



Human Space Exploration Initiative

Center for Strategic and International Studies ■ Washington, D.C.

Human Space Exploration for All

A CSIS-UNESCO Workshop ■ October 4, 2006

Executive Summary

The Center for Strategic and International Studies (CSIS) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) organized, with the sponsorship of the International Astronautical Federation (IAF) and the support of the United Nations Office for Outer Space Affairs (UNOOSA), a workshop on “Human Space Exploration Education For All” on October 4, 2006, in Valencia, Spain, during the 57th International Astronautical Congress. Over 55 participants from 18 countries (Australia, Austria, Azerbaijan, Bangladesh, Brazil, Canada, China, France, Germany, Iran, Japan, Jordan, Pakistan, Philippines, Spain, the United Kingdom, the United States, and Vietnam) attended the workshop.

Workshop participants addressed existing human space exploration education activities and materials and how best to promote, disseminate, and use them worldwide. Many space agencies have already invested in space exploration education activities and materials for their young people. The workshop provided a forum for the National Aeronautics and Space Administration, Canadian Space Agency, European Space Agency, and Japan Aerospace Exploration Agency to share information on their space education activities, including dissemination practices, relevant impact assessments, and lessons learned. Workshop participants from developed and developing countries addressed their experiences and the challenges of making materials like these available to youth globally. They also discussed the best and most appropriate ways of promoting, adapting, and disseminating these materials for use by educators and youth worldwide.

Workshop participants acknowledged the importance of sharing knowledge and discoveries resulting from space exploration with the world’s young generation with the goals of inspiring them and providing them with opportunities to benefit from what has been learned and to participate in future space exploration activities. They agreed that the creation of a Web site in several languages that provided access to human space exploration education content would be highly desirable and an important contribution to reaching these goals.

Building on the results of this workshop, CSIS and IAF will create a multilingual Web site providing access to human space exploration education materials and activities for educators and youth worldwide. Partnerships with other organizations will be sought to provide information, expertise, and support to the Web site and its users.

Background

The idea for the workshop originated from the Human Space Exploration Initiative (HSEI) at the Center for Strategic and International Studies (CSIS), which is examining new international perspectives on the future of human presence in space, assessing their relative prospects, and building a new common global vision and agenda for the future of human space exploration. CSIS is holding a series of workshops in the areas of governance, public support, and financial mechanisms to develop an understanding of the near-term and long-term challenges and opportunities in each of these areas. A critical component of this initiative is public support for an expansive vision for human space exploration.

CSIS held a major conference on the future of human space exploration in Brussels, Belgium, in February 2005 in conjunction with the European Commission’s Earth and Space Week. Leading authorities and experts from the political, business, and space exploration communities spoke on the prospects and challenges for the future of human space exploration. They addressed the challenges of building and sustaining public support, inspiring the next generation, and developing the space workforce of the future. To motivate the next generation around the world and make space exploration a global enterprise, it was recommended that the global space community (both public and private) make new multiyear funding commitments and build a broader base of interest in space exploration among young people around the world.

Space exploration has enhanced man's knowledge of the universe, leading to discoveries that have helped improve life on Earth. Today, many countries are embarking on new initiatives in human space exploration, building on the achievements of the past several decades. How can the resulting knowledge and discoveries be best shared with the young generation not only in spacefaring nations but worldwide? How can we bridge the gap between developed and developing countries so that we can provide opportunities for all of the world's youth to take advantage of what we have learned and perhaps enter the space workforce of the future? The "Human Space Exploration Education for All" workshop was organized to address these questions.

Workshop Sponsors

CSIS, the United Nations Educational, Scientific, and Cultural Organization (UNESCO), and the International Astronautical Federation (IAF) all recognize the importance of these questions and have taken action to address them consistent with their organizations' roles and objectives. To enhance these existing activities, the three organizations agreed to work together to hold a workshop for participants from developed and developing countries to share information, perspectives, and ideas on these questions so that further action could be taken to provide opportunities for the world's next generation. At the workshop, each of the participating organizations discussed their objectives and activities and why they were sponsoring this workshop.

Center for Strategic and International Studies

Vincent Sabathier, director of space initiatives at CSIS, presented the Human Space Exploration Initiative that CSIS developed to promote global and long-term human space exploration. The goals of the initiative are to establish an International Space Governance Forum, institute a global commitment to space education, and identify and promote creative new financial mechanisms (such as a Global Prize for Space Exploration, a Global Venture Fund, and novel models for financial cooperation). The strategy and objectives of the public support goal include the establishment of a network of universities, creation of primary and secondary school curricula (including a course on the International Space Station and cooperation with UNESCO and IAF on this "Human Space Exploration Education for All" workshop), and creation of a human space exploration education Web site to collate distance learning and online teacher resources. Mr. Sabathier said that CSIS will provide core support for the creation of a human space exploration education Web site.

