

# NEW ENGLAND SPACE SCIENCE INITIATIVE IN EDUCATION (NESSIE)

## Annual Report for FY2006 (October 2005 – September 2006)

### EXECUTIVE SUMMARY:

Since its inception in 2002, the New England Space Science Initiative in Education (NESSIE) has been serving the educational needs and interests of space scientists, educators, students, and the scientifically-curious public. By “fostering partnerships in cosmic discovery,” we have brokered and facilitated a wide range of educational programs. Highlights for this year included the *Pioneers in Space* public panel discussion on the past, present, and future of space exploration; the *Lowell Lectures in Astronomy* on NASA’s Vision for Space Exploration; podcasts, videocasts, and television broadcasts on the latest news in space science; the ninth *Project ASTRO Boston* workshop for partnering scientists and educators; the sixth *Exceptional Needs Workshop* for educators and education product developers; the second park-based *Community Cosmos* workshop for community educators; the first two *Excellence in Teaching Introductory Astronomy* workshops for college faculty in New England; continuing professional development workshops on pre-service teacher preparation and the involvement of scientists in E/PO -- at meetings of the AAS, ASP, and the NASA E/PO Support Network; seminar courses on *Space Science Education* and *Space Science & Technology* for college students; the first *Northeast Ballooning Workshop* for MS, HS, and college students; and the first *New England Summit on Earth and Space Science Education* for K-14 teachers, informal educators, and E/PO professionals. We continue to be leaders in space science education research, with new publications that synthesize what has been learned in this vital field. Our website at <http://www.mos.org/nessie> has become a popular “watering hole” for our key constituencies. As NASA re-focuses on the educational pipeline to “inspire, engage, educate, and employ,” we are poised to provide key services towards these ends.

### INTRODUCTION

The New England Space Science Initiative in Education (NESSIE) is one of seven regional broker/facilitators within the NASA’s Support Network in Space Science Education and Public Outreach (E/PO). NESSIE is charged with initiating and catalyzing collaborations among space scientists and educators within both the formal and informal education communities. In essence, NESSIE “fosters partnerships in cosmic discovery.” Its region of operation spans the six New England states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. NESSIE itself is a collaboration among space scientists and educators at the Museum of Science, Boston, Harvard-Smithsonian Center for Astrophysics, and Tufts University. Its office is located at the Museum of Science, Boston. NESSIE can be accessed in the following ways ...

Internet: <http://www.mos.org/nessie>,  
E-mail: [nessie@mos.org](mailto:nessie@mos.org),  
Telephone number (617) 589-0227,  
Postal mail: NESSIE, Museum of Science, Science Park, Boston, MA 02114-1099.

#### NESSIE PERSONNEL:

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## CONTRIBUTING TO THE EDUCATION PIPELINE:

During the past year, the NASA Office of Space Science merged with the Office of Earth Science to form the Science Mission Directorate (SMD). The SMD consists of 4 science divisions – Earth Science, Heliophysics, Planetary Science, and Astrophysics. Parallel with this transition, attention was re-focused on the educational programs throughout NASA and how they could be improved in quality and coherence. The resulting *NASA Education Strategic Coordination Framework* outlines a portfolio approach to education and public outreach that is consistent with NASA’s critical goal of ensuring a highly educated and well-prepared workforce. A key purpose of this framework is to develop a balanced education portfolio which promotes and integrates the progression to “inspire, engage, educate, and employ.” In the spirit of this progression, we summarize below our programmatic activities in space science E/PO as they fit into the education pipeline.

### *TO INSPIRE:*

The first steps along the education pipeline often occur in the classroom under the tutelage of a skilled and inspiring teacher. However, many other inspirational experiences can take place outside of school – in public museums and planetaria, at star parties, club events and other public venues, and through books, magazine articles, television shows and other media.

