

NSBRI Education and Outreach Team Strategic Plan

14.0 EDUCATION AND OUTREACH

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14.1 INTRODUCTION

NASA's space program has enjoyed extraordinary success over the past 40 years. Program accomplishments and discoveries have broadened our understanding of the solar system and universe, as well as life on Earth. The space program has helped to advance human civilization by advancing fields as diverse as telecommunications, navigation systems and lightweight construction materials and medicine. With the establishment of the National Space Biomedical Research Institute (NSBRI) in 1997, NASA expanded its goal, to enhance health and healthcare delivery on Earth through research that will allow humans to engage safely in long-term space exploration beyond Earth orbit.

NSBRI discoveries and research are beginning to produce countermeasures to the harmful effects of microgravity and space radiation. Simultaneously, NSBRI will bring discoveries and products of clinical benefit to mankind on Earth, enhancing treatments for health issues such as muscle wasting, osteoporosis, shift-related sleep disorders and radiation-related conditions. The Institute also is researching ways to deliver improved medical care on space missions with new technologies and remote-treatment advances.

The mission of the NSBRI Education and Outreach Team is to communicate the significance and excitement of space life sciences to local, national and international audiences, while transferring and disseminating knowledge gained via the biomedical advances achieved by NSBRI Research Teams. This mission is being accomplished through an integrated array of programs focusing on students and educators at all grade levels, as well as the general public.

NSBRI Education and Outreach Team members include some of the nation's most prestigious research institutions, all leaders in educational outreach programming: Baylor College of Medicine (BCM), Massachusetts Institute of Technology (MIT), Morehouse School of Medicine (MSM), Mount Sinai School of Medicine (MSSM), Rice University (RU), Texas A&M University (TAMU), University of Texas-Medical Branch (UTMB) and University of Washington (UW).

14.2 NEED

Each decade brings new challenges and participants who work to advance the mission of NASA's space program. Unfortunately, the initial stunning success of the space program may

have fostered the impression that space travel has few associated risks. These perceptions are not accurate and must be addressed to assure public support.

The NSBRI Education and Outreach Team strives to promote understanding of and support for both NASA's and NSBRI's activities by working across the educational continuum to share the new discoveries resulting from NSBRI-led research. Through teacher professional development, innovative curricular materials and university courses, and use of various media, Team members are strengthening NASA's connection to the public. In addition, NSBRI's Education and Outreach is addressing NASA Administrator Sean O'Keefe's strong commitment to motivating young people to pursue careers in science, technology and engineering through the excitement of space exploration.

14.3 GOALS

The Education and Outreach Team develops and implements activities that address five major programmatic goals, developed jointly by Team partners, in coordination with the NSBRI leadership, to assure that Team projects address overarching NSBRI objectives.

Goal 1: *Design and conduct a variety of teacher professional development programs to help teachers understand space life sciences and change their practices and behaviors to improve the learning experiences they provide students.*

Goal 2: *Develop curricular materials that span the educational continuum; are aligned with national science standards; provide accurate, balanced, effective and inquiry-based instruction; and expand students' understanding of on-going NSBRI research.*

Goal 3: Increase science literacy and public awareness of the real-life impacts of NSBRI research through media, informal science activities, direct mailings and magazine stories.

Goal 4: *Promote educational access and career awareness in space life science fields among high school and undergraduate students as well as high school teachers.*

Goal 5: *Integrate NSBRI-focused teacher professional development, curricular materials, scientific literacy initiatives, and educational and career access activities among all Education and Outreach Teams, other NSBRI Teams and public venues.*

14.4 DESCRIPTION AND EVALUATION OF CURRENT PROGRAM

The Educational and Outreach Team is comprised of experienced educators and scientists from some of the most noted research institutions in the nation. It is establishing NSBRI as a leading resource for teacher professional development programs and quality science education materials that bring the excitement and importance of NSBRI space life science research into the nation's classrooms and homes. Hundreds of teachers and thousands of students are benefiting from programs and activities conducted by the Education and Outreach Team. The public is being reached through media programs and national magazine articles.

NSBRI Education and Outreach Team members are expanding the scope of their projects by partnering with local and national organizations. Team partners include: public schools and school districts in 24 states, Atlanta Public Television and Radio, Emory University, Fernbank Science Center Museum, Excellence in Education, Harvard Medical School, Houston Public Television, Houston Independent School District, Johnson Space Center, New York Public Schools, New York Hall of Science, North Forest (TX) Independent School District, Space

Center Houston, Spelman College, Texas Alliance for Science, Mathematics and Technology, Texas Rural Systemic Initiative, the Texas Statewide Systemic Initiative and the Washington NASA Space Grant.