United Nations Educational, Scientific and Cultural Organization

Yolanda Berenguer, UNESCO space education coordinator, introduced the recommendations of previous education conferences and workshops that laid the foundation for the deliberations at this workshop:

- The UNESCO/ICSU World Conference on Science (1999, Budapest) called for the improvement of science education at all levels by introducing new curricula and innovative teaching methodologies;
- The UNISPACE-III (1999, Vienna) emphasized the need to provide the young generation with opportunities to learn more about space-related issues;
- The IAF/IAA/ISU/UNESCO Workshop (2003, Paris) proposed to make space-related education materials available to students and educators.

Ms. Berenguer then recalled the aims of the Space Education Program, which include enhancing space-related subjects in schools and universities, particularly in developing countries, and promoting their integration in the science curricula and teacher training program. Raising awareness of decisionmakers and the public at large of the role and contribution of space technology to societal well-being is another objective of the Space Education Program. To this end, UNESCO has held training workshops for students and teachers on diverse space topics in developing countries with plans to hold further workshops in the near future. Ms. Berenguer was confident that the presentations and discussions during this workshop would enhance UNESCO's efforts in this area.

International Astronautical Federation

James Zimmerman, IAF president, welcomed the workshop participants and highlighted the importance of taking steps to provide opportunities for the world's next generation to benefit from and become engaged in space exploration in the coming decades. He summarized some of the previous efforts undertaken by IAF and others in this area, including the IAC student program and education workshops conducted in conjunction with the United Nations Office of Outer Space Affairs (UNOOSA), and called on the workshop participants to build on these efforts and develop concrete steps to be taken following the workshop.

Philippe Willekens, IAF executive director, talked about the need to simplify access to existing space education materials. At previous conferences and workshops, developing countries have expressed their needs for these materials, but access to existing materials is too complex and vast. Therefore, a reference window to existing Web sites needs to be developed that gives a

general orientation to the materials in simple language that is internationally balanced and neutral. He presented IAF's current Space Education Project data base and said that IAF is offering to host a human space exploration education Web site using the existing IAF portal with the project database as a starting point. IAF is also offering a network of experts worldwide that can provide support for this effort.

Space as Inspiration

The workshop sponsors invited two astronauts to the workshop to address human space exploration activities and why these activities are important, as well as inspirational, to young people.

Jean-Jacques Favier, deputy director for advanced concepts and strategy at the Centre National d'Etudes Spatiales (CNES), gave the keynote address on space exploration and the reasons why space is important for everyone, not just those who are directly involved. He spoke about his background in science and his own involvement in space activities, and he stressed the importance of sharing this information and how inspiring it can be for young people. He related his experiences in reaching out to the youth in developing countries through his participation in the UNESCO Space Education Program workshops, highlighting the impact that he has seen this kind of outreach have.

Pedro Duque, a member of the European Space Agency (ESA) Astronaut Corps, closed the workshop by conveying to participants his pleasure that this topic was being addressed because it is so important for mankind's future. He relayed his personal observations of how sharing space exploration experiences and benefits can make a difference in a young person's life. His remarks reinforced the discussions and conclusions of the workshop on what steps can and should be taken to provide opportunities for the next generation to benefit from and become engaged in space exploration in the coming decades.

Space Agency Presentations

The National Aeronautics and Space Administration (NASA), Canadian Space Agency (CSA), European Space Agency (ESA), and Japan Aerospace Exploration Agency (JAXA) made presentations on their human space education materials and activities, highlighting dissemination practices, assessments, and lessons learned. The space agencies provided lists of their materials and/or included this information in their presentations.

Space Agency Education Objectives and Space Exploration Content

John M. Hairston Jr., NASA assistant administrator for education (acting), said the fundamental driver for NASA's education activities is the need for science, technology, and engineering (ST&E) graduates in the United States. He said the U.S. ST&E workforce is declining, and the trend for enrollment in ST&E undergraduate and graduate studies is downward. To meet these challenges, NASA has developed an education portfolio strategic framework to work with the academic community to prepare the next generation of explorers and innovators. The framework highlights agency content, people, and facilities as the foundation for sponsored educational opportunities, while developing new nontraditional partnerships. It identifies three priorities for NASA to work with academia, industry, and informal educators to foster increased studies in science, technology, engineering, and mathematics in order to strengthen the nation's workforce, attract and retain students, and promote engagement in NASA's missions.