NESSIE has been on the vanguard of facilitating these “informal” inspirational experiences. This November, we hosted *Pioneers of Space* – a public panel discussion that featured veterans of the American and former Soviet space programs. Discussions by these pioneers ranged from the pre-Sputnik era, through the Gemini/Apollo era, to the Space Shuttle, International Space Station and beyond. Opinions of the panelists and assessments of the audience indicated strong interests in international cooperation and in advancing science as the major motivator for future policy. The entire discussion is available on streaming video at <http://www.mos.org/nessie/pioneersofspace>, along with a full report that describes the assessment results.

In April-May, we co-hosted with the Charles Hayden Planetarium this year’s *Lowell Lectures in Astronomy*. The theme for this year was NASA’s Vision for Space Exploration. Neil de Grasse Tyson (AMNH, Princeton) and Jonathan McDowell (CfA, Sky & Telescope) kicked things off with a conversation on the “Vision” that has humans going back to the Moon, onto Mars, and beyond. Jeff Hoffman (MIT, MASGC) followed with a presentation on the technological strategies that are being considered for realizing this ambitious Vision. Jim Bell (Cornell) concluded the lecture series, presenting “Postcards from Mars” that featured stunning views from the Mars Exploration Rovers (Spirit and Opportunity). Webcasts of these lectures are available through WGBH at <http://forum.wgbh.org/wgbh/>.

Throughout the year, space scientists and their discoveries were featured in presentations and interviews that were communicated live from the Current Science & Technology Center in the Museum of Science, or via CS&T podcasts, videocasts, and television

broadcasts. Arrangements between the CS&T Center and New England Cable News (NECN) has enabled features on space science to be communicated to television audiences. Many of these multi-media pieces are available at <http://www.mos.org/cst>.

NESSIE facilitated other forms of community outreach as participants of National Astronomy Day in May, Space Day in June, *Family ASTRO* events in November and December, and various meetings of regional astronomy clubs. These sorts of events, along with other publicly accessible experiential opportunities at observatories, planetaria, and astronomy clubs are listed on the NESSIE website at <http://www.mos.org/nessie>.

#### *TO ENGAGE:*

Much of NESSIE's efforts are aimed at partnering space scientists with educators, with the aim of enabling mutually beneficial programs in space science education. Towards these ends, we work closely with the scientists and educators, both separately and together. Our outreach efforts can take the form of brokering and facilitating professional development workshops, linking individual educators with space scientists, and consulting with space scientists on E/PO proposals.

For the past two years, we have published quarterly e-newsletters that are written for the benefit of space scientists with interests in E/PO. As of this August, the *Folio of Information for New England Space Scientists in Education (FINESSE)* is up to issue #8. This e-newsletter is distributed by e-mail to approximately 500 members of the American Astronomical Society and other space scientists in New England. It is also available online at the NESSIE website <http://www.mos.org/nessie>.

We have also helped to carry out targeted workshops for space scientists – under the auspices of the Scientist Communication and Involvement Working Group (SCIWG) and on our own. Highlights for this year were SCIWG-run workshops at the January and June meetings of the AAS, a workshop for Chandra scientists (with the SEU Education Forum) on ways of modeling the universe, and a workshop for CfA scientists that involved learning to use a StarLab planetarium as part of one's E/PO program. The SCIWG website can be accessed at <http://www.sciwg.org/>, and its website for interested scientists is available at <http://www.scientistsineducation.org>.

Through *Project ASTRO*, we are in close contact with both scientists and educators. The *Project ASTRO* workshops are especially valuable, as they co-train the scientists and educators to work together in the classroom – where they implement standards-based learner-centered activities that make full use of NASA education materials. This highly successful model has engaged dozens of scientists and hundreds of teachers throughout the Greater Boston Area, Rhode Island and southern New Hampshire. Both *Project ASTRO Boston* and *Family ASTRO* can be accessed on the NESSIE website <http://www.mos.org/nessie> under its extensive listings of programs and resources for educators.