The Education and Outreach Team continues to conduct activities that address the five program goals. The wide range of Team projects are designed to address the ultimate mission of communicating the significance and excitement of space life sciences to a variety of audiences, while transferring and disseminating knowledge gained via the biomedical advances achieved by NSBRI Research Teams. Table 14.1 (below) delineates which primary activities of each

TABLE 14.1. CURRENT NSBRI EDUCATION AND OUTREACH PROJECTS				
PI/PROJECT	GOAL ADDRESSED			
	Teacher Professional Development	Curriculum Development	Science Literacy/Public Awareness	Career Awareness and Access
William A. Thomson, PhD <i>From Outer Space to Inner Space: Sharing NSBRI Progress with the Community</i>	Summer and School Year Teacher Professional Development at Conferences and Meetings	Elementary/Middle School Curriculum Materials	Educational Television and News Stories; Space Center Houston	Television Stories; Space Center Houston
Dava J. Newman, PhD <i>Space Biomedical Sciences and Engineering Curr. and Outreach Project</i>		Undergraduate and Graduate Courses; K-12 materials	Modular "Knowledge Station" (Interactive Exhibit)	Modular "Knowledge Station" (Interactive Exhibit)
Marlene MacLeish, EdD <i>Secondary and College Education for the Next Generation of Space Life Scientists</i>	Year-long Residency Program for Secondary School Teachers; Problem-Based Teacher Field Test Program	Undergraduate Courses; Secondary School Curriculum	NSBRI-Film Archive	NSBRI-Film Archive; Undergraduate Summer Research Program
Patrick J Gannon, PhD <i>Defying Gravity: Enduring Life In Space</i>	Science Teacher Teaming Teacher Workshops; Summer Program	9th Grade Curriculum	Museum Exhibits; Newsletters; Websites	Museum Exhibits; Newsletters; Websites
Roland B. Smith, EdD <i>Outreach Program for the Professional Development of Students and Teachers on Studies Related to Biomedicine in Outer Space</i>	Year-long Program for 20 Secondary School Teachers	Teacher-Developed Secondary Curriculum Units	Museum Exhibits; Websites	Summer Research Experiences for High School Students
Robert James, PhD <i>Teacher Academy Project</i>	Master NSBRI Teacher/ Teacher Workshops	Middle School Online Curriculum Projects	Texas Legislative Conferences	Annual Youth Symposia for Middle and High School Students
Deborah L. Illman, PhD <i>Northwest Outreach Program on Space Biomedical Research</i>			NSBRI Magazine Stories; Science Communication Workshops; Writer-in-Residence Program	NSBRI Magazine Stories-- Middle School "SciScape" Inserts-- (Some experiences for high school students)

Education and Outreach Team partner institution/project satisfy which goals. Goal 5, *Integration*, does not appear in this Table, as integration is not so much a separate aim as an overarching characteristic that applies to all Education and Outreach Team objectives.

Program Description

Following is a brief description of each Education and Outreach Team partner institution/project and its activities. It expands upon Table 14.1 and explains the general activities used to address the team's goals.

Baylor College of Medicine (BCM)—From Outer Space to Inner Space: Sharing NSBRI Progress with the Community. BCM, Space Center Houston, Houston Public Television and the

Houston Independent School District are collaborating to convey the excitement and promise of NSBRI space life sciences research to students, teachers and the general public through coordinated formal and informal educational opportunities that will be embedded within local and state science education reform programs.

This partnership engages scientists and educators in the production, evaluation and dissemination of a planned series of elementary and middle school curriculum materials based on NSBRI research themes. It also produces bimonthly, nationally distributed radio stories on NSBRI research areas. The partnership reaches thousands of students, teachers and members of the general public each year. It also generates public awareness and appreciation of the benefits of NSBRI research. Project activities are aimed at middle school (grades 5-8), which has been identified as a particularly weak link in the K-12 science/mathematics education continuum.

Measurable project objectives are: (1) collaboratively create, evaluate and disseminate three interdisciplinary teaching units (one per year) on NSBRI research themes for middle school students; (2) improve teacher practice and content knowledge through multiple professional development opportunities conducted in formal and informal educational settings; (3) develop an online workshop resource for NSBRI scientists to use for outreach to teachers, students and the community-at-large; and (4) create and implement cost-effective models for communicating NSBRI research to local and national populations through television and radio short-format news and newsmagazine stories.

Massachusetts Institute of Technology (MIT)—*Space Biomedical Sciences and Engineering Curriculum and Outreach Project*. MIT is developing curricular materials to educate a generation of scholars in space life sciences by transferring NSBRI space life sciences research into undergraduate courses and to younger students and the public. One graduate course has been developed and is being piloted at MIT: *Sensori-Neural Systems: From the Vestibular Periphery to Motor Responses, Perception and Adaptation*. Five course faculty are affiliated with other NSBRI research projects. One undergraduate course also will be developed: *Space Biomedical Engineering and Life Support Systems*. Its modular materials will cover eight of twelve NSBRI research areas and will be designed for adoption among NSBRI consortium institutions.

