, ISTE Cyber Café, NSTA Learning Center, etc.
6. **Pipeline:** The majority of these resources target the middle school population but the sites will also provide content for higher level audiences. The development of career-related resources (i.e.vodcasts, Facebook interviews, images) will be linked to materials that support the content of each career being highlighted.
7. **Dissemination:** The MMS website (Phases I and II) will be publicized at all MMS events, workshops and conferences. It will be connected to the NASA portal and other existing high leverage websites including those hosted by Sun-Earth Day, NASA Edge, Goddard Space Flight Center, the International Society for Technology and Educat**i**on, etc. Additional emphasis will be given to social networking components of each program.
8. **Responsibilities:** A GSFC web designer will work with the MMS E/PO Mission Lead and the MMS E/PO team to coordinate content and design for Phases I and II of the MMS website.
9. **Evaluation: Analysis of content and developmental level of website materials. Ongoing web stats.**
10. **Timeline:** 
    1. Phase I: December 2011
    2. Phase II: December 2013

### NSTA Learning Center [in development]

1. **Overview of Activity with Objectives and Outcomes:** NSTA's Learning Center is an e-professional development (PD) portal with growing connections to NASA science. Teachers gain access to more than 5,800 different resources, of which over 1,800 are free. A suite of practical tools such as My Library, My PD Record, and My PD Plan and Portfolio help to organize and document their PD growth. In addition to providing professional development, the Learning Center also has an ongoing infrastructure of forums through which educators share best practices, resource materials, content information, and a variety of other information in a well-developed and moderated environment. The on-demand portal with its rich suite of free tools assists teachers as they diagnose, plan, track, and certify their professional development growth.

**Objective:** To encourage educators to use the LC to create an individualized 'Professional Development Plan & Portfolio (PDP)' that includes an emphasis on MMS science content and related resources.

**Outcome:** Participating educators will create personalized plans that outline their professional development experiences related to MMS science content over a period of time, describing how they will support increased student learning through their increased teacher knowledge and skills. LC allows them to voluntarily upload portfolio materials, such as samples of student work or augmented lesson plans, and generate written reflections that demonstrate and support their growth over time.

**Objective:** To encourage educators to use the LC to generate a personalized library of resources based on MMS science content and related resources.

**Outcome:** Participating educators will use the 'My Library' feature of the LC to organize all of their selected Learning Center and NASA resources including links, activities, lesson plans, etc. Resources can be sorted and further subdivided into smaller personalized libraries (Magnetism, Plasma, Space Weather) that can then be shared with other educator along with personalized annotated notes.

1. **Rationale and Impact:** The Learning Center currently has over 75,000 active accounts using more than 570,000 items, selected from over 6,100 digital assets currently available on the e-PD portal.
2. **Identified Need:** With its variety of online resources and opportunities, the Learning Center provides a proven scalable and sustainable solution to help teachers access high-quality e-PD resources specifically targeted for their individual needs.
3. **Intended Audience:** K-12 science teachers
4. **Diversity**
5. **Linkages**
6. **Pipeline**
7. **Dissemination:** The MMS and GPM missions would work together with NSTA staff to encourage teachers already participating in the LC and in existing NASA programs to participate. Educator participation will be encouraged through the development of social media, podcasts and/or workshops developed by the GPM and MMS E/PO teams.
8. **Responsibilities**
9. **Evaluation**
10. **Timeline**

### Second Life (Phase I completed)

1. **Overview of Activity with Objectives and Outcomes:** NASA Learning Technologies (NLT) will provide content and infrastructure support for the MMS E/PO activities through the virtual world Second Life. The primary education uses of Second Life are for distance learning and professional development. The virtual teaching environment offers a level of participatory engagement with instant peer feedback that promotes learning about heliophysics and the NASA research. The 3D immersion of a virtual teaching world provides a sense of telepresence with other learners and that feeling of being present while remotely located. This promotes a level of shared learning for critical thinking and internalized understanding of an important area of NASA research.

**Objective:** To design a 3D MMS model and E/PO materials at the Second Life NASA eEducation island

**Outcome:** The NLT team will work with the MMS E/PO Lead to map current MMS education resources to virtual 3D objects and representations within Second Life : 3D models, exhibits, real-world education materials. In addition the NASA EDGE (NE) Team will produce a short MMS video segment from within the virtual world. This video segment will be shared on the MMS website and social media venues: YouTube, Facebook, Twitter. This will enable participants not familiar with the Second Life environment to take advantage of key VR resources.

**Objective:** To provide real-time streaming of MMS events into Second Life as agreed upon with the MMS E/PO lead

**Outcome:**  The NLT team will work with the MMS mission E/PO lead to ensure that key ‘live’ MMS events are streamed into the Second Life environment. When appropriate, MMS scientists, engineers and educators will be invited to speak from within Second Life. All necessary technical assistance to ensure a positive experience for each speaker and all participants will be provided.

1. **Rationale and Impact:** This is a natural extension of the network of educators that participate in MMS, Sun-Earth Day and Space Weather Action Center activities. Additionally, there are extensive networks of educators currently resident in Second Life including professional organizations such as ISTE and hundreds of accredited education institutions that will be invited to participate. 300 universities around the world teach courses or conduct research in SL and new institutions have emerged that operate exclusively within Second Life to deliver distance learning content to a worldwide audience at low cost. NASA currently hosts 6 islands in Second Life. MMS will be placed on the eEducation Island that currently receives over 500 visitors per month.
2. **Identified Need:** Science and technology are critical to the future prosperity and security of the United States and it is essential our economic vitality to produce a scientific and technologically literate electorate. Through this project, K-12 educators and students will engage with a range of STEM activities that highlight the importance of both the MMS mission and the relevance of the study of Earth’s magnetosphere. The flexible nature of the building and multimedia tools available makes Second Life a natural environment for hands-on learning and collaboration. The development of MMS education resources will have a significant impact on the science and teaching community as experienced through Second Life.
3. **Intended Audience:** Second Life is used as a professional development platform for education by many institutions, universities, libraries and government entities. Instructors and researchers in Second Life use virtual worlds because it is more personal than traditional distance learning. The online resources, interactive objects, simulations and visualizations are available 24/7. Continued access to materials is critical for educators to successfully enhance student performance therefore the infrastructure and resources created for MMS will remain available to all educators.
4. **Diversity**: The LT team possesses unique knowledge in the development of non-traditional interfaces to make math and science more accessible to those with disabilities, having developed several STEM applications for the blind and visually-impaired [references here]. For this reason, the LT team is tasked with doing research on the accessibility of virtual worlds and is committed to making NASA’s virtual world projects as accessible as possible.
5. **Linkages:** This project will link to MMS education resources through the MMS E/PO website, social media venues and will receive national recognition through the NASA Educator Resource Center Network.
6. **Pipeline** This project will promote STEM careers and access to NASA employment opportunities by using speakers who join professional development activities as avatars or through multimedia and mixed media broadcast speaking engagements. The educator’s newfound excitement and knowledge will find its way into a classroom with greater enthusiasm and confidence and will inspire students to want to learn more about STEM related topics.
7. **Dissemination:** The virtual world component of MMS will join other examples of sustainable NASA education assets at the NASA eEducation island in Second Life associated with heliophysics including SDO, ACE and SOHO and the upcoming Magnetospheric Multiscale Mission (MMS). Dedicated social media tools including the new MMS Cyber Café will disseminate and sustain critical knowledge regarding space weather, heliophysics and science. The NASA Edge team will produce video segments associated with heliophysics from within the virtual world with our collaborator NASA EDGE (NE). Additional 5 minute ‘How to Participate’ segments will be produced and shared on the MMS, SED and NASA Edge websites, YouTube, Facebook and Twitter accounts.
8. **Responsibilities:** NASA Learning Technologies (NLT) will be responsible for delivering the educational materials to the MMS team and assisting in their submission to the NASA product review process.
9. **Evaluation:** Analysis of what is offered, what MMS content is presented. Web stats for visitors to SL.
10. **Timeline:** NLT will deliver 3D models of the four MMS spacecraft by Sept. 1, 2011.The connected speaker series schedule and associated activities will be completed by October 1, 2011.