We have also engaged educators in targeted ways. In December, we brokered and facilitated a workshop for elementary science teachers, curriculum developers, and administrators that was held at Wheelock College. The key outcome of this workshop was a better understanding of the partnerships that are necessary to implement true reform in elementary and middle-school science education. We also partnered with the New England Space Grant Consortia to conduct workshops for NASA Explorer School teachers. These partnerships have led to closer relations with the participating Space Grant Consortia and the Explorer Schools.

For the second summer, we co-hosted *Community Cosmos* – a park-based educator enrichment program that engages school, scout, park, and other community educators in exploring life on Earth, the Earth in space, and our cosmic origins. The 3-day workshop occurred again at Halibut Point State Park in Rockport, MA, where there is ready access to 450 million-year-old rocks, teeming tide pools, and dark night skies. This year, the workshop featured a keynote talk by Samuel Kounaves (Tufts) on the search for life on Mars and the Phoenix mission for which he has developed a chemical wetlab. The *Community Cosmos* program has been featured in a local newspaper article, talks at the AGU, AAS, and this September, in a special session on park-based E/PO at the ASP meeting in Baltimore. Although the Spitzer Space Telescope E/PO funding for the program will soon run out, we are looking for other ways to promulgate similar community educator programs at state parks.

The preparation of pre-service science educators has been recognized as one of the key links in the education pipeline. During the past two years, NESSIE has been a strong advocate for understanding the challenges and opportunities in pre-service education, and to move forward with what we have learned. Through the Pre-Service Education Working Group (PSEWG), we have helped to host workshops at meetings of the AAS and ASP, as well as a special “advance” of the PSEWG itself in West Virginia this May. Having allied ourselves with the Association of Science Teacher Educators (ASTE), the PSWG is poised to advance the cause of effective space science education for the next generation of teachers. The website for the PSWG is hosted by the south-central broker/facilitators at <http://www.lpi.usra.edu/education/score/>.

Closer to home, NESSIE has helped to engage faculty at Tufts University in addressing the challenges of science, technology, engineering, and mathematics (STEM) education. We helped to co-found the *Tufts University ESTEEMS Collaboration* (where ESTEEMS = Ecosystem for Science Teaching, Engineering Education, and Mathematics Scholastics). In October, *ESTEEMS* hosted a *Faculty Roundtable on STEM Education*. Besides the obvious networking, the Roundtable enabled an assessment of the challenges and opportunities in advancing STEM education reform at Tufts and beyond. One major finding was the value of engaging students in research as early as possible. The *ESTEEMS* website can be found at <http://www.tuftsesteems.org>. This coming year, we will be working to make the website more dynamic and to foster targeted programs.

We culminated this year’s engagement efforts with the first *New England Summit on Earth and Space Science Education* that occurred September 25 (see

<http://www.mos.org/summit>). Hosted by the Museum of Science, with support from NESSIE and the Massachusetts Space Grant Consortium (MASGC), the Summit provided a means of assessing the needs and interests of the K-12, informal, and community education providers in New England. We also directed the deliberations to yield common messages that can be leveraged to help shape the future of Earth and space science education throughout New England. We are currently digesting the abundant input from this meeting.

#### *TO EDUCATE:*

Although NESSIE is not charged to directly provide educational services to students, it facilitates many workshops for in-service teachers (see above) and fosters academic environments whereby students can interact with space scientists. Through NESSIE co-sponsorship, a seminar course on *Space Science Education* has been offered at Tufts University for the past three years. This pilot course has introduced interested students to space science educators within the formal, informal, and NASA E/PO communities. It has also served as an important model for developing more ambitious pre-service science education curricula through the PSEWG. Another seminar course on *Space Science and Technology* has provided a vital venue for space scientists to interact with students. More important, it has attracted engineering students to the exciting field of space science – causing some of these students to double-major in astrophysics. One outcome is the gainful employment of these graduates by aerospace companies. Beginning this September, we are piloting a seminar course on *Cosmochemistry and Astrobiology* that is intended to feature space and life scientists who are active in this interdisciplinary field, while serving students with multi-disciplinary backgrounds and interests.