K-12 modular labs and activities will be developed for teachers to insert in established anatomy and physiology classes. These labs emphasize space biomedicine and engineering skills. The integration of these modules focuses on an end-term student designed project of an exercise machine that will counter the physiological effects of long-term space flight: “*Spacercise*”. For the public, MIT will design a knowledge station that allows learners to interact with curricular materials via state-of-the-art information technology and a physical platform designed specifically to facilitate human interaction and learning.

Intended outcomes are to: (1) provide multi-level space life sciences curriculum; (2) excite and educate the public about the wonders of science, engineering and medicine by disseminating knowledge gained through NSBRI research; and (3) develop a set of innovative pedagogical strategies that represent the application of tested learning principles as a basis for comprehensive educational evaluation tools. In addition, the project will develop multimedia tools that are particularly suited to active learning accessible through the Internet. The evaluation plan will assess learning and knowledge transfer of curriculum that makes use of these technological advances as well as assessment of the new student (or 'learner') population.

Morehouse School of Medicine (MSM)—Secondary and College Education for the Next Generation of Space Life Scientists. The MSM program is multi-faceted. *The MSM-Fernbank Museum Space Station Teacher Institute* admits two science teachers into a yearlong residency at MSM to develop, test and disseminate secondary problem-based curriculum supplements. Teachers work with scientists and physicians to develop problem-based field test capabilities and to write a cardiovascular case, *Bobby's Beat*. They attend the Texas A&M Teacher Academy to learn this method and develop leadership skills.

The *MSM-Georgia Institute of Technology SECME Program* delivers a teacher professional development module on the Human Body in Space at the annual SECME national meeting, and also sponsor a noted space scientist lecture to address the estimated one thousand attendees. The *Summer Research Program* enrolls four undergraduate students, selected from a national applicant pool, to engage in a research-intensive internship at MSM. One MSM medical student is sponsored to undertake clinical research in the Harvard Medical School Sleep and Circadian laboratory headed by an NSBRI scientist. A longitudinal database is maintained to measure the outcome of the program.

The *NSBRI Film Archive* contains more than 150 hours of video relating to NASA's Neurolab mission, NSBRI team science, and the Human Body in Space course. This one-of-a-kind repository will be used to develop interactive Internet accompaniments to the proposed textbook and the problem-based cases written by the teacher fellows. It also will support the outreach and public affairs of the entire NSBRI enterprise. An electronic, undergraduate curriculum on the human body and weightlessness will use a multidisciplinary perspective to support national undergraduate, science education standards and space life sciences at the college level.

Mount Sinai School of Medicine (MSSM)—Defying Gravity: Enduring Life in Space. MSSM is developing a 9th grade, space-based science and mathematics curriculum that links human health in Earth's gravity and in space's microgravity. It explores scientific knowledge essential to formulate countermeasures; provides working models of scientific and mathematical principles; and includes hands-on laboratory sessions with group discussion to demonstrate current paradigms and unifying principles that relate research to space biomedicine and hypothesis testing. The curriculum integrates mathematical principles to concepts in the biological and physical sciences and technology, and to data collection, organization, analysis and graph design.

Defying Gravity is being developed by educators from MSSM Teacher's Summer Institute 2001: A Space Research Odyssey. It will be field tested at the New York City Life Sciences Secondary School, among an underrepresented and academically challenged student population. Products derived will include: a hard copy of the curriculum; an interactive Internet version of the stand-alone curriculum with downloadable text, images and digital video/audio sessions; a live scientist discussion room; teacher's lounge email FAQ and questions; interactive CD ROMs of selected curricular components; a *High School Teaching for Biomedical Scientists handbook*; a hands-on exhibit at the New York Hall of Science; and National multi-media outreach and dissemination via MSSM and NSBRI/Public Broadcasting Services (PBS) television channels.

Rice University/University of Texas Medical Branch (RU/UTMB)—Outreach Program for the Professional Development of Students and Teachers on Studies Related to Biomedicine in Outer Space. This collaboration attracts young people to space-related enrichment programs, promotes excellence and innovation in America's science education system, and enhances the scientific background of teachers, students, their families and the community as a whole. It consists of the

Academic Development of High School Students (Summer Student Research Program) and the Teacher Institute for the Advancement of Space Science Education (Teacher Professional Development Institute).