### Social Media

1. **Overview of Activity with Objectives and Outcomes:** NASA projects and activities are required to “draw from audiences that have demonstrated interest in NASA and connect participants to the next level of engagement.” Ongoing communication between Heliophysics scientists, educators and the general public is greatly enhanced through a growing social network (Facebook, Twitter, YouTube, Flickr, blogs, Pinterest, Instagram, etc.).These networks excel at user interaction and communication, providing the perfect framework for continual feedback and ideas. It also provides a venue for real-time updates on space weather, sunspots, aurora, E/PO events and missions. Developing and integrating MMS information into these networks will strengthen the relationship we have with our existing community and greatly broaden the reach of our E/PO program. Guidelines about the latest trends, how to participate, tips and tricks, etc. will be developed to assist MMS team members in providing consistent and effective interactions.

**Objective:** To promote a highly interactive and vibrant social media community during all phases of mission development.

**Outcome:** The team will develop, maintain and moderate an MMS presence in social media applications.

**Objective:** To develop a social media plan and a set of social media guidelines (based on current NASA social media guidelines) for MMS personnel interacting directly with the public.

**Outcome:** The plan and guidelines will assist standardize all varieties of social media interactions between MMS personnel and the public. Guidelines and tips will be developed and shared with MMS personnel through monthly emails, internal blog posts, face-to-face interactions, ‘Social Media Brush-ups’, etc.

1. **Rationale and Impact:** According to the report ‘Digital IQ Index: Public Sector’, “NASA has pioneered efforts on every platform, demonstrating that the agency’s innovation orientation extends well beyond its space program. Its technology-rich site attracts over three million unique visitors per month, and the organization boasts more than 600,000 Twitter followers and 150,000 Facebook fans, confirming the power of strong content.” These interactions will be uniquely beneficial to MMS. They open the very real possibility of accumulating similarly large numbers of followers that the team can still interact with individually, increasing public support for the mission.
2. **Identified Need:** Many people would like to participate in social media but feel that they don’t have time to learn or aren’t sure how they could participate. MMS would offer a series of social media guidelines to quickly inform MMS personnel about the latest trends, how to participate, tips and tricks, etc.
3. **Intended Audience:** General public
4. **Diversity:** The MMS social media campaign will foster and support the development of a diverse community of learners. MMS will connect and foster the growing community of diverse learners already engaged through successful social networks that include the SDO mission, Sun-Earth Day, NASA Edge, etc. A new online resources called, ‘The Faces of MMS’, consisting of an ongoing series of brief interviews about MMS personnel will be featured on Facebook, the MMS website and the Space Weather Media Viewer. This series will highlight accomplishments, influences and backgrounds of our diverse MMS community.
5. **Linkages:** Social media also provides a variety of ways by which MMS can communicate with the public by asking questions, sharing information, providing/receive feedback, etc. MMS moderators will foster discussions, comments and questions based on all aspects of the MMS E/PO program. Social media ‘share’ buttons will be installed on all MMS web pages, allowing MMS and the public to instantly share online resources including mission highlights, new educational resources, press releases, images, etc.
6. **Pipeline:** An emphasis will be given to the new career-based resources included in various programs described in this plan -- see ‘MMS Website’s Faces of MMS’, ‘Space Weather Media Viewer’ , ‘Space Weather Action Center’ career clips, and ‘Video Podcasting Program’.
7. **Dissemination:** MMS will connect directly to NASA’s existing social media presence and to successful social media networks maintained by NASA Edge, the SDO mission, and Sun-Earth Day.
8. **Responsibilities:** The E/PO Mission Lead will work with the E/PO team to maintain and moderate all MMS social media sites. The lead will also work closely with the growing list of social media experts within the SEPOF community.
9. **Evaluation:** Analysis of social media efforts in terms of concepts addressed and users/usage.
10. **Timeline:**
11. Development of Facebook, Twitter, YouTube accounts (2011)
12. Development of Pinterest accounts (2012)
13. Development of social media plan (2013)

### Space Math

1. **Overview of Activity with Objectives and Outcomes: For MMS,** the successful Space Math @ NASA program will explicitly show the interconnections between MMS science and engineering topics and math concepts, at the pre-algebra level through to grades 8 and beyond. The program will develop a collection of math resources and individual problems that feature MMS science and engineering concepts. MMS will also utilize existing Space Math resource books on space weather and magnetism developed in conjunction with other missions (IMAGE, SOHO, Hinode) but complement MMS science.

**Objective:** To develop a series of Space Math activities based on the science of the MMS mission

**Outcome:** Space Math will develop problems that cover concepts in vector math, for which MMS is a perfect exemplar. The MMS constellation of spacecraft will be measuring a number of vector quantities during the course of its mission. These will include the constellation state vector (location of four satellites in 3-D space) as well as the components of the various electric and magnetic fields within the measuring volume of the constellation. A Vector Math guide will also be developed to provide additional examples using actual MMS data.

**Objective:** To develop a new MMS poster connecting spacecraft models, educator guide and Space Math activities.

**Outcome:** We will develop math extensions for the MMS Transmedia Book and iBook, which complement the construction of a mobile based upon spacecraft blueprints. This will be a significant engineering-math application project that capitalizes on the MMS constellation’s unique geometric attributes.