NASA has developed a large number of human space exploration education materials and resources, and Mr. Hairston provided workshop participants with a list of those that have been successfully used by educators and students and proven to be easily replicable. He highlighted NASA's Reduced Gravity Flight Program, which provides extended term educational/research experience for teams of students, including experiments in microgravity conditions on aircraft. Another successful NASA program is Explorer Schools, which establishes a three-year partnership between NASA and school teams to provide students and educators with tools, experiences, and opportunities to further their education in science, technology, engineering, and mathematics via unique NASA expertise and resources. Mr. Hairston noted that this program has been replicated in the Netherlands. The Delta Researcher Schools project uses the excitement of human spaceflight, the International Space Station, and other international projects to inspire students' interest in science, technology, engineering, and mathematics.

Marilyn Steinberg, program manager of the CSA Space Awareness and Learning Program, said the mandate of their program is to "increase scientific literacy of students and educators such that the students are inspired and both students and educators are equipped to undertake careers in science and technology in Canada." CSA has over 20 human space exploration education products and resources related to the following themes: Living and working in a closed environment; radiation; International Space Station (ISS); space navigation; orbital mechanics; spacesuits; microgravity; robotics/ISS; astronaut training; and water recycling. CSA also has extensive space educator professional development activities. Ms. Steinberg noted that CSA's design policy takes into account several factors, including Canadian application of constructivist learning theory and the depth of educator knowledge of science, technology, and mathematics (STM). Some of the challenges they face include insufficient depth

of knowledge of STM concepts, inherent fear of STM subject matter, limited access to physical tools, and limited access to subject matter experts.

Piero Messina, of the ESA Exploration Program, presented ESA's Human Exploration Program education products. ESA has developed International Space Station (ISS) education kits for primary and secondary schools. The ISS education kit for primary schools explains various aspects of life in space and what it is like to live and work onboard the ISS. The kit contains background information, worksheets, color posters, and teacher's guides. It is currently available in English and will be available in all 12 ESA languages by next year. The kit for secondary schools covers various aspects of the ISS, including what it is, how it is being built, what it's like to live and work onboard, and what future voyages will be like. In addition to text and explanations about the ISS, the kit contains related interdisciplinary exercises, a teacher's guide, and presentation materials. It is available in all 12 ESA languages.

ESA is also producing DVD lessons, a series of 20-minute lessons that include unique experiments performed by astronauts in space, to explain basic science concepts fitting the European curricula to pupils aged 12 to 18. DVD lessons have been developed on Newton's Laws of Motion, human physiology, and chemistry; a fourth DVD on robotics will be completed next year. Each DVD is in all 12 ESA languages and includes a teacher's guide with suggestions for related classroom experiments and activities. ESA has also developed an ISS 3-D game that combines space/ISS simulations with computer games and topics of European curricula. It is available in all 12 ESA languages and includes a teacher's guide. "Space Academy," a 3-D education tool that will provide teachers with a pedagogical tool including computer-based exercises related to the European curricula (and to space) for pupils aged 12 to 15, will be available in all 12 ESA languages next year.

Eijiro Hirohama, senior adviser to the director, and Takemi Chiku, associate senior administrator, JAXA Space Education Office, described JAXA's approach to developing space education materials. Their goal is to "help young people acquire insights and develop their own visions" by sharing "the excitement of solving the mysteries of the universe and learning more about achievements in space activities." JAXA space education objectives are to assist in the maturation of children using space materials so that they understand the links among space, nature, people, and society, as well as science and technology. Through their activities, JAXA aims to promote understanding of the thinking process behind the knowledge, increase appreciation of science and technology, and promote an understanding of the importance of contributing to building a better future.

JAXA develops education materials, publications, videos, and CD-ROMs for teachers. Ms. Chiku highlighted JAXA's introductory education materials on space activities. She said they were developed for use at the beginning of a teaching unit of the existing curriculum in order to stimulate students' interest in the subjects to be taught in the unit. She highlighted an example of how they use space materials in a homemaking course on learning about "living," "eating," and "housing." The introductory materials use photographs from space that trace the evolution of food that astronauts have eaten in space from Mercury to the International Space Station today to stimulate the interest of students in this subject.

Dissemination Practices and Lessons Learned

An important part of NASA's strategy is to support educators who play a key role in engaging and preparing today's youth, according to Mr. Hariston. NASA provides educators with tools, experiences and opportunities to further their education. Students participate in unique NASA learning experiences that enhance their knowledge of science, technology, engineering, and mathematics (STEM) and inspire pursuit of STEM careers. NASA supports the role of educational institutions, providing the framework to bring together students, families, and educators for educational improvement.