Students and teachers are partnered with ongoing space biomedicine research projects conducted at Rice and UTMB. The *Teacher Institute* selects 16 secondary school teachers in a yearlong program to enhance their knowledge of space biomedicine through interactive discussions with researchers; a one-day, hands-on research experience; and special tours of NASA Johnson Space Center and Space Center Houston. Teachers use their knowledge to design a space biomedicine mini-module/unit plan to be taught in class and refined for publication on the Rice, UTMB and NSBRI educational resources web sites. The *Student Research component* enrolls 12 high school summer students to conduct research projects in Rice and UTMB science labs, participate in a field trips, and meet researchers engaged in a wide variety of space biomedicine research.

Texas A&M University (TAMU)—Teacher Academy Project. The NSBRI *Teacher Academy Project (NSBRI TAP)* prepares Master Teachers to assist their peers in infusing cutting-edge, space-based science activities into middle school. The specific objectives are to: (1) establish a national cadre of 90 middle level science teachers and prepare them to provide staff development that will reach 1,800 middle level science teachers; (2) identify and provide access to extant teaching resources for middle level science educators; and (3) develop supportive partnerships to access and utilize the resources and skills of key organizations, and work collaboratively with other NSBRI member institutions to improve the quality of middle level science in the classrooms of teachers who participate in NSBRI activities.

NSBRI TAP will select a cadre of master teachers to help develop a summer institute. These teachers will utilize recent NSBRI scientific discoveries to create curricular supplements, attend a leadership and staff development training module, and engage in follow-up activities and conferences to obtain certification as master teachers and Fellows of the Academy. Academy Fellows will form a national professional development staff that trains all middle level science teachers to implement space-based science. It is anticipated that extensive collaborations with other Education and Outreach teams will occur with respect to resource sharing and support with the identification of master teachers. *TAP* also will produce a national cadre of 90 master teachers who are successful in helping at least 1,800 of their peer space science teachers to implement space-based science in their classrooms. Both qualitative and quantitative data will be collected, with on-going analysis of the data shared with the Director.

The University of Washington (UW)—Northwest Outreach Program on Space Biomedicine Research. The UW program leverages an existing communication/education program, *Northwest Science & Technology*, at UW to: (1) transfer/disseminate space biomedical knowledge to homes and classrooms throughout the Northwest; (2) increase literacy about science in general, and about space biomedical research and terrestrial applications in particular, among the general public, teachers and students; (3) prepare scientists and future reporters and public information officers to communicate more effectively about science and space biomedicine issues to general audiences; and (4) attract young people to careers in NSBRI space biomedical research.

The program will develop and disseminate articles on space biomedical research via *Northwest Science & Technology (NWS&T)* magazine, a new regional science publication with a circulation of almost 30,000 in the Pacific Northwest region and beyond. Student writers will write, adapt and disseminate special materials on space biomedical research for middle school students and

their parents and teachers via an insert in *NWS&T*. In addition, the UW program will deliver a series of three summer science writing workshops for NSBRI consortium members.

The Education and Outreach Team institutions enjoy a significant amount of synergistic interaction with each other and with other NSBRI Research Teams. Such interactions, which work towards achieving Goal 5, *integration*, are delineated in Table 14.2. Goal 5, itself, does not appear in this Table, as integration is not so much a separate aim as an overarching characteristic that applies to all Education and Outreach Team objectives.

Table 14.2. Integration Activities by NSBRI Research Area/Education and Outreach Goals

NSBRI RESEARCH AREAS	EDUCATION AND OUTREACH GOALS			
	Teacher Professional Development	Curriculum Development	Science Literacy/Public Awareness	Career Awareness and Access
Bone Loss	BCM, TAMU, RU/UTMB	BCM, MIT, MSSM	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW, TAMU
Cardiovascular Alterations	TAMU	MIT, MSM	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW, TAMU
Human Performance Factors, Sleep and Chronobiology	BCM, TAMU	BCM, MSSM	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW
Immunology, Infection and Hematology	RU/UTMB	MSSM	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW
Integrated Human Function		MIT	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW
Muscle Alterations And Atrophy	BCM, TAMU, RU/UTMB	BCM, MIT, MSM, RU/UTMB	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW, TAMU
Neurobehavioral and Psychosocial Factors	TAMU, RU/UTMB	MIT, MSSM, RU/UTMB	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW
Neurobehavioral Adaptation	TAMU, RU/UTMB	MIT, MSSM	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW
Nutrition, Physical Fitness and Rehabilitation	BCM, TAMU	BCM, MIT, MSM	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW
Radiation Effects	TAMU, RU/UTMB	MSSM, TAMU, RU/UTMB	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW, TAMU
Smart Medical Systems		MIT	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW
Technology Development	TAMU	MIT	BCM, MIT, MSM, MSSM, RU/UTMB, TAMU, UW	MIT, MSM, RU/UTMB, UW