**Outcome**: Dr. Majorie Darrah(an Associate Professor of Mathematics at West Virginia University) will work with the Space Math PI to assist him in developing authentic mathematic problems that MMS scientists and engineers face. (see ‘LEGO Robotics Team’ description)

**Outcome:**  Todd Ensign, NASA IV&V Educator Resource Center (ERC) Program Manager, will work with the MMS E/PO Lead to produce a Bookmark/Activity that has the appearance of an engineering technical drawing. It will encourage students to create a paper MMS mobile for classroom display and include text and links to additional activities, including the new Lego guide (see Section 5.1.6), MMS paper model and Space Math activities.

1. **Rationale and Impact:** Space Math resources achieved its three millionth download of individual math problems and problem books early in 2011. Annual teacher surveys indicate that the resources have achieved a broad impact among students in participating schools, and that the number of individual monthly users continues to grow at a rate of 5% per month. Its resources are being used across NASA missions as an enhancement that provides much-needed math content, which continues to be in high demand by participating teachers.
2. **Identified Need: Space Math Leverages NASA science mission EPO efforts by providing math enrichments to a variety of mission press releases and EPO products. Partnerships with all of the major SMD missions allows the project to develop math problems that fill a major need among middle and high school teachers and students; 'real-world' examples of how mathematics is employed in the process of exploration and discovery at NASA.**
3. **Intended Audience: Grades 8 through** high school
4. **Diversity:** Space Math has a commitment to diversity outreach by partnering with a number of Case Study schools in urban settings, which have demographics drawn from traditionally underserved student populations. Case Study schools are specific schools that are partnering with Space Math to create math-enrichments for their students on a more formal, programmatic, basis. These schools provide specific feedback about Space Math problems related to students performance and level of interest.
5. **Linkages:** The materials produces through Space Math will be directly linked to efforts in other NASA programs such as NASA Edge and Sun-Earth Day. Users will have a ‘hands-on’ way to learn about the MMS spacecraft while being linked to online resources that will enable them to ‘follow the build’.
6. **Pipeline:** Although NASA E/PO has traditionally provided math resources for pre-algebra students, to insure that students remain in the NASA career pipeline through high school, new resources must be offered that demonstrate how advanced math, algebra and trigonometry are employed in science and engineering applications.
7. **Dissemination:** Materials will be disseminated through the MMS and Space Math websites, social networking, and ERCs across the nation.
8. **Responsibilities:** Sten Odenwald (Space Math PI) will be responsible for delivering the Space Math educational materials and assisting in their submission to the NASA product review process.
9. **Evaluation: Analysis of products for which MMS concepts and audiences they address (internal and external). Field test data collected if available from developers. Number of products created and distributed to what audiences.**
10. **Timeline:**
11. Space Math activities will be completed by Nov. 1, 2011
12. Up to two additional Space Math Activities per year

### Space Weather Action Center

1. **Overview of Activity with Objectives and Outcomes:** This program encourages students to design, assemble and use an 'easy to make' learning center called a Space Weather Action Centers (SWAC) .These centers provide a focused environment where students can monitor and report the progress of a solar storm. As part of the SWAC setup, each center includes one computer with internet access to current and archived NASA data. Student flip charts offer 'Step by Step' instructions needed to quickly retrieve and transfer data to specified data collection sheets. Additional directions are provided to help students transform all of the newly acquired information into regularly scheduled news reports. Ultimately these brief reports can be presented through variety of accessible media including inexpensive video editing software and/or already existing school-based broadcast studios.

**Objective:** To develop a series of sample news scripts that students can use to create SWAC News Reports specific to MMS.

**Outcome:** Prior to the launch of MMS, the MMS E/PO Lead will work with the SWAC team to develop a series of sample news scripts that will focus on the key MMS related topics including: science, engineering, instrumentation, the people of MMS (scientists, engineers, graphic artists, and educators), etc.

1. **Rational and Impact:** The SWAC program allows users to gain a deeper understanding of the interrelated story of heliophysics and how each mission plays a significant part. By integrating MMS content into the SWAC program, users will understand ‘why’ MMS is so important to our understanding of space weather and its effects. SWAC educator guides and resources currently receive over 2000 new downloads each month. Through a recent NASA SMD ROSES grant, the Challenger Learning Centers (CLC) program integrated SWAC into four mission simulations. By placing MMS content in the SWAC program, we will be able to leverage CLCs work with over 6,000 schools in 30 states.
2. **Identified Need:** Research verifies that educators want training in the use of technology, they need data for classroom analysis and they desire to stay current in their subject area to ensure that students meet their required academic levels. The SWAC program helps teachers to meet this need.
3. **Intended Audience:** Middle and school teachers and students
4. **Diversity:** Easily accessed educational multi- media technologies are geared to increase participation and to engage under-served groups. By following the guidelines and resources SWAC responds to the needs of a diverse education community with a tailored education program that will effectively integrate the use of digital video, audio, and graphic technologies into curriculum and learning activities. Participants are also encouraged to construct tactile displays, listen to radio wave files and develop their own multimedia presentations.
5. **Linkages:** The Space Weather Media Viewer is the primary tool used in the SWAC program. MMS will contribute to the viewer by adding a STEM careers section. Video highlights and transcripts from the viewer can be used in student news reports. Additional information about the mission will be obtained from the MMS website.
6. **Pipeline:** SWAC is developed to provide multiple entry points, ranging from very simple to challenging. Students begin at an entry level that is appropriate for their cognitive ability and can progress to the use of more difficult data once they understand the analysis of the entry data. Students will be encouraged to write SWAC news reports about MMS STEM related content. Links will be provided to the MMS website where they will also have access to MMS related careers in STEM, graphic design and support.
7. **Dissemination:**  The SWAC program continues to grow in popularity among educators. It has appeared on NASA TV and NASA Edge programs and is consistently featured on a variety of NASA websites and heliophysics educational programs. It is fully integrated into the Challenger Learning Center program and is the main education program that supports NASA’s Space Weather Media Viewer and app.
8. **Responsibilities:** Troy Cline (MMS E/PO Mission Lead) will work closely with members of the SWAC team to ensure that MMS is represented on the SWAC website and multimedia tools.
9. **Evaluation:** Analysis of SWAC integration (internal and external). Field test with existing SWAC users. Web stats.
10. **Timeline:** MMS will be integrated into the SWAC program by Dec 2013

### Space Weather Media Viewer and Mobile App

1. **Overview of Activity with Objectives and Outcomes:** The Space Weather Media Viewer (and mobile app) is an application built to support Education and Public Outreach activities of NASA. Many of the images that appear in this viewer are "near-real time" and come from a variety of NASA Missions. Near real time data and additional resources are designed in the Space Weather Media Viewer (SWMV) as a single place of access. This online tool and supporting app has full-screen capabilities and broadcast quality video and provides ‘one stop shopping’ for the latest mission data, visualizations, scientist interviews and data tutorials. The SWMV can provide a quick look at the sun as it is today. SWMV was developed through funding from NASA HQ Education office, mission support (Ulysses, Voyager, Themis, RHESSI, SOHO, STEREO, Hinode, ACE) and Sun Earth-Day.

