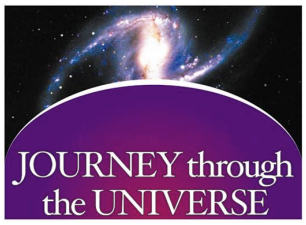
A Proposed *Journey through the Universe* Program in Baltimore City



Needs/Problems to be Addressed, Measurable Objectives, and Evaluation Plan

I.1. Need/problem to be addressed

This section provides an understanding of how the proposed initiative addresses local Baltimore City Public Schools (BCPSS) needs in science education. These flow directly from strategic needs at the national level through mandatory science testing requirements as defined by the No Child Left Behind Act of 2001, and the gathering momentum of several pieces of legislation that comprise the American Competitiveness Initiative.

National need: America's leadership in science and technology markets has helped secure the standard of living Americans have enjoyed for decades. Currently the U.S. employs close to one-third of the worlds researchers in science and engineering, and accounts for 40% of all R&D spending, though possesses only 5% of the world population. Yet at the dawn of the 21st century the United States faces an unprecedented level of global competition in emerging science and technology markets, and whose sobering consequences are addressed in a February 2006 report of the National Academy of Sciences titled *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*.

One driver of emerging markets is innovation-based development in science and technology, and in this context, American innovation must be the means to maintain a leadership role. Yet America's technical workforce is aging, and the number of students choosing careers in science and technology fields, and who are also U.S. citizens, is decreasing.

As a benchmark, Goldman Sachs projects that the combined economies of the BRICs (Brazil, Russia, India, and China) can surpass those of the G6 in just 40 years. Long term strategic planning to ensure U.S. competitiveness into the future is required now. In this context, the engineers entering the job market in just ten years are currently in 6th grade. Science education programming that can captivate and inspire, deliver on curricular requirements and national benchmarks, and target even elementary school grades, is now of national strategic importance.

The February 2006 report of the National Academies has served as a catalyst for legislation that *in toto* comprises the American Competitiveness Initiative (ACI) that includes as benchmarks: 100,000 highly qualified math and science teachers by 2015, and tripling the number of advanced placement tests in math and science passed by low-income students.

Local Need: The No Child Left Behind Act dictates that Maryland students will be tested in science beginning formally in the 2007-08 academic year as part of the Maryland School Assessment (MSA) test, and teachers of science will need to demonstrate proficiency in science content. In

addition, the science portion of the curriculum implemented across the state—the Maryland Voluntary State Curriculum (VSC)—is based on the National Science Education Standards, which include earth and space science as a core strand. An understanding of Earth's place in the Solar System, and the Sun's place among the stars are key conceptual elements of the VSC, and the MSA test.

More specifically, from BCPSS:

1. *Student Needs*
   - The state of Maryland will be testing all fifth and eighth grade students in science on the MSA in SY 2007-08.
   - Students need to develop a conceptual understanding of science content identified on the Maryland VSC and be able to use the skills and processes identified as objectives during inquiry based hands-on investigations.

   - BCPSS needs to *reintroduce* science to the 5th grade curriculum. Concentration on reading and math in recent years has all but eliminated science instruction.

   The proposed initiative addresses these needs by introducing a 5th grade science curriculum keyed to the VSC and MSA astronomy content for both 4th and 5th grade.

   - We do not want science to be a reading lesson but an "aha!" experience in which students act like scientists, *i.e.,* working collaboratively and individually, questioning, proposing solutions, observing, investigating, gathering evidence, and sharing their experiences in oral and/or written form, answering questions about their work, defending their positions with evidence, and changing their positions when the evidence requires.

   Lessons comprising the Compendium of Lessons proposed as the 5th grade curriculum are designed to develop conceptual understanding through activities that seamlessly integrate content and process. Lessons are instructionally designed to support facilitation of inquiry-based learning, and student AS scientist. The lessons were created as part of the Voyage Scale Model Solar System project. More on the pedagogical philosophy can be found at: http://www.voyagesolarsystem.org/education/ed_pedagogy.html.

   - Students need to be excited about science. Our students need more role models in order to "see themselves" as scientists and/or engineers.