BCM: Baylor College of Medicine; MIT: Massachusetts Institute of Technology; MSM: Morehouse School of Medicine; MSSM: Mount Sinai School of Medicine; RU/UTMB: Rice University/The University of Texas Medical Branch; TAMU: Texas A&M University; UW: University of Washington

Evaluation of Current Program

Gaps. The NSBRI External Advisory Council and the 2000 NSBRI Site Visit Team made five recommendations for the Education and Outreach Team: (1) improve dissemination, feedback

and assessment methodologies; (2) establish a coordinated development plan; (3) establish university level education programs; (4) articulate the Team's unique abilities to contribute to national education; (5) promote diversity. The addition of MIT to the Education and Outreach Team will help to establish university-level education. MIT will develop and test two graduate level courses, one of which will be offered to undergraduate students. The remaining recommendations are being addressed in the strategic objectives outlined in Section 14.5.

Team members have collaboratively established the strategic goals and objectives for NSBRI Education and Outreach. Through retreats and conference calls, team members have identified the challenges of building a national identity for NSBRI through educational outreach. It was agreed that the quality of materials and activities and the extent to which they are disseminated would be initial defining factors for all NSBRI sponsored educational activities. Once planned and implemented, presentations and publications will document the programmatic impacts.

14.5 OBJECTIVES AND STRATEGIC ACTIVITIES

Below is a brief description of strategic activities to achieve NSBRI Education and Outreach Team objectives and goals. Table 14.3 provides a timetable for completion of these activities.

Goal 1: *Design and conduct a variety of teacher professional development programs to help teachers understand space life sciences and change their practices and behaviors to improve the learning experiences they provide students.*

Objective 1A. Enhance the space-based science and technological readiness, skill and teaching impact of educators by providing professional development that focuses on partnerships with scientists and increased teacher content knowledge.

- Create a national Teacher Academy.
- Offer school-year and summer professional development opportunities for K-12 teachers.
- Involve scientists in professional development for teachers.
- Implement teacher mentorship programs within schools.
- Sponsor year-long internships for teachers.

Objective 1B. Utilize NSBRI-generated resources to empower educators to teach all students more effectively and communicate these new instructional resources to peers in education.

- Align curriculum materials based on NSBRI research to national science standards.
- Develop science education reform leaders within the scientific and K-12 education communities.
- Design, create and deploy Internet-based teaching and science education resources.

Goal 2: *Develop curricular materials that span the educational continuum; are aligned with national science standards; provide accurate, balanced, effective and inquiry-based instruction; and expand students' understanding of on-going NSBRI research.*

Objective 2A. Develop and implement high-quality NSBRI-based science, mathematics, and reading/language arts instructional materials designed to facilitate measurable success for all students, apply best understandings of how students learn, and incorporate assessment as an integral component.

- Produce a 9th grade space science program.
- Develop elementary/middle school instructional programs focusing on NSBRI research.

- Create problem-based cases for high school and undergraduate students.
- Facilitate the development of teacher-generated classroom materials.
- Design and implement studies that examine the effectiveness of NSBRI-sponsored Internet-based curriculum materials, as compared to traditionally formatted materials.

Objective 2B. Promote excellence, achievement and systemic change in education through the dissemination of materials described in Goal 2, Objective A.

- Offer local, regional and national teacher professional development on NSBRI materials.
- Partner with NASA for teacher professional development and materials dissemination.
- Partner with informal education centers and museums for teacher professional development and materials dissemination.
- Advertise materials in appropriate journals.
- Direct mail materials to schools.

Goal 3: *Increase science literacy and public awareness of the real-life impacts of NSBRI research through media, informal science activities, direct mailings and magazine stories.*

Objective 3A. Increase scientific literacy by involving scientists in community education and bringing NSBRI and space-based science into classrooms and homes.

- Involve NSBRI and other scientists in teacher professional development and community outreach activities.
- Produce NSBRI-related exhibits and activities at informal education centers and museums.
- Generate TV news and magazine stories focusing on NSBRI advances and research.

Objective 3B. Create and support stimulating, informal space life sciences education programs outside of school to develop and maintain public interest in, and awareness of, NSBRI scientific and technological developments.

- Develop, publish and disseminate NSBRI science activities for families through available media.
- Produce NSBRI-related exhibits and activities at museums and informal education centers.

Objective 3C. Foster healthy behaviors and attitudes among students and families, and increase opportunities for families to become more involved in their children's learning through family-school-community partnerships.

- Produce NSBRI-related exhibits and activities at museums and informal education centers.
- Develop, publish and disseminate NSBRI science activities for families through available media.
- Produce NSBRI-related TV health education segments and TV news stories.

Objective 3D. Develop and implement a media plan to include, but not be limited to: public affairs announcements and programs for radio and television, brochures, posters, video-documents and websites, and a national writer-in-residence program.