**Objective:** To bring NASA Heliophysics data into a classroom to gain interest in heliophysics, and provide an interest level that maintains students’ involvement in STEM careers.

**Outcome:** The NASA Edge team will work with the MMS E/PO lead to create a series of 8 (2-3 min) video clips that will be used in the development of a new ‘STEM Careers’ section of the SWMV and mobile app. Videos will include interviews with MMS scientists, engineers, educators and support personnel. Additional career-based interviews will appear on the MMS website and social media venues.

**Objective:** To promote the science and engineering goals of the MMS mission while encouraging the public to ‘follow the mission’. Links back to the MMS website would be included where users would find additional ‘Career based’ videos and written interviews (Faces of MMS).

**Outcome:** MMS will work with the developers of the SWMV and mobile app to include the latest MMS animations, visualizations and images.

1. **Rationale and Impact:**  Science and technology are critical to the future prosperity and security of the United States and it is essential our economic vitality to produce a scientific and technologically literate electorate. Through this project, K-12 educators and students will engage with a range of STEM activities that highlight the importance of both the MMS mission and the relevance of the study of Earth’s magnetosphere. The online viewer receives over 50,000 views per month while the mobile app receives over 1000 downloads per day. Between January and March of 2011, the resources in the viewer received well over 2 million views.
2. **Identified Need:** The SWMV and mobile app were developed to address the following needs: (a) Get young people interested in NASA space science content in particular the system-science of Heliophysics. (b) Improve STEM literacy, knowledge, and skills. (c) In conjunction with other resources, provide opportunities for K-12 students with authentic NASA mission activities; and (d) Communicate information to public about NASA mission activities.
3. **Intended Audience:** Used in conjunction with the Space Weather Action Center (http://sunearthday.nasa.gov/swac), teachers use mobile devices such as the iPhone, iTouch and Droid to view NASA data. Since these devices are portable, they can be used in conjunction with other hands on and outdoor activities such as sunspot viewing.As “stand alone” iPhone and Google Android applications, the formal and informal audiences can easily view near real-time and other data sets from NASA Missions.
4. **Diversity:** Through the SWMV and mobile App, MMS will automatically be featured though international programs that engage a large diverse pool of students, educators and general public. Many of these stakeholders include education, science, and minority professional societies such as the National Science Teachers Association (NSTA), the Association of Science and Technology Centers (ASTC), Challenger Centers, Girl Scouts of America (GSUSA), Aerospace Education Services Project (AESP), the Astronomical League, the National Society of Black Physicists (NSBP), the Bureau of Indian Education (BIE), and many more.
5. **Linkages:** MMS will support the development of a new ‘Careers’ section the SWMV tool. This new section will feature MMS personnel in the areas of STEM, graphic design and support. It will include links to the appropriate sections of the MMS website.
6. **Pipeline:** The SWMV and mobile app provides a new and compelling method for K-12 students and educators to access information about NASA missions and NASA datasets. It provides a compelling way to get young people interested in NASA space science content in particular the system-science of Heliophysics. MMS will provide an additional component to the tool that will focus on the 'people of the Mission', their careers and career advice.
7. **Dissemination:** This tool will receive national recognition through the NASA Educator Resource Center Network, the Challenger Center Network, the Sun-Earth Day program, the Space Weather Action Center and NASA Portal. It is currently recognized by Boing Boing as one of the Top 5 IOS Apps for Space and Astronomy.
8. **Responsibilities:** Jim Spadaccini (Director of IDEUM and Developer of the SWMV tool), Troy Cline (MMS E/PO Mission Lead and Co Producer of the SWMV tool), Elaine Lewis (Sun-Earth Day Lead and Co Producer of the SWMV tool)
9. **Evaluation:** Analysis of additions for MMS concepts addressed. Web stats.
10. **Timeline:** MMS will be integrated into the SWMV tool by Dec 2013

### Sun-Earth Day

1. **Overview of Activity with Objectives and Outcomes:** Sun-Earth Day (SED) continues to be an award-winning, high-impact, mission-first program that has been uniquely successful in keeping heliophysics topics, and its supporting missions, constantly in the public eye. This program, funded through support by NASA's Heliophysics missions and EPOESS grants, coordinates scientific and educational resources of NASA’s heliophysics missions to tell a compelling and coherent story of the processes and phenomena that cover nearly all aspects of the system-wide interconnections within the heliosphere. This program provides missions with the opportunity to engage millions of students, teachers and the general public, both nationally and world-wide. The program and website is updated every September with new resources. Through the 20,000 registered educators, and education offices of NASA field centers, the SED program continues to have a positive impact on millions of students. For over 10 years SED has reached audiences in the millions worldwide. In 2012 it is anticipated that the Sun-Earth Day webcast will reach an audience of over 50 million. With that in mind, MMS will be featured in the Sun-Earth Day webcast as one of NASA’s newest missions.

MMS will work with the SED program to achieve the following Objective and Outcomes:

**Objective:** To work with SED team to include MMS materials and resources in existing high impact SED E/PO efforts:

**Outcome:** Highlight MMS science and engineering topics and careers in SED events, live shows, webcasts, etc.

**Outcome:** Develop 6 MMS focused audio podcasts per year

**Outcome:** Include 20,000 MMS Posters and/or bookmarks in the annual SED teacher resource packet

**Outcome:** Leverage SED’s Facebook, Twitter, and YouTube accounts. Participate in SED Tweetups!

**Outcome:** Work with SED team to include MMS content in Technology Through Time articles, image Gallery, video Gallery, and links.