   The proposed classroom visits by practicing space science researchers/engineers are powerful experiences for students based on extensive assessment data gleaned from Journey through the Universe researcher visits to 4,650 classrooms in 1,550 schools for 196,700 grade K-12 students. Role model diversity is evident in the 114 science researchers/engineers in the Journey thorugh the Universe Visiting Researcher pool: 41 are women and 15 are African-American.

2. *Teacher needs:*
   - Many elementary teachers do not have a science background and because they lack a science background they are reluctant to teach science unless they feel they "have all the answers." Space science (the astronomy component of the VSC) is particularly difficult to

teach because one can not do "hands-on" science investigations unless powerful modeling opportunities are embedded in inqury-based, hands-on lessons.

The proposed educator workshops are conducted by a space science educator and space science researcher, reflecting individuals with deep expertise in both process and content. These instructors model best teaching practices in a science classroom with teacher as facilitator and students empowering themselves to 'own' the investigation. The lessons embrace the power of modeling as the means of immersing students in inquiry-based hands-on activities that reflect authentic scientific exploration. For more on the commitment to modeling, visit: http://www.voyagesolarsystem.org/DC/DC_models.html.

- BCPSS wants to *reconstitute* a a corps of lead science teachers as a district-wide asset. Such an established corps was lost in recent years due to a concentration on reading and math.

The proposed initiative critically relies on BCPSS's commitment to a new corps of lead science teachers. They are fully integrated into the Local Team, are provided separate professional development, assist in the professional development workshops for 5th grade teachers of science, and are central to the sustainaiblity plan beyond the proposed 3-year performance period (see Section III.)

3. *Community needs:*
   - BCPSS wants to engage families of students

   The proposed initiative includes school field trips designed for family learning to the Maryland Science Center, with programming reflective of the subjects addressed in the Compendium of Lessons.

   - BCPSS wants to build relationships with local area and community-based organizations with a vested interest in science education.

   The proposed initiative includes the Maryland Science Center and NASA Goddard Space Flight Center (NASA/GSFC) as partners, and many of the Visiting Researchers will be from local area research organizations, e.g.: NASA/GSFC, Johns Hopkins' Physics Dept. and Applied Physics Laboratory, Space Telescope Science Institute, and NCESSE. The Baltimore Mayor's Office is also engaged regarding exploring placement of a Voyage model Solar System in the Inner Harbor.

I.2. Summarize project goals and specific measurable objectives to be achieved during the funding period

The following objectives/measures are identified for School Year (SY) 2007-08. While objectives/measures for SY2008-09 and SY2009-10 are expected to be similar, they will ultimately be framed in light of the assessment results from the preceding years. It may be helpful to consider the objectives/measures below from the vantage point of the SY2007-08 schedule provided in Section IV.1.

- By October 2007, 5th grade teachers of science will be provided with the *Journey through the Universe Compendium of Lessons* and training on the astronomy lessons. 90% of teachers will

attend the professional development session. 80% of the participants will indicate that they strongly agree/agree that the professional development met their needs and plan to use it in the future.

- By November 2007, space science researchers will visits 100% of 5th grade classrooms. 80% of 5th grade students will indicate that they strongly agree/agree that the researchers' visits increased their interest in science, that they have a better understanding of the importance of studying science, and have an increased interest in the field of science as a profession. 80% of 5th grade teachers will indicate that the presentations were age appropriate and relevant to the curriculum.

- By November 2007, 30% of 5th grade students' families will attend a family program. 90% will indicate that they strongly agree/agree that they have a deeper understanding of science, scientists, and space exploration as a result of the program, and that they are now better able to foster conversations about these subjects with their children.

- By January 2008, 5th grade teachers of science will be provided with training on the astrobiology lessons. 90% of teachers will attend the professional development session. 80% of the participants will indicate that they strongly agree/agree that the professional development met their needs and plan to use it in the future.

- By February 2008, science benchmark tests will be given in grade 5: on astronomy content in November, and astrobiology content in February.

- By February 2008, BCPSS' Department of Research, Evaluation, Assessment and Analysis (DREAA) will have completed science benchmark data analysis and returned the data to the schools. We expect a 94% student participation rate and 100% of school level data to be analyzed by DREAA and reported to the Area Academic Officers and schools in order to be used to inform and drive science instruction in advance of the April 2008 MSA.