One of the most promising means of enabling student-centered inquiry-driven education in space science and technology is through a student ballooning program. This July, NESSIE and the MASGC co-hosted the first *Northeast Scientific Ballooning Workshop* in Rockport, MA. Benefiting from the expertise of balloon science educators from Puerto Rico, New York, and Vermont, students built instrumented payloads, launched them into the stratosphere, tracked their travel out to sea, and recovered them by boat. Middle-school, high-school, and college students were involved in all aspects of the ballooning mission. Stories on this exciting program have appeared in local, school, and university publications (see <http://tuftsjournal.tufts.edu/briefs/index.shtml>). Together with the MASGC, the MARSSB broker/facilitator, and our minority partners at the City University of New York, we are beginning plans to continue this program with another launch in Spring 2007.

#### *TO EMPLOY:*

NESSIE contributes to the education pipeline at this uppermost level by offering summer student internships. To date, we have hosted 7 internships involving 5 students from Tufts University. These students provided valuable support to NESSIE – helping with running workshops and symposia, managing databases and surveys, and assisting with live and media presentations. In turn, the students have gained valuable experiences in

the multi-faceted field of space science education. The 5 students have since gone on to careers as a middle-school science teacher, a STEM education Ph.D. candidate, an optical physicist, an occupational therapy M.S. candidate, and an astrophysics B.S. candidate.

NESSIE also supports the New England Space Grant Consortia in enabling student fellowships in space science and technology. In our first year as a MASGC affiliate, we have helped to realize 3 student fellowships at Tufts University. In the coming year, we expect to leverage opportunities for similar fellowship programs elsewhere in Massachusetts and the rest of New England.

#### ASSESSMENTS:

As our Broker/Facilitator program has matured, we have learned how to assess our efforts without further infusions of funding. With assistance from Sue Cohen and the Leslie/PERG group, we have learned how to implement introductory questionnaires as well as formative and follow-up evaluations of our various professional development programs. We have also grown more comfortable with administering surveys of scientists and educators. Last summer, our Tufts intern Radha Pertaub carried out telephone interviews with scientists who have won E/PO awards and with educators who have obtained professional development through NESSIE. Her write-up of the scientists' responses was communicated to the Scientist Communication and Involvement Working Group (SCIWG) and NASA/HQ, and was used as part of larger surveys by these groups.

Another form of assessment is the education research that Cary Sneider and colleagues have been pursuing. Here, assessment of commonly-held perceptions of the Earth, Moon, Solar System, and Universe can be used to inform the development of future educational programs and products relating to space science. To date, two studies have been published in the *Astronomy Education Review* (and are on the NESSIE website). Publication of third study -- on perceptions of gravity -- is forthcoming.

The NASA EDCATS/NEEIS reporting system provides a more quantitative but less nuanced means for capturing some of our educational impact. Last year, we tallied 15 "active" Activities with 61 Events that involved 100 engagements by scientists, about 200,000 direct participants, and at least this number of electronic participants. This year, we tallied 15 active Activities with 103 Events that involved 126 scientist engagements, about 152,000 direct participants, and at least 200,000 electronic participants. Based on these statistics, our cost effectiveness can be roughly estimated as follows ...

\$1.25 per direct participant (named and anonymous)  
\$2500 per scientist engagement (including only those we directly facilitate)  
\$4100 per event.

\$4200 per publication including the estimated \$30,000 cost of having run the *Cosmos in the Classroom 2004* conference and published the proceedings.

\$2700 per publication without including *Cosmos in the Classroom 2004*.

Many of these publications are online, and so it is difficult to tell how many "indirect" participants are enjoying them. A very rough guess would be about 10,000 to 100,000 readers, yielding the cost of a few cents per reader. All of these publication costs were estimated, having taken into account our staff time.

Of course, some events were considerably more resource intensive than others. Moreover, this sort of cost averaging naively considers the entire NESSIE budget being used for each collection of direct participants, scientist engagements, events, and online readers. As such, these costs are grossly overestimated. Nevertheless, they provide a useful way to compare with other outreach endeavors.