- Share NSBRI research and educational opportunities through public media.
- Produce NSBRI-related TV health education segments and TV news stories.
- Continue to build a film archive of NASA footage from SpaceLab missions.

- Print quarterly NSBRI-focused magazine stories for dissemination to lay and professional audiences.

Goal 4: *Promote educational access and career awareness in space life science fields among high school and undergraduate students as well as high school teachers.*

Objective 4A. Attract more young students (especially those from underrepresented groups) to careers in space life sciences, engineering and technology-based fields.

- Conduct summer internship programs for students from underrepresented groups.
- Give targeted presentations on NSBRI activities for undergraduate students.
- Develop undergraduate and graduate courses focusing on NSBRI research.
- Establish NSBRI as a national leader in development and deployment of K-16 Internet distance education.
- Offer online graduate programs in space life science education for K-12 science, mathematics, physical education and language arts teachers.

Objective 4B. Establish partnerships with external groups that bring additional funding support to NSBRI activities and assist the Education and Outreach Team to disseminate and promote space-life science education programs.

- Integrate NSBRI activities into existing funded programs, such as NSF-funded systemic initiatives.
- Develop and submit new applications to create and conduct new NSBRI-related projects.
- Establish an International Society of Space Life Sciences Educators, with fellowships for members.
- Create a Center for Research in Space Life Science and Health Education to infuse NSBRI research into educational practice in schools and study ways to increase student motivation in science education and career pursuits.
- Enter into commercial partnerships with publishers, software manufacturers and broadcast media corporations to disseminate information and materials nationally that describe and promote application of NSBRI educational activities.

Goal 5: *Integrate NSBRI-focused teacher professional development, curricular materials, scientific literacy initiatives, and educational and career access activities among all Education and Outreach Teams, other NSBRI Teams and public venues.*

Objective 5A. Integrate NSBRI materials, programs and findings across all institutions of the NSBRI Education and Outreach Team.

- Establish a peer review process for educational relevance and practice, alignment with NSBRI research themes and national science standards, and also for accuracy, balance and potential bias.
- Create and deploy Internet-based educational resources to include downloadable slide presentations, streaming video and links to other NASA-based educational resources.
- Hold annual workshops to share findings and products developed among Education and Outreach Team institutions.

Objective 5B. Integrate NSBRI materials, programs and findings among all other NSBRI Teams.

- Establish a process for NSBRI scientific review of materials and activities developed by the Education and Outreach Team.

- Engage NSBRI scientists in the development of educational materials and the design and conduct of teacher professional enhancement activities.
- Hold annual communications workshops with NSBRI scientists to develop strategies to work with schools and the general public.
- Work with NSBRI research teams to identify potential partners and scientific resources at NASA.

Objective 5C. Integrate NSBRI materials, programs and findings into venues outside of NSBRI.

- Generate and broadcast television features that share the findings and contributions of NSBRI-based research with the general public.
- Establish partnerships with professional societies, state and national governments and informal science organizations to disseminate and promote NSBRI educational materials and activities.
- Develop mechanisms to integrate NASA-developed educational materials into NSBRI outreach activities.

14.6 SUMMARY

The Education and Outreach Team develops and implements activities that address the five major programmatic goals identified below. Team partners developed these strategic goals in coordination with the NSBRI leadership, to assure that Education and Outreach Team activities address overarching NASA and NSBRI objectives.

Goal 1: *Design and conduct a variety of teacher professional development programs to help teachers understand space life sciences and change their practices and behaviors to improve the learning experiences they provide students.*

Teachers are the critical link between curricula, students and their parents. NSBRI teacher professional development activities are designed to help teachers understand space life sciences and change their practices and behaviors to improve the learning experiences they provide students. They also help biomedical space scientists to understand the complex issues involved in instructing today's youth. Teacher Professional Development activities include workshops, summer institutes and research experiences.

Examples of activities being conducted include the numerous NSBRI-focused workshops being carried out by Baylor College of Medicine in Texas and around the US, including activities being coordinated jointly with Space Center Houston for hundreds of teachers in the Houston area, and partnerships with school districts making NSBRI materials part of their curricula. Morehouse School of Medicine's Teacher Institute is a partnership with the Georgia Institute of Technology, DeKalb School System, Fernbank Science Museum, Atlanta Educational Telecommunications Collaborative, Inc., and NSBRI's Teacher Academy at Texas A&M University. Rice University and The University of Texas Medical Branch at Galveston have teamed to create a two-week summer science institute for Houston-area teachers, and Texas A&M is impacting teachers profoundly through its Teacher Academy Project. Master Teachers come from around the US to participate in this project, which provides teachers with intensive field experiences, insight from science and educational experts and new resources to use in their classrooms.