1. **Rational and Impact:** SED has enabled multiple points of access to and usage of NASA heliophysics resources. The yearly themes allow broad mission participation to address NASA’s science questions of solar variation, the planetary systems’ response, and human impacts. The program components tell an integrated story of heliophysics system science through the people, data, and discoveries from multiple missions. Currently, SED’s registered impact extends to a rapidly growing list of 12,900 educators, 3,669 museums, 9,000 astronomers, and 2,300 scientists. The web-based resources, webcasts and vodcasts have been accessed over 200 million times since SED began in 1999.
2. **Identified Need:** The SED program was developed in response to a need for a highly leveraged education framework to help the heliophysics missions tell their integrated and cross discipline stories to students, teachers, and the public. SED’s strategy has been to identify annual themes that have an intrinsic interest to the general public. They then bring the theme and the issues to the public using media that appeal to various segments of the intended audiences.
3. **Intended Audience:** K-12 Educators and students, science centers, museums, amateur astronomers, scientists, community groups, general public
4. **Diversity:** Sun-Earth Day capitalizes on the connections already made with the varied communities of enthusiastic teachers and students that make up its inherently diverse audience. To aid in expanding its reach, SED continues in forming strategic partnerships with organizations that can help shape and promote outreach to diverse audiences. These connections create inroads for forming better partnerships within these communities and tailoring more effective SED programs for underserved populations.
5. **Linkages:** The Sun-Earth Day program has allowed multiple points of access to and usage of NASA heliophysics resources. Since 2000 Sun-Earth Day has inspired millions, engaging the general public with public programs, empowering educators in K-12 schools and museums, who in turn educate many students in STEM with NASA online and printed resources.
6. **Pipeline:** Educators who participate in SED gain knowledge of and confidence in teaching Heliophysics. The program continues to provide online and onsite training to students and teachers with heliophysics system science. Each year SED distributes more than 20,000 packets of NASA approved products developed by missions. Many science centers, museums, planetaria, scouts, astronomy clubs, and out-of-school-time groups have already taken the ideas and timing of Sun-Earth Day to run their own programs. By establishing SED Event Centers and SED Event Classrooms, SED gains a deeper understanding of how educators use heliophysics resources within their programs to establish a STEM literate community.
7. **Dissemination:** The annual Teacher Resource Packet, distributed to 20,000 teachers and other audiences each year, supports the dissemination of high-quality mission resources, and provides a theme-based 'wrapper' for a diverse collection of science topics. Museums and science centers have begun to create independent programs coordinated with SED but capable of sustained long-term action w/o SED help. SED resources and experts are used, year-round by NASA Centers especially during summer teacher workshops (e.g. Heliophysics Ambassadors, AESP).
8. **Responsibilities:**
   1. Ms. Elaine Lewis is Lead for the Sun-Earth Day program. She has extensive experience in teaching and curriculum development. She will serve as the general coordinator for all activities related to the application of Sun-Earth Day events.
   2. Mr. Troy Cline is the E/PO Lead for the MMS mission. He also works closely with the SED team to oversee development of online content for social networking, Sun-Earth Day website content, and audio podcasts.
   3. Other members of the SED team include: Ms. Carolyn Ng (informal co lead), Dr. Sten Odenwald (science writer), Mr. Bryan Stephenson (web programmer and media specialist), Mr. Lou Mayo (science writer and Amateur Astronomy co lead).
9. **Evaluation:** Analysis of products for what MMS concepts are addressed for what audiences. Tracking of production and distribution.
10. **Timeline**: The following activities will occur annully.
    1. **April-August:** Make appropriate content connections between MMS and SED resources, gather MMS related stats from SED stats, work with SED team to include MMS in new SED resources (website, flyer, activities), finalize new website content and connections to MMS
    2. **September- December:** Announce new theme and website through SED, MMS and other NASA networks, work with SED Team to plan main event in March, send MMS materials for inclusion in SED packet, packet dissemination, finalize plans for main SED event/webcast/vodcast.
    3. **January-March:** Continue social media campaign and connections to MMS resources; participate in SED main event (webcast, social media, vodcasts, etc.)

### Video Podcasting Program - NASA EDGE

1. **Overview of Activity with Objectives and Outcomes:** NASA EDGE is an unscripted, non-traditional video podcast or vodcast designed to highlight all things NASA in a unique and fun way. Built in the framework of sports talk radio (i.e. Mike and Mike in the Morning - ESPN Radio), NASA EDGE has generated a positive buzz for NASA in a way in which young teens and adults can relate.

**Objective:** To develop a series of NASA EDGE vodcast segments (2 per year)

**Outcome:** Each NASA EDGE individual vodcast segment will focus on a particular component of the MMS mission. For example, one segment will focus on the science instruments and another will focus on the engineering design of the MMS satellite.

**Objective:** To develop an introductory NASA EDGE vodcast (FY2011)

**Outcome:** (23:30) The introductory vodcast will provide a basic understanding of the MMS mission including the MMS goals and objectives.

**Objective:** To develop a NASA EDGE Live webcast at the launch of MMS (FY2014)

**Outcome:** (60:00) NASA EDGE will conduct a live webcast from the MMS launch facility. The hour-long webcast will provide the latest updates on MMS up to launch. MMS subject matter experts will join the NASA EDGE Hosts live on set.

**Objective:** To develop a series of 'Book End' and/or Career-based 5min video clips for YouTube and website (5 per year)

**Outcome:** The NASA EDGE team will produce a series of 5min MMs career-based video clips and/or short introductions and conclusions to a series of MMS videos provided by the MMS E/PO Mission Lead. Each series will appear on the MMS YouTube channel and website.

1. **Rationale and Impact:** The NASA Edge strategy is to inspire the public with multimedia approaches with topics that have an intrinsic interest to the general public. By using a combination of funny, offbeat and informative sketches, features and interviews, the NASA EDGE team created a show that reaches a much broader online audience, surpassing an incredible 18 million downloads since May 7, 2011. MMS was featured on a NASA Edge vodcast in March 2011 that received over 300,000 downloads over a 3 month period.
2. **Identified Need:** Through video podcasting MSS will be able to appeal to various segments of our intended audiences with the latest MMS developments, issues and E/PO resources.
3. **Intended Audience:** NASA EDGE has a diverse audience ranging from young students to senior citizens. The NASA EDGE outreach program is a great medium through which the general public and students can learn about the MMS mission. The show reaches an online audience surpassing 18 million downloads since May 7, 2011.
4. **Diversity:** Video podcasting has a demonstrable impact on attracting diverse populations to careers in STEM. Each vodcast will highlight that impact that our diverse MMS family has on the success of the mission.
5. **Linkages:** MMS and NASA content for the NASA Edge vodcasts is identified in the objectives and outcomes above. This project will link to NASA Education through the portal, MMS E/PO website, and will receive national distribution through the NASA EDGE network (website, iTunes, Roku and other social media outlets).
6. **Pipeline:** A series of short ‘career based’ video podcasts will be produced that will draw attention to the pipeline of opportunities from which MMS can recruit youth, educators and the public, and to which those who participate in MMS activities can follow up to learn more. A supporting resource called ‘Faces of MMS’ will be place on Facebook where users can gain more information either before or after viewing the vodcasts.
7. **Dissemination:** The materials developed through this project will be disseminated through the NASA portal, MMS website, NASA EDGE website, iTunes, Roku and other social media outlets.
8. **Responsibilities:** NASA EDGE will be responsible for delivering the educational materials to the MMS team.
9. **Evaluation:** Analysis of the products for MMS concepts addressed. Tracking of production, distribution and use.
10. **Timeline:** NASA EDGE will deliver a series of MMS vodcasts consisting of the following: 1 Introductory NASA EDGE vodcast by Dec 2011, 6 NE@Segments by Dec 2014 (1-2 per year), 1 NE Live show by Dec 2014, 20 ‘Book End’ and/or career-based vodcasts by Dec 2014 (5 per year).