For example, one can compare the cost of production and marketing per audience member for a blockbuster movie. For example, *The Return of the King* cost its producers/marketers \$144M. It grossed \$1.1B, which at \$6/ticket amounts to 183M tickets worldwide. The cost per ticket is then 79 cents. Compare this with the average cost/ticket for all movies in a year. For the year 2003, it was \$21. In other words, there were a lot of money losers out there!  
(see <http://www.boxofficemojo.com/yearly/>).

Where do we fit it? Pretty close to blockbuster status -- with about \$1.25 per direct participant (named and anonymous) according to our crude estimates.

Finally, the Portfolio Activity which we fulfilled this April provides a further look at where our funds were spent. The NESSIE Portfolio (available upon request) confirmed that NESSIE supported a full range of services along the Education Pipeline.

#### PROSPECTUS:

NESSIE will be funded by NASA through June 2007. In our remaining time, we will continue our "yeoman services" of brokering and facilitating educational programs that involve partnerships among scientists and educators. We will also make a concerted effort to archive our activities, with the aim of informing and empowering the Earth and space science E/PO community. Our specific activities will include ...

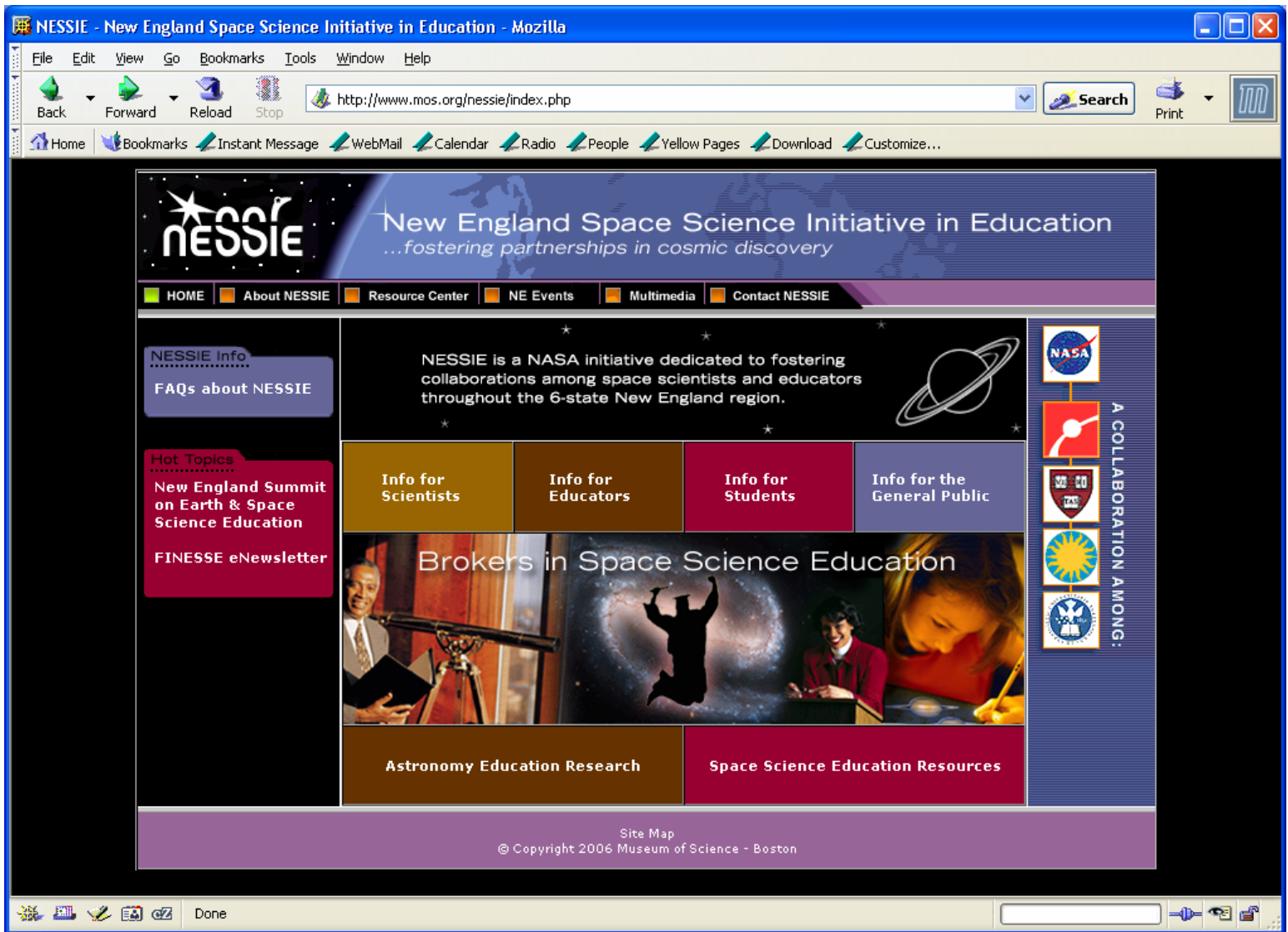
- √ Respond to requests to assist with proposals and partnerships involving educators and NASA scientists and engineers. Such partnerships will continue to include the New England Space Grant Consortia, Explorer Schools, Center for Astronomy Education, Challenger Centers and other informal science education institutions in New England, Project ASTRO and Family ASTRO, ASP, AAS, AGU, working groups within the NASA/SMD E/PO Support Network, and the other forums and brokers in the SN.
- √ Archive effective ways of working that we've developed over the last five years, both as an individual project team and in collaboration with other leaders of the NASA