Goal 2: *Develop curricular materials that span the educational continuum; are aligned with national science standards; provide accurate, balanced, effective and inquiry-based instruction; and expand students' understanding of on-going NSBRI research.*

NSBRI curriculum development activities are occurring across the educational continuum from primary grades through graduate preparation. At the K-12 levels, materials are being developed that are aligned to the national science standards. These materials are addressing the need for accurate, balanced, effective and inquiry-based materials for the nation's classrooms. At the undergraduate and graduate levels, courses are being developed to expand students' understanding of on-going NSBRI research.

There is a great deal of emphasis on curriculum development among Education and Outreach partner institutions. For example, Mount Sinai School of Medicine is carrying out a wide array of innovative curriculum development activities involving New York City museums, scientists, teachers and students, both in the summer and during the school year, through its *Defying Gravity* program. Meanwhile, Baylor College of Medicine is producing NSBRI-focused teacher activity guides under the *From Outer Space to Inner Space* program. These guides relate directly to NSBRI science objectives and seek to share the excitement of space life sciences via innovative classroom activities. In addition, TAMU is developing and field testing three online modules on energy (radiation).

Goal 3: *Increase science literacy and public awareness of the real-life impacts of NSBRI research through media, informal science activities, direct mailings and magazine stories.*

Promoting greater understanding and awareness of NSBRI space life sciences research is essential for public support. Numerous activities are underway. They include television and radio news programs, informal science activities at museums, direct mailings of informational posters to schools and magazine stories designed to expand public understanding of how NSBRI research will impact long-term space exploration and the everyday world.

Promoting public awareness of NSBRI activities and increasing science literacy are strengths of the Education and Outreach Team. In fact, all activities of the Team address these very important goals. However, some Team activities are designed and conducted specifically for this purpose. The University of Washington's journal, *Northwest Science & Technology Report*, is reaching out to readers (including general public, students and educators) in the northwest US with stories and information about NASA and space life sciences. Morehouse School of Medicine's Multimedia Archive contains NSBRI research, NASA's Neurolab Mission and other topics. This footage has been used by the Discovery Channel, ZDF-German TV, Atlanta and DeKalb public schools, and others. Simultaneously, Baylor College of Medicine has produced numerous *Radio HealthLine* stories, distributed to radio stations around the nation, and numerous news-format stories for KUHT, Public Broadcasting in Houston, all focusing on NSBRI-related research and health issues.

Goal 4: *Promote educational access and career awareness in space life science fields among high school and undergraduate students as well as high school teachers.*

There are many barriers to promoting diversity and access to careers in the space life sciences. Activities within this theme include research experiences for high school and undergraduate

students as well as high school teachers in NSBRI laboratories. Courses focusing on NSBRI research areas will assist in promoting undergraduate and graduate students' interest in space life sciences research careers.

All partners in the Education and Outreach team are involved in promoting access and career awareness. Some of the more prominent Team activities in this area include Mt. Sinai's multi-faceted *Defying Gravity* program, Morehouse's Undergraduate Summer Research project, the Rice University/University of Texas Medical Branch Student Research Seminar, the inserts included in the *Northwest Science & Technology Report* by the University of Washington to attract young readers to science and space biomedical research, and Texas A&M University's annual Youth Symposia on careers in science for several hundred Texas middle and high school students. The scope of these diverse programs is wide, covering the educational spectrum, from young students to undergraduates, not to mention educators and the general public, as well as all demographic groups.

Goal 5: *Integrate NSBRI-focused teacher professional development, curricular materials, scientific literacy initiatives, and educational and career access activities among all Education and Outreach Teams, other NSBRI Teams and public venues.*

Integration of NSBRI-focused programs, materials and activities may be the most important goal of Education and Outreach Team. As mentioned earlier in this Strategic Plan, the Team's mission is to communicate the significance and excitement of NSBRI research to diverse audiences, while transferring and disseminating knowledge gained by NSBRI Research Teams. In fact, this aim is the specific driving force behind most, if not all, Team activities.

Member institutions of the Education and Outreach Team already have begun to share their NSBRI products among each other. Examples include Texas A&M University's Teacher Academy, curricular materials developed by Morehouse School of Medicine and Baylor College of Medicine, and University of Washington's *Northwest Science & Technology Report*. Further, several team activities—such as those related to media or teacher professional development—are being introduced to public audiences. Of course, these examples are but of few of the NSBRI Education and Outreach Team products that we anticipate integrating into the NSBRI community and beyond. Schools, universities, informal educational organizations and the general public have demonstrated a great interest in space and the science of space exploration. Our Team is harnessing our varied specialties, experiences and resources to share the excitement and real-world implications of NSBRI with students and the American public.