## Detailed Description of Science Payload E/PO Activities

The content of this section can be found in the Education and Public Outreach (E/PO) Plan for MMS (GSFC MIS Document 461-PROJ-PLAN-0108). We can integrate this content here with the present Mission level plan and format, or add it as an Appendix to this document, as agreed upon during review.

# Management Structure

The E/PO team is headed by Troy Cline of Goddard Space Flight Center and Professor Patricia Reiff of Rice University.

**Troy Cline** is the E/PO Mission Lead for the Magnetospheric Multiscale Mission (MMS). He is responsible for mission level public outreach activities and coordination of overall EPO efforts. His responsibilities include planning, coordinating, implementing, and managing the MMS mission’s outreach activities to meet NASA’s EPO goals and guidelines. He has a Master’s degree in Educational Technology and Leadership with an extensive background in educational technology, curriculum design, cross-cultural classroom instruction, project management and award-winning NASA E/PO projects. His additional experience includes social networking, podcast development, graphic design, product development, workshop coordination, and public speaking.

**Pat Reiff** is the E/PO Science Lead and has a track record of over 20 years of funded E/PO activities and was named the “Athelstan Spilhaus” winner by the American Geophysical Union for her lifetime achievements in public education.

The team is comprised of the leads of each of the individual E/PO components (described below).

Organization Chart: In development

## Team members:

**E/PO Team (GSFC):**

Troy Cline (E/PO Mission Lead), GSFC

Thomas E. Moore, MMS Project Scientist

Guan Le, MMS Deputy Project Scientist

Mark Adrian, MMS Deputy Project Scientist

Beth Barbier, GSFC, MMS E/PO Advisor

**Partners:**

Sten Odenwald, GSFC (Space Math; press liaison)

Rita Karl, Challenger Learning Centers

Louis Mayo, After School Astronomy Clubs

Elaine Lewis, Sun-Earth Day

Kelli Harrington, ISTE

**E/PO Team (SwRI, Rice, UNH)**

Patricia Reiff (E/PO Science Lead), Rice University

Colin Law (Associate Lead, programming and web design), Rice University

Roy Torbert, University of New Hampshire (SMART program)

Bill Lewis (MMS Web design), Southwest Research Institute

Dan Boice (YES program)

Jim Allan, Texas School for the Blind and Visually Impaired (Space Camp for the Blind)

**SwRI Advisory Committee :**

* Mark Moldwin, University of Michigan, Head
* Carolyn Sumners, Houston Museum of Natural Science
* Emily CoBabe-Amman, LASP, University of Colorado
* Louis Maher, Exxon (Retired), materials for vision impaired

# Evaluation Plan

## Design and Methods

The evaluation is designed to support education and public outreach by establishing criteria for successful activities, monitoring the fidelity of the implementation to the plans, and providing feedback (formative component). The summative evaluation examines the extent to which, and conditions under which the objectives are met. It is informed by the formative evaluation, and is also used to report to funders and other stakeholders (SMD E/PO lead). The evaluation will use a mixed methods approach in which quantitative and qualitative data are collected (Frechtling, 2010). In this kind of project, it is important to collect data on resources, access, participants, conditions of use and effects on the knowledge, attitudes, skills and aspirations of those engaged (Rockwell and Bennett, 2004).

## Evaluation by Objective

In this section, we describe the evaluation methods for the planned activities by objective for Education (first section) and Outreach (second section)/