Space Science E/PO Support Network. The result of this effort will be a collection of papers that will be published as a book of interest to astronomy and space science educators, space scientists interested in E/PO, and administrators of science, health, and technology E/PO programs.

- √ Complete the work of collecting, analyzing, and reporting on the results of educational research with the aim of serving the needs and interests of NASA product developers, teachers, and other educators. The result will be a book submitted to a publisher.
- √ Decommission our website, compile and distribute contact lists and other assets that we've developed or acquired, and which may be useful to others.

In this way, we intend to be useful to the Earth and space science E/PO community well after our funding ends. As NASA re-focuses on the educational pipeline to “inspire, engage, educate, and employ,” we are poised to provide key services towards these ends.

APPENDIX: IMAGES



Home page of the NESSIE website.

NESSIE and the Museum of Science Boston  
present

# PIONEERS OF SPACE

Friday, November 11, 2005  
4:00 PM in Cahners Theater  
Museum of Science Boston

*From Sputnik to the  
International Space Station  
and beyond...*




## Pioneers of Space Panel Discussion

final report

by Karen Spence, Cary Sneider and William Waller  
New England Space Science Initiative in Education (NESSIE)  
Museum of Science, Boston February 15, 2006

Cover of the final report on the *Pioneers of Space* Panel Discussion.



# New England Space Science Initiative in Education

...fostering partnerships in cosmic discovery

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**Sept '05**  
Pioneers of Space Project!

**Ongoing**  
Current NASA Television Education File Schedule


NESSIE

## Astronomy Education Research

The following articles were published through [Astronomy Education Review](#) and are each composed of research studies compiled by NESSIE agents that best represent excellence in space science education.







**Part I - Learning about the Earth's Shape and Gravity: A Guide for Teachers and Curriculum Developers**  
*Lori Agan, Wheaton College; Cary Snieder, Museum of Science, Boston; Volume 2, Sep 2003 - Jan 2004.*  
The scientific model of the Earth in space--consisting of the spherical Earth and gravity concepts--is one of the first models that children encounter in their science classes. Children's understanding of these concepts is essential for further conceptual development in astronomy.  
[Complete article at the Astronomy Education Review website](#)




**Part II - Learning about Phases of the Moon and Eclipses: A Guide for Teachers and Curriculum Developers**  
*Claudine Kavanagh, Tufts University; Lori Agan, Bath Middle School, Bath, Maine; Cary Snieder, Museum of Science, Boston; Volume 4, 2005*  
National Science Education Standards (1996), published by the National Research Council, recommends that students learn to explain Moon phases and eclipses by the time they graduate from eighth grade. It is clear from the research literature, however, that misconceptions about Moon phases and eclipses are widespread and resistant to change, even among adults.  
[Complete article at the Astronomy Education Review website](#)

A COLLABORATION AMONG:
 




**Future articles**



**Part III - The Reasons for the Seasons**  
If you'd like to be notified when *The Reasons for the Seasons* is published, please [contact us](#).