- By implementing the *Journey through the Universe* program, student scores on the science benchmarks will show a 10% improvement from SY2006-07 to SY2007-08. Note: a science benchmark test was given to all 5th grade students in January 2007 for SY2006-07, providing a baseline for 5th grade student scores in science *before* implementation of the *Journey* program.

- By September 2008, 5th grade science MSA data for SY2007-08 will be analyzed and compared to data from SY2006-07. Note: the MSA in science will be given to students state-wide in April 2007 (SY2006-07) to 'field test' the exam. This will provide a MSA baseline for BCPSS 5th grade student scores in science *before* implementation of the *Journey* program.

- By May 2008, DREAA will complete a program implementation analysis for SY2007-08, to assess the level of use of the *Compendium of Lessons* by 5th grade teachers of science, and the extent to which teacher-led activities at schools were conducted (multidisciplinary projects across the 5th grade, school-wide celebrations, etc.) DREAA will look at correlations between program implementation data and student scores on the benchmark tests. 80% of 5th grade teachers of science will have effectively used the *Compendium* in their classrooms.

II. EVALUATION

II.1. Summarize methods of program evaluation

The evaluations to be implemented will include both quantitative and qualitative measures:

- DREAA, in concert with the program leadership team at NCESSE and BCPSS, will develop and deliver on-line evaluation documents that 5th grade science teachers, 5th grade students, and their families will access on the Teacher/Principal Quality web site. The evaluation instruments will be available at the end of the first semester in SY2007-8, and will assess programmatic success regarding professional development workshops, classroom visits by researchers, family evenings, level and duration of use of the *Compendium of Lessons* in the classroom, and the level and duration of teacher-led activities both grade-wide, and school-wide.

  DREAA will analyze these data and provide timely reports to the leadership team for review.

- DREAA will evaluate what students have learned by comparing 5th grade science benchmark and MSA data from SY2006-07 to that from SY2007-08.

- The BCPSS Elementary Science Curriculum Specialist will monitor evidence of the following during non-evaluative classroom visits and reviews of related student work:
  - Teachers correctly implementing the *Compendium of Lessons* in their classrooms.
  - The depth and breadth of teacher-led activities at schools, both grade-wide, and school-wide.
  - Teachers engaging students in a manner that appeals to multiple intelligences.
  - Students demonstrating basic knowledge of Earth/Space science indicators and objectives contained in the MSDE Voluntary State Curriculum and Science Skills and Processes.
  - Students functioning as researchers, empowering themselves to create pathways to answers and bear witness to new personal discoveries.

II.2. How will data collected or findings of an evaluation be incorporated into long-range program and budget planning?

A number of assessment reporting pathways have been defined, allowing program success to be gauged by the stakeholders, new program directions to be defined and implemented, and budget requirements and funds availability to be reassessed on a rolling basis. The following reporting pathways are associated with SY2007-08. Reporting in successive years may be modified based on assessment results.

- Once reports are completed and reviewed by the leadership team, they will be provided to Area Academic Officers, school principals, and 5th grade teachers, the Abell Foundation, and all program partner organizations.

- A formal debriefing on results from the first benchmark test, results of other program evaluations to date, and recommended actions, will be provided to all 5th grade teachers of science on December 10, 2007. The formal debriefing for 5th grade teachers of science after the second benchmark test will take place February 29, 2008. These debriefings will allow assessment analysis to impact classroom instruction in advance of the MSA in April 2008.

- In May 2008 a *Journey through the Universe* Leadership Team Debrief will be conducted to: assess program effectiveness during SY2007-08, and define program modifications for SY2008-

09. A second debrief will take place in September 2008, once MSA test results from the prior year become available, possibly leading to added modifications to the program for SY2008-09.

II.3. How will the project/program effect a measurable change on improved/expanded delivery of services?

Through the assessment reporting and decision pathways identified in Section II.2.

II.4. What are your plans to disseminate the results of these evaluations to the public?

Results will be posted on the web, and NCESSE / BCPSS will provide appropriate reporting to the media.