It also is important to note that there necessarily will be much integration of NSBRI research into education and outreach efforts. The transfer of NSBRI research team findings is critical to our efforts to promote space exploration, generate excitement and enhance public education of NSBRI activities and goals. The work of the Education and Outreach Team in addressing our five goals already has begun to further public understanding of, and interest in, the benefits gained from NASA-sponsored NSBRI research. Such understanding and interest are essential as NASA competes for limited federal resources.

TABLE 14.3: TIMETABLE FOR COMPLETION OF TEAM STRATEGIC GOALS AND OBJECTIVES ("X" = completed; "Y" = to be completed in year indicated)													
GOAL/OBJECTIVES	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Goal 1: Design and Conduct Teacher Professional Development													
Objective 1A. Enhance space-based science and technological readiness, skill and impact of educators.													
• Create a national Teacher Academy.		X											
• Offer school-year and summer professional development for K-12 teachers.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Involve scientists in professional development for teachers.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Implement teacher mentorship programs within schools.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Sponsor year-long internships for teachers.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Objective 1B. Utilize NSBRI-generated resources to empower educators.													
• Align curriculum materials based on NSBRI research to national science standards.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Develop science education reform leaders within the scientific and K-12 education communities.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Design, create and deploy Internet-based teaching and science education resources.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Create a Center for Research in Space Life Science and Health Education.					Y	Y	Y	Y	Y	Y	Y	Y	Y
Goal 2: Develop Curricular Materials													
Objective 2A. Develop and implement high-quality NSBRI-based instructional materials.													
• Produce a 9th grade space science program.		X	X	Y	Y								
• Develop elementary/middle school instructional programs focusing on NSBRI research.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Create problem-based cases for high school and undergraduate students.		X	X	Y	Y								
• Facilitate the development of teacher-generated classroom materials.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Design/implement studies to examine effectiveness of NSBRI-sponsored Internet-based curriculum materials.			X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Objective 2B. Promote excellence, achievement and systemic change via dissemination of NSBRI materials.													
• Offer local, regional and national teacher professional development on NSBRI materials.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Partner with NASA for teacher professional development and materials dissemination.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Partner with informal education centers & museums for professional development and materials dissemination.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Advertise materials in appropriate journals.			Y	Y	Y								
• Direct mail materials to schools.		X	X										
Goal 3: Increase Science Literacy and Public Awareness of NSBRI Research													
Objective 3A. Increase scientific literacy, involve scientists and bring NSBRI to classrooms.													
• Involve NSBRI and other scientists in teacher professional development and community outreach activities.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Produce NSBRI-related exhibits and activities at informal education centers and museums		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Generate TV news and magazine stories focusing on NSBRI advances and research.			X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Objective 3B. Create and support informal space life sciences education programs outside of school.													
• Develop, publish and disseminate NSBRI science activities for families through available media.				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Produce NSBRI-related exhibits and activities at museums and informal education centers.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Objective 3C. Foster healthy behaviors/attitudes among students and families; increase family involvement.													
• Produce NSBRI-related exhibits and activities at museums and informal education centers.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Develop, publish and disseminate NSBRI science activities for families through available media.		X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Produce NSBRI-related TV health education segments and TV news stories.		X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Objective 3D. Develop and implement a media plan.													
• Share NSBRI research and educational opportunities through public media.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Produce NSBRI-related TV health education segments and TV news stories.			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Continue to build a film archive of NASA footage from SpaceLab missions.		X	X										
• Print quarterly NSBRI-focused magazine stories for dissemination to lay and professional audiences.			X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Goal 4: Promote Educational Access and Career Awareness in Space Life Science Fields													
Objective 4A. Attract more young students to space life sciences, engineering and technology-based fields.													
• Conduct summer internship programs for students from underrepresented groups.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Give targeted presentations on NSBRI activities for undergraduate students.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Develop undergraduate and graduate courses focusing on NSBRI research.		X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Establish NSBRI as a national leader in development and deployment of K-16 Internet distance education.					Y	Y	Y	Y	Y	Y	Y	Y	Y
• Offer online graduate programs in space life science education for K-12 teachers.				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Objective 4B. Establish partnerships with external groups.													
• Integrate NSBRI activities into existing funded programs.		X	X	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Develop and submit new applications to create and conduct new NSBRI-related projects.				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
• Establish an International Society of Space Life Sciences Educators, with fellowships for members.					Y	Y	Y	Y	Y	Y	Y	Y	Y
• Create a Center for Research in Space Life Science and Health Education.					Y	Y	Y	Y	Y	Y	Y	Y	Y
• Enter into commercial partnerships to disseminate NSBRI information and materials nationally.					Y	Y	Y	Y	Y	Y	Y	Y	Y