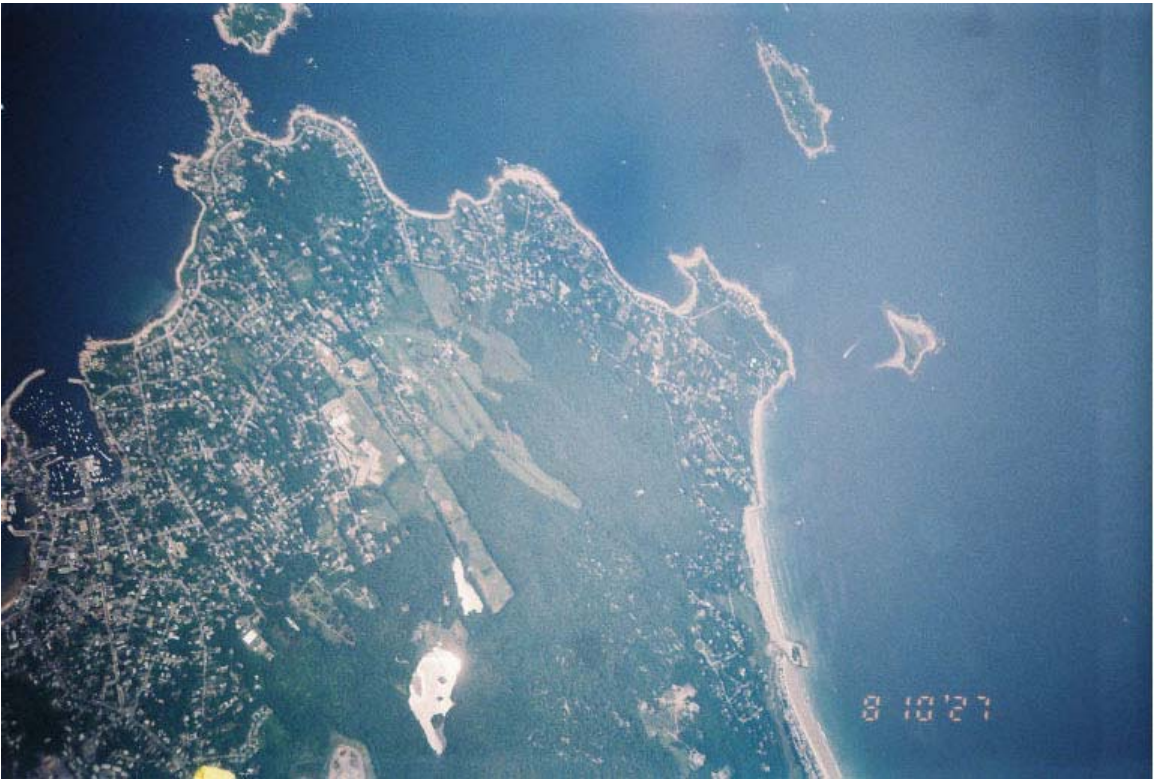


**Part IV - Stars, Galaxies, and the Universe**  
If you'd like to be notified when *Stars, Galaxies, and the Universe* is published, please [contact us](#).

If all subjects are of interest to you, [click here](#) to be notified as each article is published.

Site Map
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NESSIE webpage with links to research articles on space science education.



(Top) Preparations for launch. (Bottom) View of Rockport, MA from camera lofted into the stratosphere by students during the *Northeast Scientific Ballooning Workshop*.