|  |  |  |
| --- | --- | --- |
| Objective | Activity | Evaluation |
| Education | | |
| Engage middle and high school students in learning MMS science and instrumentation | • **Lego Models of the Spacecraft with Educator’s Guide**  • **Space Math Activities**  • **Model/Mobile STEM Poster**  • **Space Weather Action Center**  • Young Engineers and Scientists (YES) at SWRI  • SMART at UNH | Develop criteria for experiences  Analysis of planned experiences for attention to the criteria and MMS content  Identify characteristics of students including GPA, demographics, prior NASA experience…  End of experience survey for students on changes in their knowledge, attitudes, skills and aspirations, and their satisfaction with the program |
| Develop an interest level in MMS that encourages and maintains students’ involvement in STEM careers | Space Weather Media Viewer and Mobile App(@GSFC) MMS additions:  •Graphical data (post launch)  •Illustrations (science and engineering content)  •Visualizations (MMS animations)  •Videos (MMS career interviews, mission clips)  (SWAC/MMS Collaboration/Partnership) | Field test with students – effects on student interest, knowledge and attitudes about careers |
| Educate in-service and pre-service teachers (face to face) in MMS science | • Space Weather Action Center Program and Workshops  • MMS contributions to the MAGNETOSPERE section of the Space Weather Action Center  • Master of Science Teaching at Rice University courses Teaching Earth and Space Science, and Physics of Ham Radio.  • Heliophysics Ambassador program for master teachers  • Workshops at conferences. N=800/year  • Teacher professional development  • Educator guides and resources | Attendance  End of event surveys  Follow on activities of participants in other MMS or heliophysics activities such as facebook, other events…  Establish criteria for developing products based on best practices. Product review |
| Educate in-service and pre-service teachers (virtually) in MMS science | • NSTA Learning Center (@GSFC) (NSTA/MMS Collaboration)  • Second Life (@GSFC): activities include: MMS Events, NASA EDGE (NE) Vodcast,  Collaboration with existing SL partners such as museums, universities, astronomers, etc, 3D interactive Models, Learning Station,  Cyber Café | Track participation over time  Focus groups of SL participants  End of event surveys |
| Provide access to MMS data to diverse audiences that contribute to the involvement, broad understanding, and/or training of underserved and/or underutilized groups | • Space Weather Action Center  • Direct student participation in NASA science missions  • Tools that enable students to analyze science mission data  • Space Camp for the Blind at US Space Camp in Huntsville, AL 2012-16.  • Learning about MMS from data sonifications and games. Available for downloading | Develop criteria for resources, access and preparation  Apply criteria to implementation  Track number of participants and downloads  Obtain feedback from participants on engagement with the resources, and effects on their knowledge |
| Public Outreach | | |
| Develop resources to be distributed physically or virtually | • Space Weather CD-ROM created annually and sent out through Sun-Earth Day 2009=25,000  • Print and EPO Materials  • Audio podcasts  • Create sonifications for datasets Post on website for download like: <http://space.rice.edu/MMS> | Develop three sets of criteria for the content and format for: 1) the CD-ROM, 2) the audio podcasts and 3) the sonifications  NASA Product review for all three  Results of advertising the resources such as inquiries from Heliophysics Ambassadors (2009=40 inquiries), inquiries from e-Teacher list (N=3500)  Webstats on visitors and downloads |
| Provide access to resources on the Web | Web pages At GSFC and SWRI: for spacecraft & instrumentation info: education activities, podcasts, vodcasts  Wikipedia entry  Interactive Web presence | Develop criteria for MMS participation  Analyze site based on criteria and best practices  NASA Product review  Web stats (goal is >100,000 unique visitors and >50 MB downloaded), along with tracking specific downloads |
| Engage the public with MMS information through social media and virtual environments | • Social Media: to engage the public with MMS science (Facebook, Twitter, YouTube, etc.)  • Second Life: to engage the public with MMS science and engineering.(speaker series, 3D spacecraft modeling, education walk-throughs, etc. | Develop criteria for use of social media and Second Life presence  Track participation, redirects and referrals  Observe events, activities and participation in Second Life |
| Develop and provide visual representations for MMS science and instrumentation | Animations for museums \* Video Podcasting Program (@GSFC)  \*Visualizations developed through GSFC Office of Communications.  \* Planetarium show, also distributed to Discovery Dome users (75) and International Planetarium Society and regional planetarium groups such as SEPA (SouthEast Planetarium Association) and SWAP (Southwest Association of Planetariums) | Develop criteria for animations and planetarium show  Internal and external review based on criteria  NASA Product review  Document distribution, showings and attendance  Survey attendees at shows on what they learned and if they want to know more |
| Develop and provide audio media resources available on the internet | Audio Podcasting Program (@GSFC, Questions from listeners answered by MMS representatives, Career Stories, MMS Press Releases and articles, E/PO updates: media, programs, activities, events, etc. | Develop criteria for audio podcasts  Review random sample of podcasts  Analysis of sample questions from listeners |
| Engage youth and adults in learning about MMS science | • NASA After School Astronomy Club (ASAC) program  • Citizen-scientist opportunities  •Support public outreach events (i.e. Explore@NASA Goddard, Goddard Tweetups, World Science Festivals, etc.)  • Sally Ride festival at Rice U  • ‘News Writers’ Workshops:. | Develop criteria for events  Review plan, observe  End of experience surveys  Document contributions  Collect articles from news writers |

|  |  |  |
| --- | --- | --- |
| MMS Personnel Development Activity Objectives | | |
| Objective | Activity | Activity |
| Provide and/or promote, learning opportunities for MMS personnel interested in E/PO related to Social Media, classroom involvement and media outreach opportunities | • ‘One on One’ training (Face to face, Skype, etc.)  • SEPOF: (Heliophysics and Astrophysics Forums) -Professional Development Sessions for all SMD E/PO community members about Social Media  •’Tips and Tricks’ via monthly email, website, and/or MMS NING updates.  • Monthly email, website, and/or MMS NING updates.  • Social Media ‘Brush-up’ – Monthly Brown-bag talks on social media trends, ideas and how to participate. | Document attendance at activities, individual support and follow up activities by participants  Annual survey of MMS personnel on PD |
| Promote, provide and encourage sharing and dissemination of MMS E/PO outreach information and opportunities | •Weekly GSFC team tag-up meetings  •Monthly MMS E/PO team telecons | Document meeting topics, attendance and follow up |
| Promote, provide and encourage sharing and dissemination of E/PO information from other Heliophysics missions. | •Monthly SEPOF forum telecons, activities and PD opportunities  •Heliophysics Online Workspace | Document MMS team participation in Forum activities and partnerships with other missions |

## Evaluation Timeline:

The evaluation will closely follow the project timeline, moving from establishing criteria with each group, to internal and external evaluation, to field testing, tracking of production, distribution and use. All workshops and presentations will use the OEPM end of event surveys for teachers and/or students.

## Timeline

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Activities @GSFC** | **FY11** | | | | **FY12** | | | | **FY13** | | | |
| **Q1** | **Q2** | **Q3** | **Q4** | **Q1** | **Q2** | **Q3** | **Q4** | **Q1** | **Q2** | **Q3** | **Q4** |
| **Afterschool Astronomy Clubs** |  |  |  |  |  |  | x | x | x | x | x | x |
| **Audio Podcasting Program** |  |  |  |  |  |  |  |  | x | x | x | x |
| **Challenger Learning Centers** |  |  |  |  | x | x | x | x | x | x | x | x |
| **Cyber Café - ISTE** |  |  | x | x |  |  |  |  |  |  | x | x |
| **Full-Scale Student Model** |  |  |  |  |  |  |  |  | x | x | x | x |
| **Heliospheric Ambassadors** |  |  | x | x | x | x | x | x | x | x | x | x |
| **iBook (Transmedia Companion)** |  |  |  |  |  |  |  |  | x | x | x | x |
| **LEGO Robotics Team** |  |  |  | x | x | x | x | x | x | x | x | x |
| **MMS Website : Phase I** | x | x | x | x | x | x | x | x | x |  |  |  |
| **MMS Website: Phase II** |  |  |  |  |  |  |  |  |  | x | x | x |
| **NSTA Learning Center** |  |  |  |  |  |  |  |  | x | x | x | x |
| **Second Life** |  |  | x | x | x | x | x | x | x | x | x | x |
| **Social Media** | x | x | x | x | x | x | x | x | x | x | x | x |
| **Space Math** |  |  | x | x | x | x | x | x | x | x | x | x |
| **Space Weather Action Center** |  |  |  |  |  |  |  |  | x | x | x | x |
| **Space Weather Media Viewer Update** |  |  |  |  |  |  |  |  |  |  | x | x |
| **Space Weather Media Viewer Mobile App Update** |  |  |  |  |  |  |  |  |  | x |  |  |
| **Transmedia Book (digital fabrication)** |  |  |  |  |  | x | x | x |  |  |  |  |
| **Sun-Earth Day** | x | x | x | x | x | x | x | x | x | x | x | x |
| **Video Podcasting Program** |  |  |  | x | x | x | x | x | x | x | x | x |
| **Integrate Engineering Goals, Objectives and concept map into MMS E/PO Plan** |  |  |  |  |  |  |  |  |  | x | x | x |
| **Heliophysics Concept Map (development)** |  |  | x | x | x |  |  |  |  |  |  |  |