Mr. Hariston said that NASA uses the Web as a primary dissemination tool to provide easy access to its educational materials and resources, and the list of materials he provided to the workshop participants included URLs for each.

Mr. Hariston said he was particularly pleased to be at this workshop because a key element of NASA's new education framework is to involve partners and establish strategic alliances to work with NASA to inspire and engage youth. He said that NASA was very supportive of the objectives of the workshop and welcomed the opportunity to work with the sponsors in a partnership to promote human space exploration education materials and resources.

According to Ms. Steinberg, Canada's dissemination challenges are many, including a large landmass; 13 different science, technology, and mathematics curricula; two official languages; inconsistent funding levels for education; and technical infrastructure discrepancies. To meet these dissemination challenges, CSA:

- Employs top down and bottom up collaborative networking and third-party promotion (Ministries of Education, School Board superintendents, STM consultants, educator champions, science teacher associations, science center communities, national youth organizations, other government departments, and private-sector organizations);
- Develops a community presence through the use of educator conferences, science fairs, consultation meetings, and on-site

and distance learning workshops;

- Leverages digital and multimedia tools (educator database, local and third-party Web promotion, Web-based learning applications, videoconferencing, pod casting, CD-ROMs, DVDs).

She highlighted CSA's extensive use of distance and telelearning in delivering its products (all of its human space exploration education products and resources are on the Web). She also cited statistics that demonstrated how CSA's dissemination strategy has resulted in active educator and student participation in its projects and workshops and extensive requests for materials and visits to the educator resource section of the CSA Web site.

Hugo Marée, head of policy and coordination office at ESA's Education Department, discussed ESA's recent efforts to more effectively disseminate its educational materials and space products through the use of existing educational networks or structures within the ESA member states so that its materials and products can be best adapted by local education officials. ESA is issuing service contracts to existing national educational facilities within its member states to establish European Space Education Resources Offices with the ultimate goal of having such organizations operational in each of the ESA member states.

Piero Messina noted that its ISS education kits, DVDs, and 3-D products are available on the Web, and ESA plans to make its future products available on the Web. He also highlighted ESA's product evaluation efforts. ESA conducted an independent phone/e-mail survey to assess the validity of the educational products distributed; of those who responded, 80 percent have used the products in classrooms and/or educational content, and 95 percent of those who used them rate the products good to excellent. He also said ESA's DVD lessons have received outstanding reviews, including one in the UK Institute of Physics journal.

JAXA disseminates its education resources through a variety of activities, noted Mr. Hirohama and Ms. Chiku. These include direct, customized support to teachers/schools in classroom teaching, sending experts to the classrooms, supporting classroom activities, on-site events for primary and secondary school students, support to university students such as training, and collaboration with entities outside Japan. JAXA disseminates its education materials, publications, videos, CD-ROMs, and other educational resources mainly through its Web site.

The target audience of services and products of the JAXA Space Education Center would continue to be school teachers, and JAXA would continue to involve school teachers in developing educational materials with space elements. Ms. Chiku highlighted JAXA's "golden rules" for developing educational materials:

- The target audience of space education materials should be teachers;
- Teachers should be fully engaged in developing educational materials;
- Teachers are busy: new education materials should be easy to use;
- Teachers need constant technical support—after-care service and customized support are important;
- Teachers need to refresh their knowledge and enhance their understanding of current space activities.

Mr. Hirohama and Ms. Chiku noted that the usefulness of JAXA's introductory education materials with the use of space elements is increasingly being recognized by teachers for use in their classrooms and by education boards for use in their teacher training seminars.

Roundtable Discussion

Workshop participants expressed their appreciation for the information provided by the space agencies on the exciting content that has already been developed, their experiences in developing and disseminating the materials, and their assessment of the effectiveness and use of the materials. They discussed the importance of sharing knowledge and discoveries resulting from space exploration with the world's young generation with the goals of inspiring them and providing them opportunities to benefit from what has been learned and to participate in future space exploration activities.

They agreed that the creation of a multilingual Web site that provided access to human space exploration education content would be highly desirable and an important contribution to reaching these goals. A question was raised on whether the space agencies could provide a point of contact on their materials. It was noted by one agency that it is not provided with the resources by its government to respond to inquiries from around the world on a continual basis but proposed instead that the space agencies might participate in periodic telecons or meetings on an international level to support the Web site.

Other workshop participants provided ideas and insights based on their personal experience in promoting and disseminating educational content. The importance of involving educators and youth in the development of education initiatives was emphasized as critical to the success of such initiatives. And developing partnerships with nongovernmental organizations that

are engaged in education activities nationally or internationally can provide needed support to educators and youth using a human space exploration education Web site.