INVITATION TO PARTICIPATE IN

# COMMUNITY COSMOS:

## A Park-Based Educator Enrichment Program in the Earth and Space Sciences



Monday to Wednesday, July 17–19, 2006  
Halibut Point State Park (HPSP) and  
Rockport High School, Rockport, MA  
COST: Your personal travel and lodging.

*Program designed for  
Teachers, Park Interpreters,  
Librarians, Amateur  
Astronomers, Naturalists,  
Scout Leaders, and other  
Community Educators*

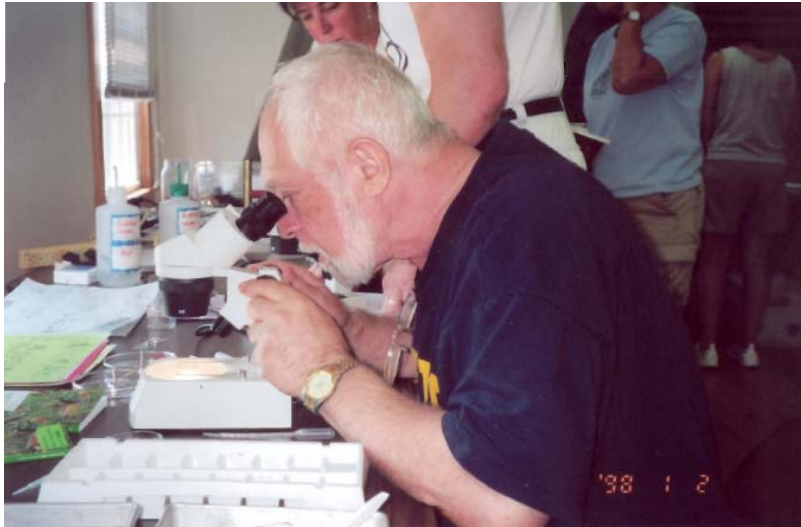


**For more information or to register**  
Contact William H. Waller, Ph.D.  
@ Tufts University  
Email: [william.waller@tufts.edu](mailto:william.waller@tufts.edu)  
Telephone (617) 627-3655  
Register online: [www.mos.org/nessie](http://www.mos.org/nessie)

### Daily Schedule

- July 17: Life on Earth - focusing on HPSP as a living laboratory
- July 18: The Earth in Space - from a variety of perspectives
- July 19: Our Cosmic Origins - cosmology to astrobiology

Community Cosmos is sponsored by NASA's Spitzer Space Telescope Education and Public Outreach Program, NASA's New England Space Science Initiative in Education (NESSIE), Rockport Public Schools, Rockport Education Foundation, Halibut Point State Park, and the Gloucester Area Astronomy Club (GAAC).



Scenes from the *Community Cosmos 2006* workshop at Halibut Point State Park.



## New England Summit on Earth and Space Science Education

On the **25th of September, 2006**, NASA-related scientists, engineers, and educators from across New England will gather at the Museum of Science for a full day of discussions -- to share ideas meet new collaborators, and reflect on how their own efforts may fit into a larger whole. Topics for discussion will include:

- Who is doing what -- and where -- in **Earth and Space Science Education**? We intend this discussion to lead to a visual map of our diverse educational programs.
- What are our common messages? In an age of profound scientific discovery amid dismaying anti-science fervor, what do we most want students, teachers, and the scientifically curious public in New England to understand?
- How can we help to improve New England's workforce in science and technology? Why is the educational pipeline leaking and what can we do about it?
- What are our regional needs in Earth and space science education? How can we network more effectively to meet these needs? What systemic reforms at the state level can we spearhead?

We will also discuss ways that we can collaborate for the upcoming **International Polar Year (IPY)**, **International Heliospheric Year (IHY)**, and **International Year of Astronomy (IYA)**.

[Post Summit Materials](#)



All documents are in pdf format

[Briefing Notebook \(7.6 MB\)](#)

[Contact List](#)

[Agenda](#)

### Sponsored by



Website for the first *New England Summit on Earth and Space Science Education*.