# Budget

(See Excel Spreadsheet)

# Acronyms: (TBD)

|  |  |
| --- | --- |
| **Abbreviation/ Acronym** | **DEFINITION** |
| AAAS | American Association for the Advancement of Science |
| AESP | Aerospace Education Specialist Program |
| ASAC | After School Astronomy Clubs |
| ASTC | Association of Science and Technology Centers |
| BIE | Bureau of Indian Education |
| CBA | Community Based Astronomy |
| CCSSE | Challenger Center for Space Science Education |
| CLC | Challenger Learning Centers |
| E/PO | Education and Public Outreach |
| ERC | Educator Resource Center |
| FLL | First Lego League |
| FIRST | For Inspiration and Recognition of Science and Technology |
| GEMS | Great Explorations in Math and Science |
| GPM | Global Precipitation Measurement |
| GSUSA | Girl Scouts |
| GSFC | Goddard Space Flight Center |
| ISTE | International Society for Technology in Education |
| IV&V | NASA Independent Verification and Validation |
| K-12 | Kindergarten through twelfth grade |
| LASP | Laboratory for Atmospheric and Space Physics |
| MARS | Morgantown Area RoboticS |
| MMS | Magnetospheric Multiscale Mission |
| NE | NASA Edge |
| NLT | NASA Learning Technologies |
| NSBP | National Society of Black Physicists |
| NETS | National Educational Technology Standards |
| NSES | National Science Education Standards |
| NSTA | National Science Teachers Association |
| PD | Professional Development |
| PLN | Professional Learning Network |
| ROSES | Research Opportunities in Space and Earth Sciences |
| SCIVIS | Space Camp for Interested Visually Impaired Students |
| SDO | Solar Dynamic Observatory |
| SED | Sun-Earth Day |
| SEPA | SouthEast Planetarium Association |
| SEPOF | Science Education and Public Outreach Forums |
| SL | Second Life |
| SMART | Solving Magnetospheric Acceleration, Reconnection, and Turbulence |
| SMD | Science Mission Directorate |
| SOHO | Solar and Heliospheric Observatory |
| STEM | Science, Technology, Engineering, Mathematics |
| SWAC | Space Weather Action Center |
| SWAP | Southwest Association of Planetariums |
| SWMV | Space Weather Media Viewer |
| SwRI | Southwest Research Institute |
| UNH | University of New Hampshire |
| VR | Virtual Reality |
| WVU | West Virginia University |
| YES | Young Engineers and Scientists |

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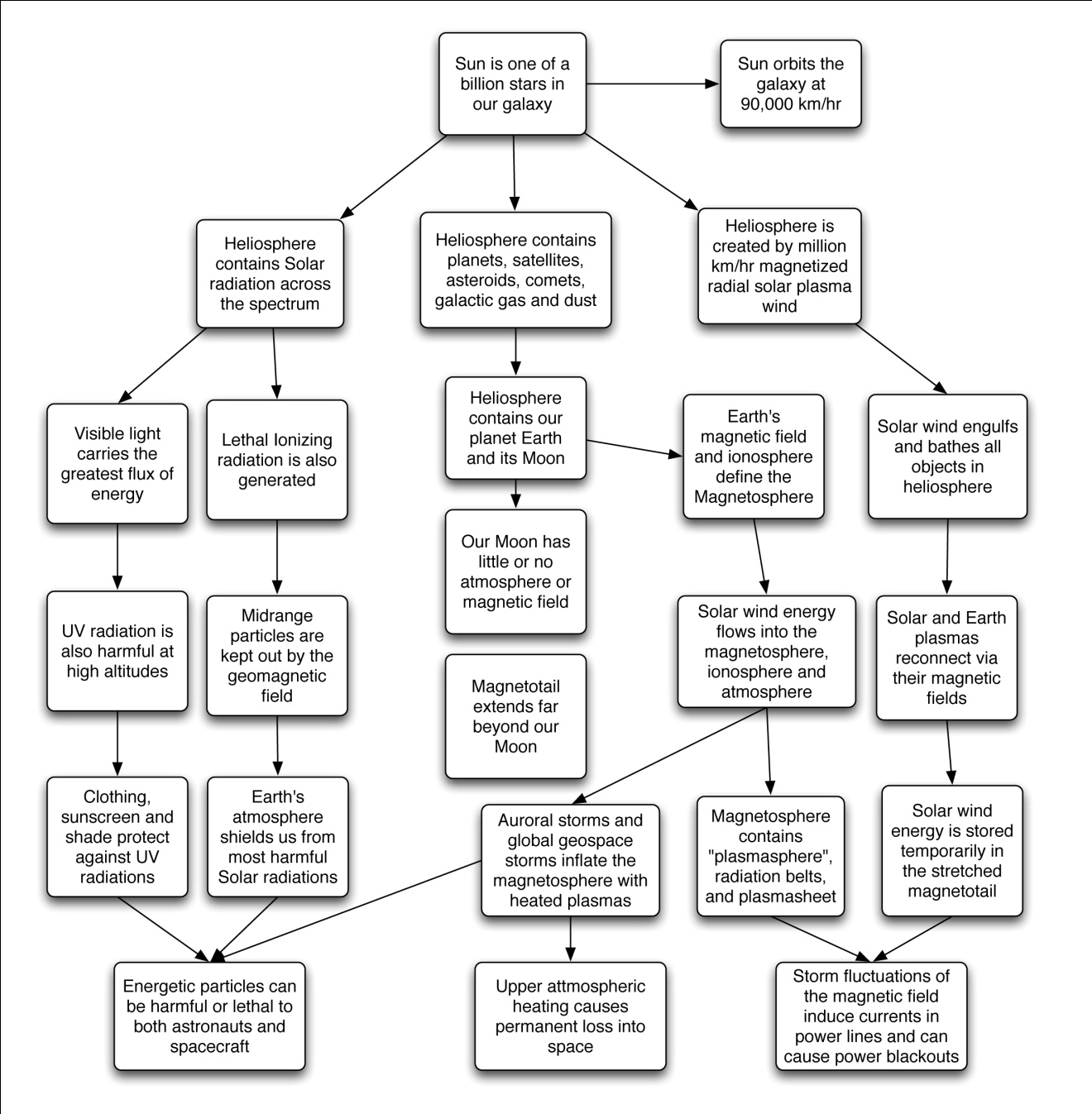
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# APPENDIX A: MMS Science Concept Map (DRAFT)



# APPENDIX B: MMS E/PO Logic Model