The workshop organizers announced that they would provide a report on this initiative at the 58th International Astronautical Congress in Hyderabad, India, in September 2007. The organizers thanked the participants for their participation and lively discussions and encouraged them to think further on the issues discussed and to provide additional insights.

Recommendations

There is a need to make human space exploration education materials readily available to youth worldwide.

Space agencies have found that educators in their countries seek out and use their human space exploration education materials in their classrooms because the materials are exciting and motivate students to learn. Astronauts have seen the positive impact that sharing their experiences in space has had on the young people they have met. Educators in developing countries have expressed a need for space education materials. Through UNESCO's workshops, teachers are motivated to learn more and develop knowledge in space-related subjects, but this effort needs to be further enhanced. It is important to find ways and means for students and teachers around the world to have easy access to and be able to use existing and planned human space exploration education materials. Such mechanisms would help bridge the gap between developed and developing countries so that the entire world's youth have the opportunity to learn about and benefit from human space activities.

A multilingual Web site on human space exploration education materials and activities should be created.

A Web site that provides links to space exploration education content that exists on multiple Web sites is the most effective means to help educators and youth around the world to become aware of the scope and breadth of the materials and activities that are available. The space agencies welcome a partnership with CSIS and IAF to make their materials available more broadly than they currently have the mandate or resources to do. IAF, acknowledged worldwide for its promotion of space exploration and its benefits, has offered to host the Web site. The site needs to be easily accessible and usable by educators and youth worldwide. It should be relevant to educators' classroom practices and exciting for youth to use. It needs to enable communications among the Web site users so that educators can share experiences and lessons learned, school-to-school collaborations can be formed, and young people can communicate with each other to share information, experiences, and ideas for their future. The Web site should provide the capability for educators and others to translate the site into multiple languages.

Space agencies and educators should identify human space exploration education content that has been successfully used in formal and informal education settings.

This effort should start with a pilot Web site utilizing a subset of the content identified by the space agencies targeted to a specific age group so that educators and youth can begin using it and provide feedback and recommendations. The site should grow and evolve by utilizing additional space agency content and soliciting educator input on content they have successfully used. Periodic telecons or meetings with the space agencies should be organized to address questions and comments raised by the users of the Web site.

Seek partnerships with networks of space professionals, universities, the private sector, and other organizations that have education and exploration objectives.

Many of these entities have synergistic goals and objectives to promote awareness of space activities and enhance education. Educators and youth accessing the Web site will require information and advice as they use the materials. Space and education professionals in these entities could provide them information, expertise, and support. Mentoring relationships between university students and youth using the Web site should be promoted, providing young people with support as they use the Web site today and as they enter the workforce tomorrow. Partnerships with these entities would help promote broad use of the Web site as many of them have developed relationships and networks with schools, educators, museums, science centers, and youth clubs. Maintaining and improving the Web site will require additional support from the private and nonprofit sectors.

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Workshop on:
“HUMAN SPACE EXPLORATION EDUCATION FOR ALL”

4 October 2006
 International Astronautical Congress
 Valencia, Spain
 Room CMR3

AGENDA

8:30	Breakfast	
9:00	Welcome	Jim ZIMMERMAN, IAF President
	Opening Remarks	Vincent SABATHIER, Director, Space Initiatives, CSIS Yolanda BERENGUER, Coordinator, Space Education Programme, UNESCO
9:10	Keynote Address	Jean-Jacques FAVIER (former astronaut), Deputy Director – Advanced Concepts and Strategy, CNES
9:20	Workshop Introductions and Agenda	Lyn WIGBELS, Visiting Fellow, CSIS
9:30	Presentations on Human Space	John M. HAIRSTON, Jr., Assistant Administrator Education Content for Education (Acting), NASA Marilyn STEINBERG, Program Manager, Space Awareness and Learning, CSA Hugo MARÉE, Head of Policy and Coordination Office, Education Department Piero Messina, Exploration Programme, ESA Eijiro HIROHAMA, Senior Advisor to the Director Takemi Chiku, Associate Senior Administrator Space Education Center, JAXA
10:30	Presentation on Human Space Exploration Website	Philippe WILLEKENS, Executive Director, IAF
10:45	Roundtable Discussion	All participants
11:45	Recommendations and Actions (Review of Draft Declaration)	Lyn WIGBELS, CSIS Yolanda BERENGUER, UNESCO Philippe WILLEKENS, IAF
12:00	Closing Remarks	Pedro DUQUE, member of the Astronaut Corps, European Space Agency (invited)

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